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DRAFT
REMEDIAL ACTION PLAN
FOR THE
METRO RAIL A-130 CORRIDOR

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FOR THE
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EXECUTIVE SUMMARY

This report presents a Remedial Action Plan (RAP) that evaluates and recommends alternatives for the management of a contamined site located in downtown Los Angeles. The site, which includes portions of a former town gas plant and butadiene manufacturing facility, is known to contain residual materials and waste products that are considered hazardous.

Under existing plans, a portion of the proposed Los Angeles Metro Rail subway system designated as the A-130 corridor will pass through the contaminated area, requiring excavation of a portion of those contaminated materials. This RAP examines viable alternatives for managing excavated materials and recommends the preferred approach for implementation.

SITE ASSESSMENT

Soil and groundwater samples from the A-130 corridor and vicinity were analyzed to determine the nature and extent of contamination present at the site. Results of those analyses confirmed the presence of several contaminants in areas of the A-130 corridor that would result in the classification of excavated materials as hazardous under California law. Contaminants identified at the site include several chemicals that have been found to cause cancer in animals in laboratory studies.

Contaminants found in the A-130 corridor are typical of the waste materials produced by town gas plants and butadiene production facilities. The investigations conducted in the development of this RAP support the conclusion that the contamination of the A-130 corridor is a direct result of past town gas and butadience production at the site.

The contamination detected at the site appears to be centered in an area of the A-130 corridor approximately 200 feet long that borders Ramirez Street. Based on current development plans for the corridor, subway construction is estimated to result in the excavation of approximately 24,000 cubic yards of soils that would require management as hazardous wastes.

EVALUATION OF REMEDIAL ALTERNATIVES

Several alternatives for site remediation were studied to determine their feasibility. These alternatives were subjected to a screening analysis based on minimum criteria for environmental and human health protection, worker safety, technical feasibility, and regulatory compliance.

Four alternatives were identified as feasible for implementation at the site. These are:

- Realignment of the A-130 corridor to avoid development in contaminated areas;
- Onsite incineration of hazardous materials using a transportable incinerator that would be brought to the site;
- Transport of hazardous materials excavated from the corridor to an existing hazardous waste landfill for disposal; and,
- Transport of hazardous materials excavated from the corridor to a new landfill that is developed exclusively for the disposal of hazardous wastes from the A-130 corridor.

The costs for implementing each of these alternatives and the time required to complete site remediation for each are estimated to be as follows:

Alternative	Cost	Required Time
1. Corridor realignment	Not determined	Not determined
2. Onsite incineration	$10,700,000	2.5 years
3. Landfilling at existing facility	$11,200,000	10 months
4. Landfilling at new, dedicated facility	$ 6,350,000	2 years

RECOMMENDED REMEDIAL ACTION

This will be determined at a later date.

1.0 INTRODUCTION

1.1 OVERVIEW AND PURPOSE OF THE REMEDIAL ACTION PLAN

This report presents a Remedial Action Plan (RAP) that evaluates and recommends alternatives for the management of a contaminated site located in downtown Los Angeles. The site, which includes portions of a former town gas plant and butadiene manufacturing facility, is known to contain residual materials and waste products that are considered hazardous.

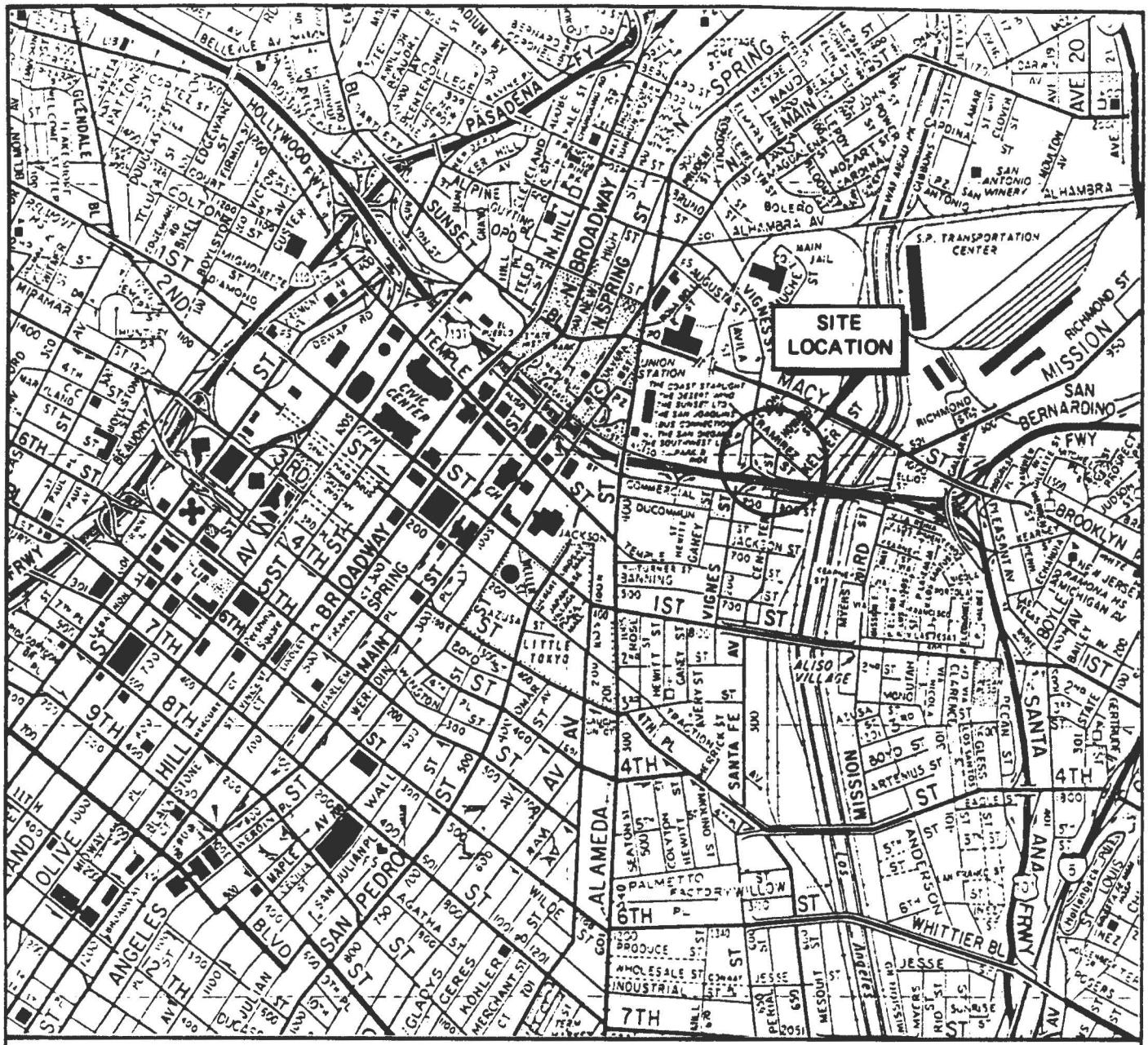
Under existing plans, the proposed Los Angeles Metro Rail subway system will pass through the contaminated area, requiring excavation of a portion of those contaminated materials. This RAP examines viable alternatives for managing excavated materials and recommends the preferred approach for implementation.

The remainder of this section provides a brief description of the Metro Rail project and key features of the study site. Section 2 assesses the nature and extent of contamination at the site. An initial screening of potential actions is described in Section 3 and viable alternatives are fully evaluated in Section 4. The results of these analyses are reviewed in Section 5 and the preferred alternative described.

1.2 PROJECT DESCRIPTION

The Southern California Rapid Transit District (RTD) is the lead agency responsible for the construction and operation of the Los Angeles Metro Rail system. The initial 4.5 mile segment of this mass transit rail system has been authorized. Ground breaking occurred in December 1986, with major construction scheduled to begin in 1987.

One portion of the Metro Rail system is the yard leads and transfer zone, designated by RTD as the A-130 corridor. This corridor lies to the east of Union Station and to the north of the Santa Ana Freeway. Figures 1 and 2 show



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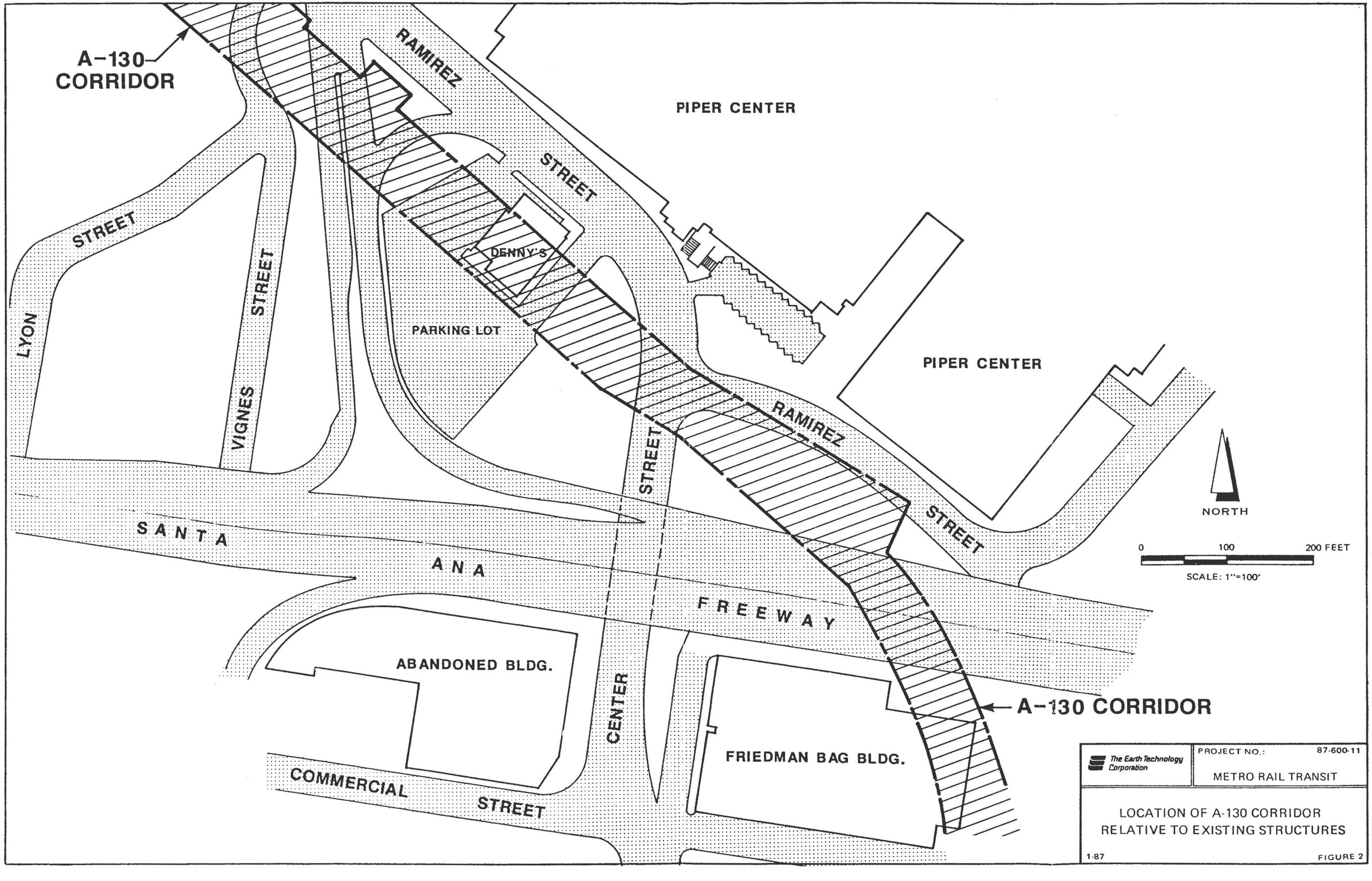
SITE LOCATION

1-87

FIGURE 1


A-130 CORRIDOR
RAMIREZ
STREET
PIPER CENTER
STREET
DENNY'S
PARKING LOT
LYON
STREET
VIGNES
STREET
PIPER CENTER
RAMIREZ
STREET
STREET
NORTH
0
100
200 FEET
SCALE: 1"=100'
SANTA
ANA
FREEWAY
ABANDONED BLDG.
CENTER
STREET
A-130 CORRIDOR
FRIEDMAN BAG BLDG.
COMMERCIAL
STREET
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LOCATION OF A-130 CORRIDOR
RELATIVE TO EXISTING STRUCTURES
1-87
FIGURE 2

the location of the A-130 corridor. The A-130 corridor is approximately 75 feet wide and 1000 feet in length. Construction in A-130 will consist of a cut-and-cover operation, where the full length and width of the corridor will be excavated. The planned depth of excavation in this segment ranges from 40 to 90 feet.

Because groundwater depth in the area of A-130 is approximately 30 feet, RTD plans to first dewater the area, then excavate. This will be accomplished by a series of pumping wells near the corridor perimeter to establish a trough of groundwater depression. Plans are to maintain groundwater depth at a level about five feet below the bottom of the excavation.

When the corridor has been excavated, construction of the Metro Rail subway tube will occur within the excavation. Upon completion of this construction, the area will be back filled to grade with soil. Backfill thickness, to grade, will be a minimum of 8 feet and a maximum of about 20 feet. After back filling, the dewatering wells will be removed from operation and groundwater allowed to return to the normal level.

1.3 SITE HISTORY

The site, the A-130 corridor of the Los Angeles Metro Rail system, is bordered by the Santa Ana Freeway (Route 101) and by Ramirez, Keller, and Lyon Streets in the City of Los Angeles (T1S, R13W, Sec. 27), California. Current land use in the vicinity consists of industrial plants, a City technical center, an Amtrak station, and a Denny's Restaurant.

Land use information is not available for the vicinity of the investigation area prior to 1870. Scattered data suggest that, from about 1870 to 1941, the Southern California Gas Company and a predecessor, the Los Angeles Gas and Electric Company, used a portion of the land on Aliso Street for coal/oil gas generation. In 1943, the Southern California Gas Company ceased the gas generation operation and converted the plant into a butadiene production

facility. Butadiene gas was produced through a thermal "cracking" process. This process consisted of heating a mixture of oil distillates with steam in gas generators. Liquid from the condensed gas was piped to the Shell Chemical Company in Torrance for purification. The Southern California Gas Company ceased production of the butadiene gas around 1946. Southern California Gas Company sold the property about 30 years ago, and there is no available data on the use of the buildings or land after 1946.

Figure 3 shows the approximate location of major buildings, structures, and buried pipes existing at the site during the period in which town gas and butadiene production occurred (approximately 1870 to 1946). These illustrations have been developed based on available historical data, maps and aerial photographs. Additional structures or facilities may have existed at the site that could not be identified from existing data.

1.4 GEOLOGY

1.4.1 Regional Geology

The site is located within the Los Angeles Basin alluviated lowland. The Basin is underlain by a structural depression composed primarily of marine and non-marine clastic sedimentary rock. Specific Basin features are:

- The Newport-Inglewood and Whittier fault zones, which separate the Basin into northwestern, southwestern, northeastern, and central blocks
- The N70W Los Angeles anticline, a major geologic influence to the central block
- A narrow fault and folding zone of the south limb of the Elysian Park anticline.

The A-130 corridor is within the central block and within the boundaries of the Newport-Inglewood, Whittier, and Santa Monica fault zones. There are no known active or potentially active faults identified within the site.

The Los Angeles City oil field is another feature specific to the area. This field is in the east-central portion of the metropolitan area and is located along the south side of the narrow fault and folding zone on the south limb of the Elysian Park Anticline. It consists of three distinct production areas - eastern, central, and western. The oil field is located to the west of the site, generally north of 7th Street and west of Broadway.

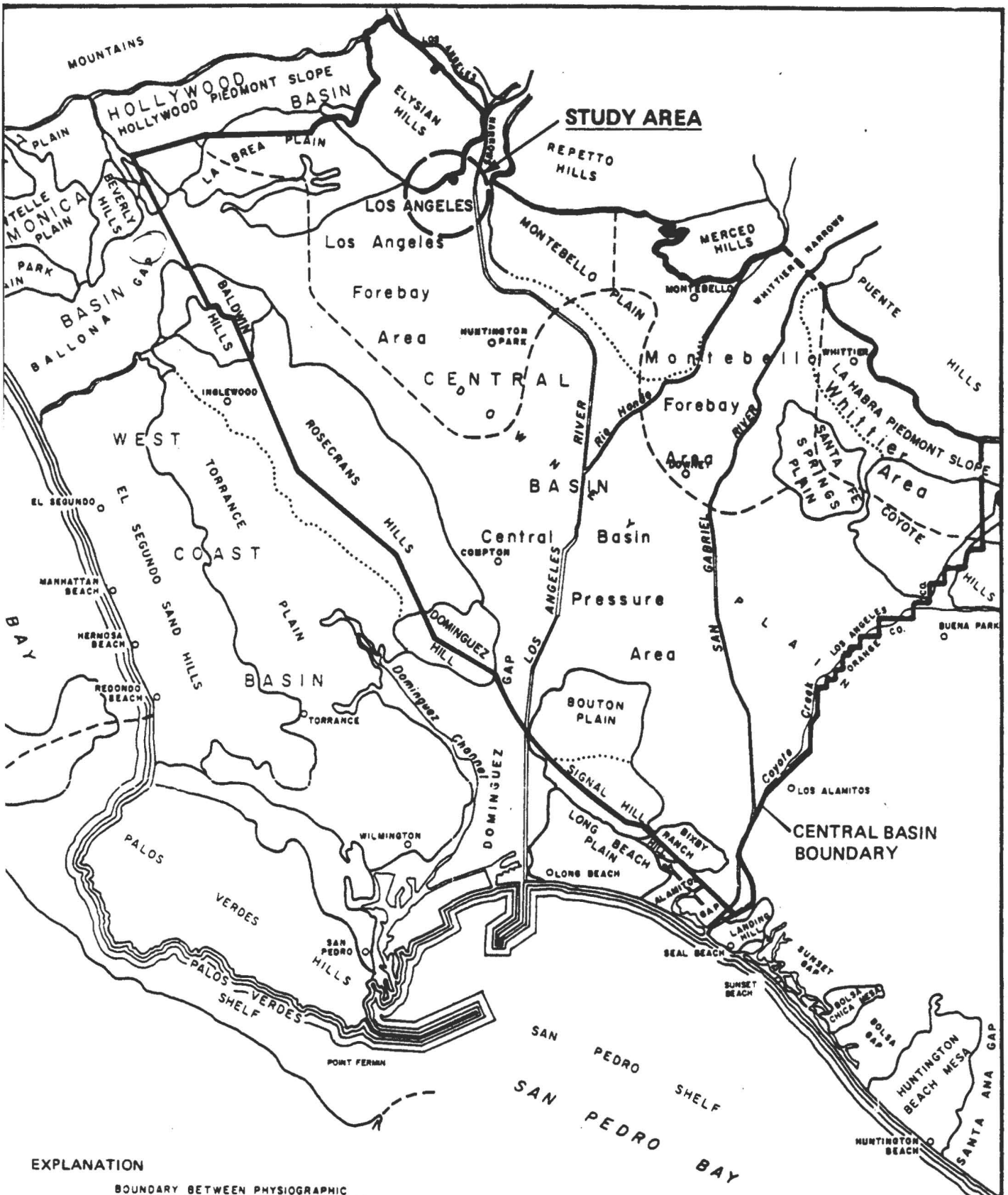
1.4.2 Site Geology

The Basin bedrock is exposed in Elysian Park, about 2 miles north of the site. The bedrock is composed of about two thousand feet of sandy siltstone and interbedded conglomerate of the Fernando Formation; an oil-bearing sandstone, shale, and siliceous shale of the Puente Formation. Previous borehole records show the Puente Formation to be 100 feet below the surface within the A-130 corridor area. Visual identification of soil samples by Earth Technology's geologist shows that subsurface soils are mainly composed of:

- An upper fill consisting of silty sand and concrete that overlies old brick paving approximately 5 feet below the surface
- An upper unit of silty sand and clayey sand that grades to sand
- A middle unit of gravelly sands and cobbles
- A lower unit of sand that grades to gravelly sands and cobbles.

1.5 SITE HYDROLOGY

The site is located in the Los Angeles Forebay area. Figure 4 shows the boundary of the forebay area. A semiperched aquifer consisting of coarse sands and gravels is common near the surface in the Forebay area. Thickness of the aquifer is 0 to 60 feet, and occurs as irregular patches. The Gasper and Exposition aquifers exist west and south of the Los Angeles River and in the



EXPLANATION

- BOUNDARY BETWEEN PHYSIOGRAPHIC FEATURES (DOTTED WHERE APPROXIMATE OR POORLY DEFINED)
- BOUNDARY OF GROUND WATER BASIN
- BOUNDARY OF FOREBAY AND WHITTIER AREA
- AXIS OF SUBMARINE CANYON

BOUNDARY BETWEEN FOREBAY AND PRESSURE AREA FROM BULLETIN 45 (CALIF. D.W.R. 1934)

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PHYSIOGRAPHIC FEATURES AND GROUND WATER BASINS

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FIGURE 4

site vicinity (Department of Water Resources, Bulletin No. 104). These aquifers are from 10 feet to greater than 100 feet in thickness and consist mainly of sand and gravel with clay and silt lenses. The aquifers are not differentiated from each other and are overlain by alluvium. Historically, wells were installed in the Gasper aquifer. These existing well yields are high.

Groundwater on site was encountered at approximately 30 feet below the surface. Water-bearing material consists of coarse sands and gravelly sands with occasional lenses of clay. The water-bearing zones appear to have an upper and lower unit separated by gravel and cobble. Previous studies have estimated a groundwater gradient of approximately 0.006 feet per foot (vertical/horizontal) at the site sloping downward in a southeasterly direction (Converse Consultants, 1983).

Based on regional groundwater data from the Los Angeles County Flood Control District, the 1975 static groundwater table is 50 to 100 feet below the bedrock surface in the vicinity of Union Station, approximately 1 mile west of the study site, which indicates regional perched conditions.

2.0 SITE CONTAMINATION ASSESSMENT

This section describes the investigations conducted to assess the nature and extent of contamination in the vicinity of the A-130 corridor and provides an assessment of the data gathered in those investigations.

2.1 PREVIOUS STUDIES

Soil borings conducted between 1981 and 1983 as part of planning efforts for the El Monte Busway project and the Metro Rail project revealed the presence of construction rubble and organic materials beneath the ground surface in and near the A-130 corridor. As those studies were conducted to gather geotechnical data, no assessments of the nature or extent of the contamination were attempted at that time.

During excavation of footings for the El Monte Busway in 1986, building debris, underground pipes, and organic contaminants were discovered below ground in the vicinity of the A-130 corridor. Tar within one of the pipes as analyzed and found to contain 27 percent napthaline and approximately 10 percent other organics. Consultants to C.C. Meyers, Inc., the construction contractor for the busway construction, were retained to further characterize the contamination encountered. Those efforts included 7 soil borings in close proximity to the A-130 corridor. The data gathered in that study (Woodward-Clyde Consultants, 1986) are presented in Section 2.2 of this document together with data gathered in later studies.

The results of the Woodward-Clyde study indicate extensive soil contamination approximately 70 to 150 feet southwest of the A-130, ranging in depth from 2 to 30 feet below the ground surface. No soil samples were taken below the 30 foot depth.

Although all of the borings in proximity to the A-130 corridor revealed some degree of contamination, contaminated soil appears to exist in distinct

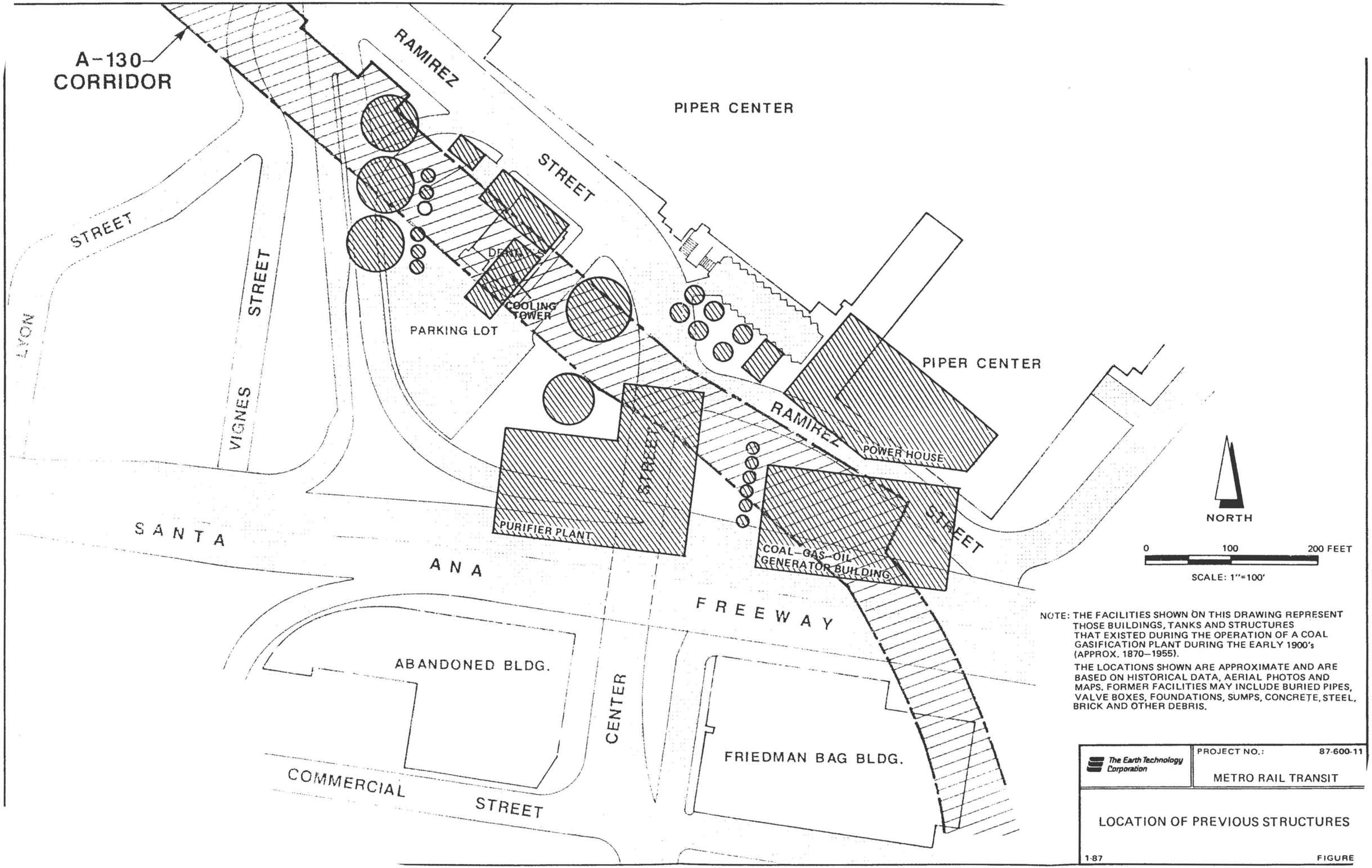
pockets. By analyzing samples taken at different depths within several of the borings, the Meyers study was able to identify the approximate vertical boundaries of some of these pockets.

2.2 RECENT INVESTIGATIONS

During the period of September 1986 to January 1987, The Earth Technology Corporation (ETC) investigated the nature and extent of contamination in the A-130 corridor and surrounding areas to support the development of this RAP. Under contact to Metro Rail Transit Consultants, ETC completed 20 soil borings and installed 2 groundwater monitoring wells (Earth Technology Corporation, 1986 and Earth Technology Corporation, 1987). Figure 5 shows the location of these borings and wells as well as the 7 borings southwest of the site completed in the Woodward-Clyde study. Borehole logs from the development of each of the 27 sampling sites are attached to this report as Appendix A.

In addition to the borings shown in Figure 5, 16 unsuccessful borings were attempted. Underground obstructions identified in these unsuccessful attempts included concrete, concrete reinforcing bars (rebar), and concrete pipes. Based on these observations and observations of nearby excavations opened during construction of the El Monte Busway, it appears that the site is underlain by significant amounts of rubble from previous site activities, including bricks, portions of concrete foundations, and iron and concrete piping. What appeared to be an abandoned underground tank or sump was encountered 15 feet below the surface at BH-08(A).

Fill material was encountered in most boreholes located in or in the immediate vicinity of the A-130 corridor from about 0.5 to 5 feet in depth. The fill consists of dark brown silty sand and apparently overlies remnants of an old brick road at several locations. Between 6 and 15 feet, pieces of brick, wood, concrete, pipes and building foundations were encountered. It was impossible to identify whether soils immediatley beneath the brick road remnants were fill or native soils. Below 15 feet, the soil consists mainly of



NOTE: THE FACILITIES SHOWN ON THIS DRAWING REPRESENT THOSE BUILDINGS, TANKS AND STRUCTURES THAT EXISTED DURING THE OPERATION OF A COAL GASIFICATION PLANT DURING THE EARLY 1900's (APPROX. 1870–1955).

THE LOCATIONS SHOWN ARE APPROXIMATE AND ARE BASED ON HISTORICAL DATA, AERIAL PHOTOS AND MAPS. FORMER FACILITIES MAY INCLUDE BURIED PIPES, VALVE BOXES, FOUNDATIONS, SUMPS, CONCRETE, STEEL, BRICK AND OTHER DEBRIS.

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LOCATION OF PREVIOUS STRUCTURES

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FIGURE

coarse sand, sandy gravel, and cobble. Occassional lenses of clayey sands and boulders were encountered.

A black oily substance with a tarlike odor was encountered in the following boreholes at the indicated depths:

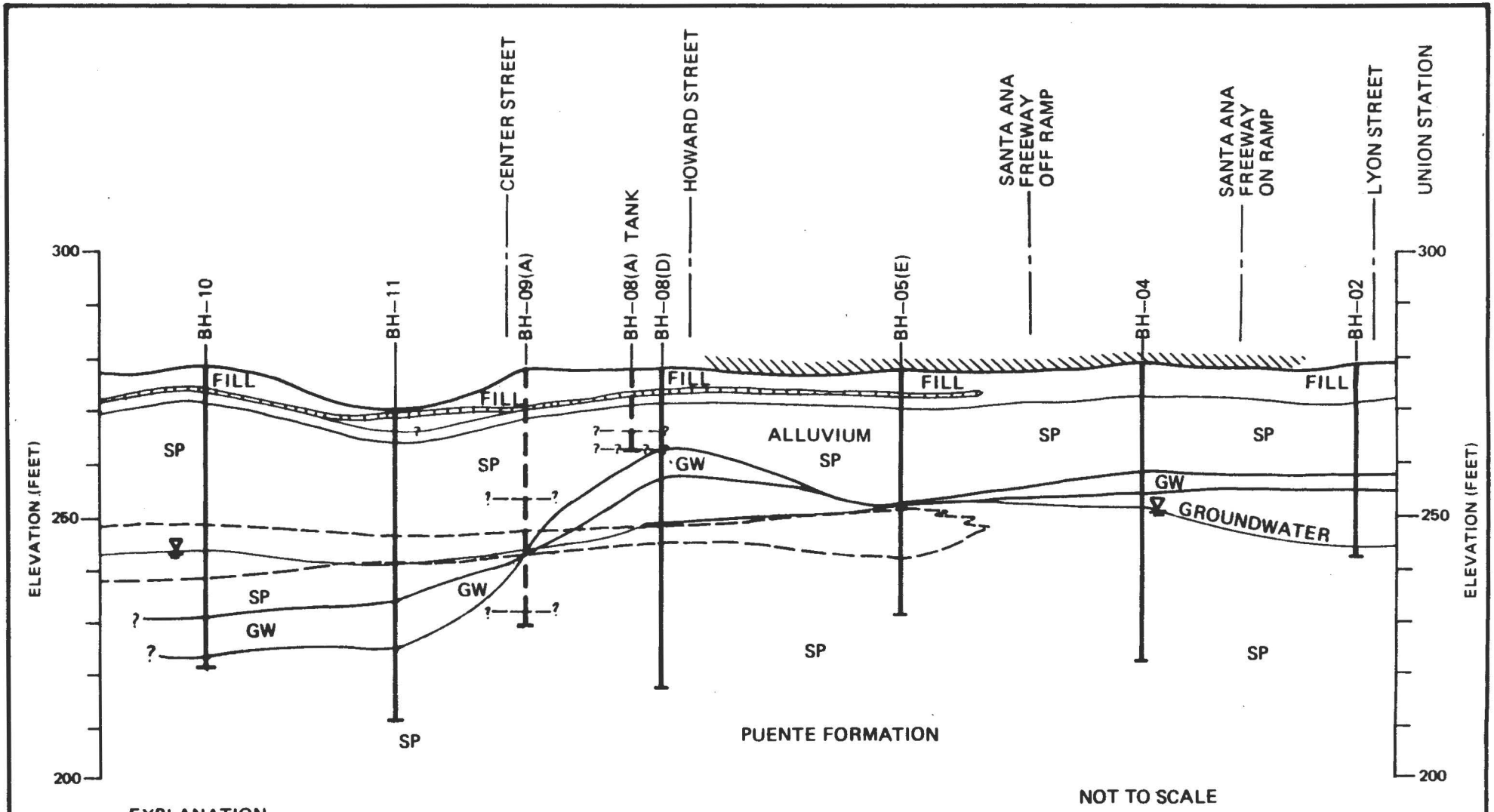
Borehole	Range Encountered
BH-05(E)	24 - 45 ft
BH-08(A)	15 ft (abandoned tank)
BH-08(D)	29 - 45 ft
BH-09(A)	25 - 35 ft
BH-10	29 - 40 ft
BH-11	25 - 26 ft

Figure 6 presents a cross-sectional representation of subsurface conditions in the A-130 corridor developed based on the borehole observations.

A total of 67 soil samples and 22 groundwater samples from the vicinity of the A-130 corridor were subjected to laboratory analyses in the ETC and Woodward-Clyde studies. Table 1 identifies the sample types and depths from which they were taken. Table 2 identifies the types of analyses performed on the soil and groundwater samples. Complete tabulations of the analytical results for the ETC samples are presented in Appendix B. Appendix C contains the analytical results from the Woodward-Clyde investigation.

2.3 ASSESSMENT OF SITE CONTAMINATION

The types of contaminants detected at the site and the relative proportion of contaminants to each other are typical of those reported at other coal gasification sites (Salvesen, 1984 and Anastos, 1986). Although some contaminants, such as ethylbenzene, have not been reported in the literature as occurring at town gas sites, they are known to be byproducts from the manufacture of butadiene by thermal cracking. Based on the analytical data developed at the site



EXPLANATION

SP	POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES
GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES (WITH COBBLE)
— —	BLACK OILY SUBSTANCE
═══	OLD BRICK ROAD
\\\\	PAVED AREA

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SITE PROFILE

1-87

FIGURE 6

TABLE 1. SOIL AND GROUNDWATER SAMPLES FROM THE A-130 CORRIDOR AND VICINITY SUBJECTED TO LABORATORY ANALYSES (Sheet 1 of 2)

Borehole	Soil Samples Depth (ft)	No Groundwater Samples Analyzed
BH-01	30	1
BH-02	35	2
BH-04	25	1
BH-05(E)	35	1
	40	
	45	
BH-06	30	1
BH-06(A)	30	1
BH-07(H)	30	1
BH-08(A)	15	1
BH-08(D)	30	1
	45	
	60	
BH-09(A)	30	1
	50	
BH-10	30	1
BH-11	25 + 30 (composite)	2
BH-201	30	1
BH-202	30	0
	40	
BH-203	10	1
	35	
BH-204	30	1
BH-205	55	1
BH-206A	15	1
	35	
BH-207	30	1
BH-208	25	1
BH-209	?	1
BH-6-1	2	0
	5	
	10	
B-6-2	2	0
	5	
	10	
	15	
	25	
	30	

TABLE 1. SOIL AND GROUNDWATER SAMPLES FROM THE A-130 CORRIDOR AND VICINITY SUBJECTED TO LABORATORY ANALYSES (Sheet 2 of 2)

Borehole	Soil Samples Depth (ft)	No Groundwater Samples Analyzed
B-6-3	2	0
	5	
	10	
	15	
	20	
	25	
	30	
B-7-1	2	0
	5	
	10	
	15	
	20	
	25	
	30	
B-7-2	2	0
B-7-3	2	0
	5	
	10	
	15	
	20	
	30	
B-9-1	2	0
	5	
	10	
	15	
	20	
	25	
	30	

Total Number of Soil Samples = 67
Total Number of Groundwater Samples = 14

Table 2. SOIL AND GROUNDWATER ANALYSES CONDUCTED

Analytical Method	Samples
EPA 8240 - Volatile Pollutants	All samples
EPA 8270 - Semi-volatile Pollutants	All ETC samples
EPA 418.1 - Total Petroleum Hydrocarbons	All ETC samples
EPA 8310 - Polynuclear Aromatics	All Meyers samples
EPA 8015 - Total Petroleum Hydrocarbons	All ETC water samples
EPA 150.1 - pH	All ETC water samples

and visual observations of borings and excavations in the site area, it is apparent that numerous pockets and layers of contaminated materials are present in the A-130 corridor as a result of the town gas and butadiene manufacturing operations that occurred between 1870 and 1943. In addition, analytical data from soil samples in the vicinity of the site and observations from excavations prepared during construction of the Piper Center and El Monte Busway confirm that contamination from these past activities is not limited to the A-130 corridor. Rather, it is evident that several areas immediately adjacent to the northern, eastern and southern boundaries of the A-130 corridor also contain high concentrations of contaminants released from the town gas and butadiene production operations.

2.4 IDENTIFICATION OF HAZARDOUS WASTES

Any contaminated soil or debris excavated from the A-130 corridor that meets the California Department of Health Services' (DOHS) definition of a hazardous waste must be either treated to render the waste nonhazardous or disposed of in a manner acceptable to DOHS. Criteria for identification of hazardous waste are found in Chapter 30, Division 4, Title 22 of the California Administrative Code. Article 11 of Title 22 identifies four criteria that characterize hazardous wastes: corrosivity, ignitability, reactivity, and toxicity.

2.4.1 Corrosivity

A waste is hazardous due to corrosivity if it has a pH less than or equal to 2.0 or greater than or equal to 12.5 or if, when mixed with water it produces a pH in that range. Alternately, a material is considered hazardous if it corrodes SAE 1020 steel at a rate greater than 0.25 inches/year under controlled test conditions (Section 66708). Although no corrosivity testing has been performed soil samples taken from the site, it is evident that the contaminants at the site are not sufficiently corrosive to render excavation

materials hazardous. The pH of all ground water samples from the site were above 6.0 and below 7.5. In addition, iron pipes discovered underground at the site that had apparently been in contact with concentrated contaminants for over 40 years appeared relatively unaffected by corrosion.

2.4.2 Ignitability

Nonliquid wastes are considered hazardous due to ignitability if they are capable of causing fire through friction, absorption of moisture, or spontaneous chemical changes and, when ignited, burn so vigorously and persistantly as to create a hazard (Section 66702). No ignitability testing has been conducted on contaminated materials from the site, however, it is evident that the contaminated soils identified during prior investigations could not sustain combustion or create an ignition hazard. Some relatively pure pockets of chemicals may exist at the site within abandoned tanks or pipes that would meet the ignitability criteria. Such concentrations of chemicals have not been identified during this study.

2.4.3 Reactivity

A waste is considered reactive and hazardous if it meets one of the following seven criteria (Section 66705):

1. It is normally unstable and readily undergoes violent change without detonating;

2. It reacts violently with water;

3. It forms potentially explosive mixtures with water;

materials hazardous. The pH of all ground water samples from the site were above 6.0 and below 7.5. In addition, iron pipes discovered underground at the site that had apparently been in contact with concentrated contaminants for over 40 years appeared relatively unaffected by corrosion.

2.4.2 Ignitability

Nonliquid wastes are considered hazardous due to ignitability if they are capable of causing fire through friction, absorption of moisture, or spontaneous chemical changes and, when ignited, burn so vigorously and persistantly as to create a hazard (Section 66702). No ignitability testing has been conducted on contaminated materials from the site, however, it is evident that the contaminated soils identified during prior investigations could not sustain combustion or create an ignition hazard. Some relatively pure pockets of chemicals may exist at the site within abandoned tanks or pipes that would meet the ignitability criteria. Such concentrations of chemicals have not been identified during this study.

2.4.3 Reactivity

A waste is considered reactive and hazardous if it meets one of the following seven criteria (Section 66705):

1. It is normally unstable and readily undergoes violent change without detonating;

2. It reacts violently with water;

3. It forms potentially explosive mixtures with water;

4. It generates dangerous quantities of toxic gases, vapors or fumes when mixed with water;

5. It contains cyanide or sulfide and generates dangerous quantities of toxic gases, vapors, or fumes when exposes to a pH between 2.0 and 12.5;

6. It is capable of explosion or detonation; or

7. It is a forbidden explosive.

Of these criteria, only the fifth is a concern for the waste types identified at the site. However, as sulfides have not been identified in greater than trace quantities in water samples at the site (2.2 mg/l maximum) no contaminated soils are anticipated that are hazardous due to reactive characteristics. Pockets of relatively pure chemicals may exist at the site within abandoned tanks or pipes that would meet the reactivity criteria for sulfide. However, none have been identified to date.

2.4.4 Toxicity

Section 66696 identifies seven criteria by which a waste may be considered hazardous due to toxicity:

1. It has an acute oral LD_{50} less than 5,000 mg/kg;

2. It has an acute dermal LD_{50} less than 4,300 mg/kg;

3. It has an acute inhalation LC_{50} less than 10,000 ppm as gas or vapor;

4. It has an acute aquatic 96-hour LC_{50} less than 500 mg/l with fathead minnows, rainbow trout or golden shiners;

5. It contains any of 16 specified chemicals with a total concentration equal to or exceeding 0.001 percent of weight;

6. It has been shown through experience or testing to pose a hazard to human health or the environment because of its carcogenicity, acute toxicity, chronic toxicity, biaccumulative properties or persistance in the environment; or

7. It is listed in 40 CFR 261 (as of July 1, 1982) as a hazardous waste.

Appendix D contains available toxicity data for each contaminant detected in soil or groundwater samples at the site. Several contaminants present at the site are materials that, in their pure state, would be considered hazardous under criteria 1 through 3 above. Table 4 list the compounds identified in soil or groundwater samples from the site and the lowest acute toxicity ratings identified for each.

Section 66696(b) provides a method for classifying materials containing compounds with an LC_{50} less than 10,000 ppm as nonhazardous based on analyses of head space vapor concentrations. No such analyses have been conducted as part of this effort, hence, any waste containing the following compounds (all of which have an LC_{50} less than 10,000 ppm) must be considered hazardous unless subjected to a headspace analysis and demonstrated to be nonhazardous:

- Benzene
- Fluorine
- Toluene
- Xylene

Section 66696(c) provides a method for classifying wastes containing constuents with an oral or dermal LD_{50} less than 5,000 or 4,300 mg/kg, respectively, as nonhazardous based on calculated oral and dermal LD_{50} ratings for the actual waste. Table 5 presents calculated acute oral and dermal toxicities for every soil sample in the A-130 corridor which contained any contaminants. As none of the calculated acute oral or dermal toxicities are

TABLE 4. ACUTE TOXICITY DATA FOR COMPOUNDS IDENTIFIED IN SITE SOILS OR GROUNDWATER
(Sheet 1 of 2)

Compound	Oral LD_{50} (mg/kg)	Dermal LD_{50} (mg/kg)	Inhalation LD_{50} (ppm)	LD_{Lo} (mg/kg)
ACENAPTHALENE	*	*	*	*
ACENAPTHYLENE	*	*	*	*
ACETONE	3,000 (mouse)	20,000 (rabbit)	*	24,000 (dog-oral)
ANTHRACENE	*	*	*	*
BENZ(e) ACEPHENANTHRYLENE (BENZO(B)FLUORANTHENE)	*	*	*	*
BENZ(a)ANTHRACENE	*	*	*	*
BENZENE	3,800 (rat)	*	9,980 (mouse)	2,000 (dog-oral)
BENZO(k)FLOURANTHENE	*	*	*	*
BENZO(ghi)PERYLENE	*	*	*	*
BIS(2-ETHYLHEXYL) PHTHALATE	30,000 (mouse)	10,000 (guinea pig)	30,000 mg/m^3 (mammal)	*
CARBON DISULFIDE	*	*	*	14 (human-oral)
CHRYSENE	*	*	*	*
DI-n-BUTYL PHTHALATE	5,282 (mouse)	*	636,000 (mouse)	*
1,2-DICHLOROETHANE	*	*	*	*
DIBENZ(a,h)ANTHRACENE	*	*	*	*
ETHYL BENZENE	3,500 (rat)	5,000 (rabbit)	*	*
FLOURANTHENE	2,000 (rat)	3,180 (rabbit)	*	*
FLOURINE	*	*	150/1H (mouse)	*
HEXONE (4-METHYL2-PENTANONE)	2,080 (rat)	*	23,200 mg/m^3 (mouse)	2,850 (mouse-oral)

TABLE 4. ACUTE TOXICITY DATA FOR COMPOUNDS IDENTIFIED IN SITE SOILS OR GROUNDWATER
(Sheet 2 of 2)

Compound	Oral LD_{50} (mg/kg)	Dermal LD_{50} (mg/kg)	Inhalation LD_{50} (ppm)	LD_{Lo} (mg/kg)
IDENO(1,2,3-ed)PYRENE	*	*	*	*
2-METHYLNAPHTHALENE	*	*	*	5,000 (rat-oral)
NAPHTHALENE	1,000 (mammal)	*	*	100 (child-oral)
PHENANTHRENE	700 (mouse)	*	*	*
PYRENE	*	*	*	*
STYRENE	316 (mouse)	*	*	*
TOLUENE	5,000 (rat)	14,000 (rabbit)	5,320 (mouse)	*
XYLENE	4,300 (rat)	*	5,000/4H (rat)	*

Source: Sax, I., Dangerous Properties of Industrial Materials, Sixth Edition, Van Nostrand Reinhold, NY, NY, 1984.

* - Indicates no data available.

TABLE 5. CALCULATED ACUTE ORAL AND DERMAL TOXICITIES FOR SITE SOIL SAMPLES

Sample	Calculated Oral LD_{50} (mg/kg)	Calculated Dermal LD_{50} (mg/kg)
BH-04	1.1×10^9	8.0×10^9
BH-05(E)-35'	2.3×10^8	*
BH-05(E)-45'	8.6×10^7	5.3×10^8
BH-06(A)	1.1×10^9	8.0×10^9
BH-07	4.1×10^6	9.7×10^7
BH-08(A)-15'	3.9×10^4	6.1×10^5
BH-8D-45'	3.9×10^9	7.5×10^9
BH-8D-30'	1.6×10^7	1.3×10^8
BH-8D-60'	8.7×10^7	3.5×10^9
BH-11-25'	8.4×10^6	4.5×10^{11}
BH-11-30'	4.1×10^7	1.6×10^9
BH-9A-30'	2.3×10^6	4.3×10^7
BH-9A-50'	*	*
BH-5E-35'	2.3×10^8	*
BH-5E-45'	8.6×10^7	5.1×10^8
BH-10-35'	*	*

* No acute toxicity data available for contaminants detected in sample.

below the thresholds of 4,300 and 5,000 mg/kg, respectively, it is concluded that none of the soils sampled at the site are considered hazardous due to acute oral or dermal toxicity.

With regard to the fifth listed toxicity criteria, none of the chemicals listed in Section 66699 have been identified at the site.

Six chemicals have been detected at the site which meet the sixth criteria regarding carcinogenicity, acute toxicity, and chronic toxicity. They are:

- Benzo(a)anthracene, a known animal carcinogen
- Benzene, a recognized leukemogen
- Benzo(a)pyrene, a known animal carcinogen
- Chrysene, a known animal carcinogen
- Dibenzo(a,h)anthracene, a known animal carcinogen
- Indeno(1,2,3-cd)pyrene, a known animal carcinogen

The presence of these chemicals at any concentration will result in classification of a waste as hazardous.

With regard to the seventh and final criteria, no listed hazardous wastes as described in 40 CFR 261 (as codified on July 1, 1982) were detected at the site.

2.5 EXTENT OF CONTAMINATION

As described in Section 2.4 the presence of any of the following chemicals would render a waste hazardous:

- Benzo(a) anthracene
- Benzene
- Benzo(a) pyrene
- Chrysene
- Dibenzo(a,h)anthracene

A-130 CORRIDOR

EXPLANATION

ESTIMATED EXTENT OF HAZARDOUS WASTE WITHIN A-130 CORRIDOR

BH-02
BH-01
BH-04
BH-05(B)
BH-06
BH-06(A)
BH-8D
BH-07(A)
BH-09(A)
B-6-1
B-6-3
B-6-2
B-7-1
B-7-2
B-7-3
BH-11
BH-10
B-9-1
BH-206
BH-201
BH-203
BH-202
BH-207
BH-208
BH-204
BH-205
BH-209

RAMIREZ STREET

PIPER CENTER

PARKING LOT

PURIFIER PLANT

POWER HOUSE

COAL GAS OIL GENERATOR BUILDING

ABANDONED BLDG.

FRIEDMAN BAG BLDG.

LYON STREET

VIGNES STREET

SANTA ANA FREEWAY

CENTER STREET

COMMERCIAL STREET

NORTH

0 100 200 FEET

SCALE: 1"=100'

A-130 CORRIDOR

The Earth Technology Corporation

PROJECT NO.: 87-600-11

METRO RAIL TRANSIT

LOCATION OF HAZARDOUS WASTE

1-87

FIGURE 7

- Fluorine
- Indeno(1,2,3-cd)pyrene
- Toluene
- Xylene

One or more of these chemicals was detected at five boring locations in the of the A-130 corridor. These are:

- BH-07
- BH-08(A)
- BH-08(D)
- BH-09
- BH-11

At BH-11, xylenes were the only constituent detected that would result in a positive hazardous waste determination. As the detected concentration of xylenes was low (2 ppm) and xylene is considered hazardous only due to its acute inhalation toxicity, it appears highly probable that a headspace vapor analysis would result in a nonhazardous determination for soils from that location.

On the basis of the analytical data available concerning the site, it is concluded that the presence of hazardous wastes in the A-130 corridor is limited to the vicinity of boreholes BH-07, BH-08(A), BH-08(D) and BH-09, all of which are located between 60 and 100 feet southeast of Denny's Restaurant. If it is presumed that the hazardous wastes extend from BH-08(A) northwest to a point midway to the nearest boring showing no hazardous waste (BH-05(E), and to the southeast from BH-09(A) to a point midway to BH-11, the volume of hazardous wastes present can be estimated. As shown in Figure 6, the areal extent of hazardous wastes in the A-130 corridor is estimated to be a strip approximately 200 feet long and 80 feet wide. Based on an average excavation depth within this area of 35 feet (Main Yard and Shops Profile Drawing C013, Revision 3, May 29, 1986) it is estimated that 20,700 cubic yards of hazardous

wastes are present in the A-130 corridor. Available minimum and in situ soil density analyses from an area approximately 250 feet to the southwest of the hazardous waste area (BH-201, BH-202, BH-203 and BH-206) indicate that soil volume expansion can be expected to range from 5 to 25 percent. Assuming an average expansion of 15 percent, the volume of hazardous wastes after excavation is estimated to be 23,800 cubic yards.

3.0 REMEDIAL ACTION ALTERNATIVE SCREENING

This section describes the criteria that control the selection of a method for remediation of the A-130 corridor and describes potential alternatives for site development and remediation. Those alternatives are reviewed in light of the screening criteria, resulting in the identification of alternatives that appear acceptable for implementation. Alternatives deemed feasible are evaluated in detail in Section 4 of this report.

3.1 REMEDIAL ACTION OBJECTIVES

The objective of the remedial action plan is to select the action that provides adequate protection of human health and the environment while meeting certain criteria regarding technical feasibility and economic viability. Selection criteria have been developed for the following factors based on general and site-specific constraining factors:

- Human Health and environmental risk
- Worker safety
- Technical feasibility
- Regulatory compliance

Each of these factors is discussed with regard to its use in screening potential remedial alternatives in the following sections.

The remediation alternative described in the remainder of this report do not address the control of contaminated groundwater. RTD has applied to the California Regional Water Quality Board for an NPDES permit for the discharge of treated groundwater. Appendix E contains copies of correspondence concerning that application as well as correspondence with other regulatory agencies with responsibilities for site remediation.

3.1.1 Human Health and Environmental Risk

A foremost objective of the action selected will be the minimization of risks to human health and the environment. As previously described, the A-130 corridor occupies only a portion of the area contaminated with residues from past coal gas and butadiene production activities. It appears highly probable that contamination in many areas adjacent to the A-130 corridor would remain in place after development of the A-130 corridor. Although remediation of the A-130 corridor would lessen the quantity of contaminated leachate generated from the site area, it would not eliminate the problem. Groundwater in the the vicinity of the site would continue to be contaminated by leachate from surrounding areas.

Under these conditions, the removal of contamination from the A-130 corridor would not have a substantial impact on any human health or environmental risks posed by the site in its present condition. For this reason, elimination of all subsurface contamination in the area of the A-130 corridor is not a goal of the remedial action plan. Rather, the control of human health and environmental risks to acceptable levels during any development activities of the A-130 corridor is the goal the remedial action plan is designed to achieve.

To achieve this goal, remedial alternatives will be evaluated based on the potential risks posed by any actions taken at the site. This include releases that may occur as a result of the onsite excavation activities, onsite management of contaminated materials, and management of any contaminated materials removed from the A-130 corridor.

3.1.2 Worker Safety

Site investigations have revealed the presence of contaminants at the site that can be hazardous to humans through dermal, oral and inhalation exposures. Therefore, remedial alternatives will be screened on the basis of the degree of hazard posed to workers involved in development of the A-130 corridor and

remediation of the site. Only alternatives in which workers can be adequately protected will be considered acceptable for potential implementation.

3.1.3 Technical Feasibility

The remediation approach selected must be one which is technically achievable. To meet this goal, alternatives which have not been successfully demonstrated under conditions similar to those present at the site and with similar types of contaminants will be eliminated from further consideration in the screening process.

3.1.4 Regulatory Compliance

The selected alternative must be one which is allowable under current and anticipated future Federal, State and local regulatory requirements. Alternatives unlikely to be approved by regulatory agencies with authority for enforcement of those requirements will not be considered further. The governmental agencies with prime responsibility for enforcement of environmental regulations applicable to remediation of the A-130 corridor are the California Department of Health Services (DHS) and the South Coast Air Quality Management District (SCAQMD).

3.2 PRELIMINARY SCREENING OF REMEDIAL ALTERNATIVES

This section describes alternatives for the management of the A-130 remedial actions and presents evaluations of each alternative with regard to the screening criteria identified in Section 3.1 The alternatives considered are:

1. No action
2. Realignment of the corridor

3. Onsite waste disposal
4. In situ bioreclamation
5. In situ chemical treatment
6. Onsite incineration
7. Offsite land disposal
8. Offsite land treatment
9. Offsite inceneration

In the remainder of this section, each of these alternatives is ranked as either acceptable or unacceptable under the established screening criteria. An unacceptable determination for any of the screening criteria is considered justification for elimination of an alternative from further consideration.

3.2.1 No Action

The no action alternative entails completion of the A-130 corridor as planned without regard for the contamination present at the site. Excavation would follow procedures normal for uncontaminated sites and all excavated materials would be hauled to a Class III landfill for disposal.

Human Health and Environmental Risk - Because materials at the site are known to meet the DHS's definition of hazardous wastes, this alternative is unacceptable. Transport and disposal of hazardous in a manner typical of that used for nonhazardous wastes could pose significant risks to human health and the environment.

Worker Safety - Excavation of contaminated site materials without regard for their known toxic properties would pose unacceptable health risks to site workers.

Technical Feasibility - No known technical constraints exist that would render the no action alternative unacceptable.

Regulatory Compliance - Management of excavation activities without regard to potential nuisances caused by odors from contaminants would not be allowed by the SCAQMD. Excavation, transport, and disposal of hazardous wastes present at the site as nonhazardous materials would not be permitted by the DHS.

Feasibility Determination - The no action alternative is deemed unacceptable under human health and environmental risk, worker safety, and regulatory compliance criteria.

3.2.2 Corridor Realignment

This alternative involves realignment of the A-130 corridor to avoid development in the area known to contain hazardous wastes. Under this scenario, the RTD would not conduct any remedial actions at the site.

Human Health and Environmental Risk - Corridor realignment would eliminate the potential for any risks to human health and the environment associated with site remediation by RTD. Therefore, realignment is deemed acceptable in terms of this criterion.

Worker Safety - By avoiding the need to excavate and manage hazardous wastes in the A-130 corridor, worker safety concerns associated with such activities are eliminated, resulting in an acceptable determination for this criterion.

Technical Feasibility - There are no known technical contraints to corridor realignment. The determination of the technical feasibility of routing the Metro Rail through a different corridor is beyond the scope of this study. Hence, the realignment alternative is considered acceptable with regard to the technical feasibility criterion.

Regulatory Compliance - None of the land in the A-130 corridor known to contain hazardous wastes is owned by RTD. Further, RTD is not responsible for the contamination of the site. Under these conditions, there is no regulatory requirement for site remediation activities by RTD. Therefore, corridor realignment is acceptable under the regulatory compliance criterion.

Feasibility Determination - Realignment of the A-130 corridor to avoid development within the area of known hazardous wastes is acceptable under all established screening criteria.

3.2.3 Onsite Waste Disposal

This alternative would involve stockpiling of hazardous wastes during excavation activities for eventual reburial in the A-130 corridor after completion of the subway construction at the site. Hazardous wastes would be placed above the subway structure and covered in a fashion that would prevent future access to the wastes from the surface without deliberate ground penetration or excavation. A goal of this alternative would be to contain hazardous wastes in a manner that would facilitate their removal at a later date. Treatment or disposal of the hazardous wastes stored in this manner could be accomplished at a future time as part of a remediation program addressing hazardous waste contamination present in areas outside of the A-130 corridor.

Human Health and Environmental Risk - Elements of the onsite disposal option that could result in risk to human health and the environment are excavation, transport, temporary storage and reburial of hazardous wastes found in the A-130 corridor. After reburial, the hazardous wastes would pose a lower risk to human health and the environment than they currently do, as they would be contained within a vault designed to prevent future releases.

Excavation and movement of hazardous wastes to a temporary storage area during development of the A-130 corridor could be accomplished with minimal risks to

human health and the environment. Similar efforts at sites throughout the country have been accomplished while controlling risks to acceptable levels.

Temporary storage of hazardous wastes during construction of the subway in the A-130 corridor could also be accomplished with control of risks to acceptable levels. Although it appears that insufficient area is present in the A-130 corridor for storage of hazardous wastes during construction, it is presumed that a suitable storage location could be identified in proximity to the site. Barriers to prevent release of hazardous constituents could be provided at the storage site and appropriate controls employed to assure the minimization of risks to human health and the environment.

Hazardous waste reburial activities would pose no significant risk to human health and the environment, provided proven procedures for management of such materials are employed. Control of dusts and nuisance odors and decontamination of equipment and the temporary storage area would be required.

On this basis, the onsite disposal option is acceptable under the human health and environmental risk criterion.

Worker Safety - Workers involved in excavation, transport, storage and reburial of hazardous can be adequately protected through the use of established procedures for contaminated site remediation and hazardous waste management. Therefore, onsite disposal is acceptable with regard to this criterion.

Technical Feasibility - The total volume of hazardous waste estimated to exist in the A-130 corridor is 20,700 cubic yards (in situ). Based on analyses of current construction plans for the A-130 corridor, it is estimated that the volume of space available for waste reburial is 15,000 cubic yards. This presumes that waste would not be placed under existing roadways or under the Santa Ana Freeway. If a 2-foot cover is placed above the wastes to achieve isolation from the accessible environment, the available space for waste

disposal is reduced by approximately 2,000 cubic yards to 13,000 cubic yards. Provision of a 1-foot thick impermeable clay liner beneath the wastes to prevent contamination or other degradation of tunnel construction materials further reduces the available volume to an estimated 12,000 cubic yards. As this is considerably less than the estimated volume of hazardous wastes requiring disposal, the onsite disposal alternative is unacceptable under the technical feasibility criterion.

Regulatory Compliance - The onsite disposal option appears permissable under existing DHS and AQMD requirements. Although the temporary storage of hazardous wastes at an offsite location may require authorization from DHS, it is reasonable to assume that such authorization could be acquired. Therefore, the onsite disposal alternative is deemed acceptable under the regulatory compliance criterion.

Feasibility Determination - The onsite disposal alternative is unacceptable due to the lack of sufficient onsite capacity to properly contain the volume of hazardous waste expected to result from development of the A-130 corridor.

3.2.4 In Situ Bioreclamation

In situ bioreclamation would entail addition of nutrients and control of the soil environment (oxygen, moisture, pH, etc.) in such a manner as to promote the natural biodegredation of hazardous wastes at the site. When it is determined that sufficient biodegration has occurred, site development would continue as planned. Any hazardous wastes not thoroughly degraded would be identified during excavation and either transported to an offsite location for treatment or disposal, or treated onsite using an acceptable treatment approach.

Human Health and Environmental Risk - If successful, insitu bioreclamation would probably result in the lowest potential risks of any remediation tech-

nique. The growth of natural bacteria already acclimated to and feeding on the waste material would be accelerated by the optimization of growth conditions. Nutrients such as nitrogen, and an oxygen source such as hydrogen peroxide, would be pumped into the contaminated soils to promote the bacterial growth. The hazardous wastes would be decomposed in situ, eliminating most of the need for hazardous waste excavation and management. Therefore, in situ bioreclamation is acceptable under the established risk criterion.

Worker Safety - In situ bioreclamation would minimize worker exposures to hazardous wastes. In addition, the growth promoters typically utilized are not hazardous if handled properly. For these reasons, in situ bioreclamation is acceptable with regard to worker safety requirements.

Technical Feasibility - Significant uncertainties exist concerning the technical feasibility of in situ bioreclamation. Proper delivery of growth-promoting chemicals to areas containing hazardous wastes would be hampered by the brick roadway underlying the surface, as well as clay lenses, pipes, concrete footings, and other obstructions to flow. The extreme heterogeneity of the soil/hazardous waste matrix at the site may also reduce biodegration efficiency.

To date, in situ bioreclamation has been successfully applied to remediation of aquifers and soils contaminated by gasoline and similar petroleum hydrocarbons (Yaniga, 1986 and Thaveri, 1985). However, no instance of complete degradation through in situ methods has been reported. Containment level reductions of 70 to 80 percent have been achieved after two to three years of treatment. As some of the contaminants present in the A-130 corridor are carcinigenic, complete degradation would be required to render the wastes nonhazardous. Although this may be achievable through long-term treatment, it has not been demonstrated satisfactorily.

Due to the uncertainties described concerning delivery systems for chemicals and degradation rates for the hazardous wastes present at the site, the in

situ treatment alternative is unacceptable under the technical feasibility criterion.

Regulatory Compliance - There are no known regulatory requirements that would prevent implementation of in situ biodegration. Therefore, this technique is considered acceptable with regard to regulatory compliance requirements.

Feasibility Determination - In situ biodegradation is deemed unacceptable owing to uncertainties concerning the technical feasibility of achieving aqequate levels of biodegradation.

3.2.5 In Situ Chemical Treatment

This alternative would entail installation of a system to flush contaminants from the soil using chemicals that would dissolve the hazardous wastes present at the site. The treatment chemicals would be distributed over or injected into the contaminated zone, allowed to flow through the soil requiring treatment, and withdrawn from points on the periphery of the area being treated using conventional withdrawal wells. Solublized contaminants would be concentrated in a surface unit for detoxification using chemical treatment or incineration, or containerized for off-site treatment or disposal.

Human Health and Environmental Risk - Assuming that a nonhazardous solute such as a surfactant or an alcohol can be identified for use in soil treatment, the risks associated with in situ chemical treatment appear to be relatively low. Proper system design would preclude subsurface releases of solublized hazardous waste to the groundwater and airborne or other releases from surface recovery and treatment systems. Therefore, it is concluded that in situ chemical treatment could implemented in a manner that would be acceptable under the established human health and environmental criterion.

Worker Safety - Through the use of proven techniques for containment of wastes and worker exposure control, worker safety could assured during in situ chemical treatment. Therefore, this alternative is acceptable under the worker safety criterion.

Technical Feasibility - In situ chemical treatment has not been successfully demonstrated on a scale comparable to that required at the A-130 corridor with similar wastes. In addition, subsurface barriers to uniform flow of treatment chemicals, such as the brick road underlying the site, could significantly reduce the effectiveness of this approach. For these reasons, in situ chemical treatment is considered unacceptable with regard to its technical feasibility.

Regulatory Compliance - No regulatory requirements have been identified that would prevent the use of in situ chemical treatment. Therefore, this alternative is acceptable under the regulatory compliance criterion.

Feasibility Determination - Uncertainties regarding the ability to adequately disperse treatment chemicals to all areas at the site and the lack of published data indicating success of in situ chemical treatment with similar wastes on a large scale result in an unacceptable determination for this alternative.

3.2.6 Onsite Incineration

Onsite incineration of hazardous wastes would be accomplished by bringing a transportable high temperature incineration system to the site and processing hazardous wastes as they are excavated. To avoid storage problems, waste excavation would have to proceed at a significantly slower rate than with other remediation approaches. The wastes would be temporarily stockpiled near the incineration unit prior to processing. After decontamination through

incineration, contaminant-free soils would be transported off site for disposal as nonhazardous wastes in a Class III landfill.

Human Health and Environmental Risk - High temperature incineration has been repeatedly demonstrated to be a low-risk approach to destruction of organic wastes. The high destruction efficiencies achievable in properly designed and operated units (over 99.99 percent) result in atmospheric emissions below detection limits.

Volatile emissions can be kept to acceptable levels during waste storage and handling through the use of enclosed bins, sprayable foams, or similar methods. A screening procedure can be utilized to verify thorough decontamination of soils, eliminating risks that would result if less than complete destruction were achieved and treated soils were transported to and disposed of in a Class III landfill. Therefore, onsite incineration is acceptable under the human health and environmental risk criterion.

Worker Safety - Proven methods for work protection can be employed during waste excavation, storage, and incinerator feeding operations to assure that unacceptable exposures to hazardous constituents do not occur. Operation of a properly designed incinerator would result in minimal exposure risks to workers. On this basis, onsite incineration is acceptable under the established worker safety criterion.

Technical Feasibility - The technical feasibility of soil decontamination has been adequately demonstrated in numerous studies. Testing by EPA and several private firms has confirmed the ability of transportable incineration to thoroughly decontaminate soils on a steady state basis. Based on those studies and evaluation of the types of wastes to be incinerated in the A-130 corridor, onsite incineration is deemed an acceptable alternative under the technical feasibility criterion.

Regulatory Compliance - Onsite incineration of hazardous waste would require a permit from the SCAQMD and would be subject to any limitations imposed by that Agency. Based on actual emissions data from units of the type that would be appropriate for use at the site, it does not appear that an emissions offset would be required (i.e., a reduction in atmospheric emissions corresponding to the increase associated with the incinerator). On this basis, onsite incineration is determined to be an acceptable alternative under the regulatory compliance criterion.

Feasibility Determination - Onsite incineration is ranked as acceptable under all of the established screening criteria.

3.2.7 Offsite Land Disposal

Under this alternative, hazardous wastes would be excavated and transported to an offsite hazardous waste landfill for permanent disposal. Several commercial landfills capable of accepting hazardous wastes isare located within a reasonable distance of the site. Alternately, RTD could develop and license a dedicated hazardous waste landfill within the Los Angeles area to reduce transportation and disposal costs.

Human Health and Environmental Risk - The potential risks associated with the offsite land disposal alternative can be controlled to acceptable levels through the use of proven controls technologies. Nuisance odors and dust can be controlled during excavation and loading operations through application of water and/or foams to the excavated areas. Transport vehicles can be sealed during movement of wastes to an offsite location to prevent waste releases and all equipment exposed to hazardous wastes can be adequately decontaminated using steam and/or detergent rinsing.

Permanent disposal in an authorized landfill is generally considered to provide adequate control of human health and environmental risks. However, land

disposal of hazardous wastes results in long-term liabilities for the waste generator should remediation of the landfill be required at a future time. Such facilities must monitor for releases during operation and for a minimum of 30 years after closure. Any releases must be stopped as soon as practicle after detection and contamination resulting from the releases remediated. On this basis, offsite land disposal is acceptable under the established risk control criterion.

Worker Safety - The use of proven methods for worker protection during waste excavation, tranport, and reburial can control worker exposure potential to acceptable safety levels.

Technical Feasibility - The technical feasibility of offsite landfilling of this type of hazardous waste is well established and is deemed acceptable under the established criterion.

Regulatory Compliance - There are no known regulatory constraints to offsite landfilling at an operating commercial facility. However, development and use of a private facility dedicated to disposal of wastes from the A-130 corridor would require extensive design and permitting efforts to be allowed. Although these requirements are not prohibitive, they may pose unacceptable timing and resource constraints. Based on these observations, offsite landfilling is acceptable in terms of regulatory feasibility.

Feasibility Determination - Offsite landfilling, either in an existing commercial facility or in a dedicated facility owned and operated by RTD, is determined to be an acceptable remediation alternative under all established screening criteria.

3.2.8 Offsite Land Treatment

Under this alternative, a dedicated land treatment unit would be constructed at an offsite location and used exclusively for the treatment of hazardous wastes from the A-130 corridor. Excavated materials would be transported to the unit, stored until treatment commences, and removed from the unit for disposal as nonhazardous wastes after thorough degradation is documented.

Human Health and Environmental Risk - As previously described for other options, excavation and transport of hazardous wastes could be accomplished with control of risks to acceptable levels. Operation of a land treatment can also provide adequate risk control, provided the unit is properly designed, operated and monitored. Systems to prevent and detect aquifer contamination would be required as would a means of controlling fugitive dusts. As such systems have been employed for refinery wastes for several years with adequate control of risks, offsite land treatment is deemed acceptable with regard to the risk control criterion.

Worker Safety - Adequate protection for workers at the remediation and land treatment sites can be provided using conventional, proven protection measures. Therefore, offsite land treatment is acceptable under the worker safety criteria.

Technical Feasibility - Although no published data have been identified demonstrating the land treatment of wastes indentical to those present at the site, very similar wastes have been thoroughly treated for several years at refineries throughout the U.S. Based on such experiences, it appears that site wastes could be adequately degraded through land treatment methods.

However, it is likely that odors generated from exposed waste would create an unacceptable nuisance. No known method that is compatible with land treatment operations exists for control of the characteristically strong odors from

polynuclear aromatics. Because of the importance of odor control, this alternative is considered unacceptable under the technical feasibility criterion.

Regulatory Compliance - Construction and operation of a hazardous waste treatment facility would require a permit or waiver from DHS and additional approvals from SCAQMD. Acquisition of such authorizations would not be possible if the odor problem is as significant as anticipated. Therefore, offsite land treatment is judged to be unacceptable under the established regulatory compliance criteria.

Feasibility Determination - Offsite land treatment is an un acceptable remediation alternative due to odor control problems.

3.2.9 Offsite Incineration

This alternative would involve excavation and transport of hazardous wastes from the site to an existing permitted hazardous waste incinerator. Wastes treated in this manner would then be analyzed to verify complete destruction of hazardous constituents and transported to a nonhazardous landfill for disposal.

Human Health and Environmental Risks - As described previously, potential risks associated with waste excavation and transport could be adequately controlled. Under the terms of their permit, operations at commercial offsite hazardous waste incinerator would be required to control risks to acceptable levels. Therefore, this alternative is acceptable under the human health and environmental risk criterion.

Work Safety -The use of proven methods for worker protection during waste excavation and transport operations can control worker exposure potential to acceptable levels. The incineration site would be required to employ methods

approved under the facility's operating permit to assure worker safety. Therefore, offsite incineration is acceptable in terms of the worker safety criterion.

Regulatory Compliance - There are no known regulatory constraints to the offsite incineration of wastes removed from the site.

Technical Feasibility - Although the decontamination of soils through high temperature incineration has been demonstrated to be effective, there are no permitted commercial facilities in California capable of providing this service. For this reason, offsite incineration is not technically acceptable.

Feasibility Determination - The offsite incineration hazardous wastes is unacceptable due to the lack of a suitable incinerator in reasonable proximity to the site.

3.3 SUMMARY OF SCREENING RESULTS

The feasibility screening process has resulted in the identification of three feasibile alternatives for remedial action:

- Corridor realignment
- Onsite incineration
- Offsite land disposal.

Each of these alternatives is evaluated in detail in Section 4 of this report to identify additional requirements affecting feasibility.

4.0 ANALYSIS OF REMEDIAL ACTION ALTERNATIVES

This section presents detailed analyses of the three remedial actions identified in Section 3 as feasible for implementation:

- Corridor reallignment
- Onsite incineration
- Offsite land disposal.

Section 4.1 analyzes the noncost criteria that impact alternative selection and Section 4.2 provides cost estimates for implementation of each alternative.

4.1 NONCOST CRITERIA ANALYSIS

This subsection assess the requirements for each feasible alternative in terms of three key noncost criteria:

- Design and operation
- Regulatory requirements
- Schedule requirements.

Several elements of site remediation activities are common to both the onsite incineration and offsite disposal alternatives. These are:

- Excavation requirements
- Onsite waste screening requirements
- Waste transport requirements.

Analyses of these requirements are not repeated for each alternative. Rather, they are discussed fully in the analysis of the first alternative and referenced thereafter.

4.1.1 Corridor Realignment

Realignment of the A-130 corridor to avoid development in areas known to contain hazardous wastes would eliminate the need for remediation of contaminated areas by RTD. Analysis of the design, regulatory, and schedule requirements for corridor realignment are beyond the scope of this study. As previously described, RTD does not own any land known to contain hazardous wastes nor is it responsible for any of the contamination that exists in area of the site. Under these conditions, realignment would remove all responsibility from RTD for site remediation.

4.1.2 Onsite Incineration

Onsite incineration would involve five distinct activities at the site; site preparation, waste excavation and screening, waste stockpiling, waste incineration, and residue management. Requirements relative to each of these activities are described in this subsection.

Design and Operating Requirements - It is presumed that the area immediately to the southwest of the portion of the A-130 corridor that contains hazardous wastes would be available for siting an incineration system and field offices. Specific site preparation requirements would include:

- Concrete pad for incineration system placement, waste stockpiling, and residue stockpiling, and storage and decontamination of earth moving equipment
- Office and equipment storage trailer
- Personnel decontamination, first aid and hygiene stations
- Equipment decontamination systems
- Fuel storage tank
- Electrical, water and telephone hookups
- Security fencing
- Site lighting

In addition, access routes for dump trucks and other heavy equipment and a stockpile area for nonhazardous excavated material would be required.

Excavation would be anticipated to proceed in stages, with hazardous wastes stockpiled adjacent to the incinerator until the storage capacity of the stockpile area is reached. The incinerator would continuously incinerate materials, drawing from the stockpile a rate of approximately 2 cubic yards/hour. Earth moving equipment would replenish the feed stockpile and load decontaminated materials into dump trucks for offsite transport and disposal as needed.

Excavation of site soils would be expected to continue on an intermittant basis during incineration activities. Excavation would be scheduled on a periodic basis to assure adequate feed stockpiling while preventing the stockpiling of excess hazardous wastes.

Analytical screening would accompany all excavation activities in areas suspected of containing hazardous wastes. Rapid turnaround field techniques for identifying volatile organics and polynuclear aromatics in soils have been identified for use at the site. These techniques, developed for EPA under the Superfund program have been proven effective for the types of contaminants encountered at the site. Appendix F presents a detailed description of these techniques.

It is anticipated that preliminary investigations would be conducted to calibrate and validate the field screening techniques before use. These same screening techniques would be utilized to verify soil decontamination efficiency on a routine basis. Weekly confirmation samples would be subjected to full laboratory analyses using EPA methods 8240 (volatile pollutants) and 8310 (polynuclear aromatics) to assure the quality of the field analyses.

A scientist knowledgeable in the identification of contaminated soils would be present onsite during all excavation activities to direct sampling activities and the management of excavated soils. An Organic Vapor Analyzer (OVA) would be utilized to help identify potentially contaminated soils. Soils exhibiting

significant (above background) OVA readings or a visual indication of contamination would be directed to a staging area for analytical determination of contamination. Soils determined to be contaminated would be transferred to the incinerator feed stockpile and noncontaminated soils to the stockpile for offsite disposal.

Fugitive dusts from excavation and management of site soils would be controlled by wetting down loose soils on a routine basis, as necessary. An inert sprayable foam would be utilized to cover exposed soils found to release odors at levels that could create a nuisance.

Hazardous wastes not amenable to incineration, such as underground pipes or tanks, would be excavated and stored in the incinerator feed staging area until sufficient quantities are available to constitute a full load. These materials would be removed by a licensed hauler for offsite disposal as hazardous wastes. Daily logs would be maintained recording pertinant data concerning excavation activities, the locations and extent of contaminants discovered, sampling conducted, incinerator operations and other pertinant observations.

After completion of excavation activities, all areas of exposed contamination (excavation walls and floor) would be covered with two layers of polyethylene liner to prevent exposure of workers during subway construction.
A sand bedding would be placed above any floor liner to prevent liner damage. Side liners would be inspected during each shift of construction activity to confirm integrity. Damage detected would be repaired before workers would be allowed to enter the area.

All contaminated equipment would be thoroughly decontaminated with an onsite steam cleaning system prior to movement offsite or into noncontaminated areas. Fixed structures such as the incinerator and concrete pad would be decontaminated at the completion of remedial activities in accordance with an approved closure plan submitted with the incineration permit application. Solid contamination residues would be drummed and transported offsite for

disposal as hazardous wastes. Liquid residues would be routed to the dewatering treatment system utilized to treat contaminated groundwater removed from the site.

Monitoring of incinerator performance parameters would be conducted as specified in the incineration operating permit. It is anticipated that these would include flow rates, feed rates, and temperatures, and exhaust CO, oxygen and total hydrocarbon levels.

Regulatory Requirements - As described in the correspondance contained in Appendix E, onsite incineration would require an operating permit from the SCAQMD. A system test would be mandated before commencement of full scale operations. The incineration permit would specify operating limits for the system and address the control of fugitive dusts and nuisance odors.

Analyses of likely emission rates indicates that levels would be below those that would trigger the need for an emissions offset.

Schedule Requirements - It is estimated that the onsite incineration alternative would require 30 months to complete, at which time construction of the subway system in the areas of contaminated soils could commence. this estimate is based on estimates provided by private contractors offering onsite incineration services. This schedule could potentially be accelerated by up to 6 months through a expedited remediation contract award procedure and rapid permit issuance by SCAQMD. Table 6 presents an estimated milestone schedule for the onsite incineration alternative.

4.1.3 Offsite Land Disposal

Offsite land disposal would involve excavation of site soils with concurrent screening to identify hazardous wastes and transport of identified hazardous wastes to a permitted offsite disposal facility. An option under this alternative would be the development of a hazardous waste landfill owned and

TABLE 6. ESTIMATED ONSITE INCINERATION SCHEDULE

	Milestone	Month of Occurrence
1.	Project initiation	0
2.	Completion of bid packages	2
3.	Award of contracts for remediation	5
4.	Submission of permit application	7
5.	Permit receipt	9
6.	Completion of site preparation, start of test burns	12
7.	Final permit receipt, commencement of operations	14
8.	Completion of remediation	29
9.	Completion of decontamination activities, removal of remedial equipment	30

operated by RTD exclusively for the disposal of hazardous wastes from the A-130 corridor.

Design and Operating Requirements - The excavation and identification of hazardous wastes under this alternative would be accomplished in a fashion identical to that described in Section 4.1.2. A significant difference is that excavation rates would not be limited by onsite treatment capability and could proceed at a faster pace.

Identified hazardous wastes would be moved from temporary staging areas to dump trucks fitted with polyethylene liners in their beds. After filling, another sheet of polyethylene would be taped to the exterior of the truck bed to thoroughly cover the wastes. A tarpoulin would be placed over the plastic top liner to prevent wind damage. Prior to leaving the site, truck tires and areas potentially contaminated with hazardous wastes would be steam cleaned to remove contamination.

The hazardous wastes would presumably by transported to a licensed Class I landfill in reasonable proximity to the site. Based on the estimated extent of contamination at the site, approximately 1500 truckloads of hazardous waste (16 cubic yard capacity) will require offsite disposal.

Initiation of the second option for offsite disposal would entail design and construction of a landfill in the Los Angeles vicinity dedicated exclusively to the disposal of hazardous wastes from the A-130 corridor. This option has the advantages of reducing the transportation requirements and the associated risks of highway accidents and hazardous waste spills.

A dedicated hazardous waste landfill would have to be constructed according to design and operating standards acceptable to DHS. These may include the use of a double synthetic liner beneath the unit with a leachate detection and removal system. Groundwater monitoring would be required during operation and after landfill closure together with routine inspections and monitoring of cover integrity.

Regulatory Requirements - Disposal of hazardous wastes at a commercial facility may require coordination with the California Highway Patrol to plan traffic routes and safety inspections. California DHS approval of transport procedures and permitting of the transport contractor would also be required.

Schedule Requirements - Table 7 presents the estimated schedule for implementation of the offsite disposal alternative using a commercial disposal facility. this estimate is based on an assumed excavation rate of 1700 cubic yards/day of both contaminated and uncontaminated soil (5 days/week). Although this rate is significantly lower than achievable excavation rates for normal site excavation activities (e.g., 3400 cubic yards/day for a 4 cubic yard dragline), excavation would necessarily proceed slower to allow continuous inspection for subsurface contamination.

Table 8 presents the estimated schedule for development of a dedicated offsite landfill. This schedule presumes relatively quick approval of RTD's permit application to construct the landfill (6 month turnaround). A six month closure is estimated to provide for settlement and consolidation of fill materials and wastes prior to placement of the final landfill cover. A post-closure care period of 30 years has been assumed.

4.2 COST ANALYSIS

This section presents the estimated costs for implementation of each of the remedial actions described in Section 4.1. These costs have been developed based on data from vendor quotes, published cost guides and project files for similar endeavors. Appropriate levels of contingency reserves and administrative costs have been added to the costs as separate line items.

To the extent possible, the cost estimates have been developed to reflect the incremental costs of remediation that would not be incurred if the site were not contaminated. For example, excavation costs would be incurred in any scenario in which the corridor is developed. Rather than including the full

TABLE 7. ESTIMATED SCHEDULE FOR OFFSITE DISPOSAL AT EXISTING CLASS I LANDFILL

	Milestone	Month of Occurrence
1.	Project initiation	0
2.	Completion of bid packages	2
3.	Award of remediation contracts	4
4.	Finalization of remediation and transport plans	6
5.	Initiation of site remediation	7
6.	Completion of remediation	10

TABLE 8. ESTIMATED SCHEDULE FOR OFFSITE DISPOSAL AT A DEDICATED LANDFILL

	Milestone	Month of Occurrence
1.	Project initiation	0
2.	Completion of bid packages	2
3.	Award of landfill design, permitting and construction contracts	4
4.	Completion of construction permit application	7
5.	Submittal of construction permit application	9
6.	Receipt of permit	15
7.	Start of construction	16
8.	Completion of construction, initiation of site remediation	20
9.	Completion of remediation	23
10.	Completion of landfill closure, start of post-closure care	29
11.	End of post-closure care	389

costs of tunnel excavation in contaminated areas with the remediation costs, only the increased costs associated with sloming down excavation to allow soil testing and stockpile management are included.

4.2.1 Corridor Alignment

Estimation of the increased costs associated with corridor realignment are beyond the scope of this study. As realignment would eliminate the need for any remediation activities by RTD, no costs are projected for site remediation under this alternative.

4.2.2 Onsite Incineration

Table 9 presents the estimated costs of site remediation through onsite incineration. A moderate contingency allocation of 15 percent was used as a large portion of the estimate was based on a firm quote. Because most of the remediation cost would be allocated to the incineration contractor, a low administration allocation of 20 percent was used. The total estimated cost of this alternative is approximately $10,700.00.

4.2.3 Offsite Landfilling

Table 10 presents the estimated costs of disposing of all site hazardous wastes at an existing Class I landfill. The high confidence in the unit costs used resulted in the use of a moderate 15 percent contingency allocation. In addition, the use of a single contractor to provide most of the high-cost services resulted in the selection of a low administrative cost allocation of 20 percent. Total costs for remediation through landfilling at an existing facility were estimated to be approximately $11,200.00

Estimated costs for the development of an offsite landfill dedicated exclusively to wastes generated during corridor remediation are presented in

Table 11. Because the degree of confidence in several of the cost elements is relatively low, a high contingency allocation of 25 percent was used. The need to coordinate the activities of several contractors and personnel is expected to result in relatively high administration costs. Therefore, an administrative allocation of 35 percent was used. Total estimated costs for this alternative are approximately $6,350,000.

TABLE 9. ESTIMATED COTS FOR ONSITE WASTE INCINERATION

	Cost Element	Cost
1.	Grade staging areas	$ 2,000
2.	Concrete pad (150' X 35' X 6')	13,900
3.	Utility hookups	15,000
4.	Fuel storage tank (10,000 gal)	10,000
5.	Office/lab trailor (50' X 10')	19,900
6.	Office equipment	2,000
7.	Personal hygiene and decon facilities	10,000
8.	Emergency equipment rental (18 mo.)	7,800
9.	Dust control water sprayer (18 mo.)	5,400
10.	Odor control foam sprayers (36)	7,200
11.	Steam cleaner	4,000
12.	Security fencing (6' X 1100', 9 ga.chain link)	31,800
13.	Gates (2 X 6' X 6', 9 ga. chain link)	1,700
14.	Lighting (4 X 25', steel poles & bases)	7,200
15.	Incinerator mobilization, permitting, testing, operator training & demobilization	1,500,000
16.	Medical screening exam (8 people X 3 exams X $430/exam)	10,300
17.	Worker training	1,000
18.	Site safety plan	5,000
19.	Personnel sampling pumps (4 X $20/day X 5 days)	400
20.	Personnel sampling analysis (10 X $400)	4,000
21.	Excavation (50,000 c.y. X $11.20/c.y.)*	560,000
22.	Move soil to incinerator (30,000 c.y. X $0.45/c.y.)	13,500
23.	Load soil to hauler (20,000 c.y. X $0.45/c.y.)	9,000
24.	Excavation observation (8 hr/day X $50/hr X 330 days)	132,000
25.	Soil & residue analysis - PNAs ($45/sample X 10/day X 330 days)	148,500
26.	Soil & residue analysis - Volitiles ($30/sample X 10/day X 330 days)	99,000
27.	Confirmation & calibration of field tests ($1,000/test X 30 tests)	30,000
28.	Incinerator operation (30,000 c.y. X $173/c.y.)	5,190,000
29.	Equipment decontamination ($100/day X 110 days)	11,000
30.	Level D Protection ($15/person/day X 220 days X 4 persons)	13,200
31.	Level C Protection ($50/person/day X 110 days X 4 persons)	22,000
32.	Screening equipment - OVA & Explosimeter ($125/day X 330 days)	41,250
33.	Plastic sheeting in tunnel ($0.10/s.f. X 40,000 s.f.)	4,000
34.	Sand bedding in tunnel ($5/c.y. X 400 c.y.)	7,000
35.	Site closure	25,000
	Subtotal	$ 7,953,050
	Contingencies @ 15%	1,192,960
	Administrative @ 20%	1,590,610
	TOTAL ESTIMATED COST	$ 10,736,620

*Excavation costs represent increased costs of tunnel excavation due to reduction in output by 50% to allow screening of 50,000 cubic yards of soil. Estimate based on estimated normal tunnel excavation cost of $22.40/cubic yard.

TABLE 10. ESTIMATED COSTS FOR OFFSITE DISPOSAL AT COMMERCIAL LANDFILL

	Cost Element	Cost
1.	Grade staging areas	$ 2,000
2.	Concrete pad (50' X 50' X 6")	7,600
3.	Utility hookups	5,000
4.	Office/lab trailer (50' X 12')	19,900
5.	Office equipment	2,000
6.	Personal hygiene and decon facilities	10,000
7.	Emergency equipment rental (3 mo.)	300
8.	Dust control water sprayer (3 mo.)	900
9.	Odor control foam sprayers (36)	7,200
10.	Steam cleaner	4,000
11.	Security fencing (6' X 1100', 9 ga. chain link)	31,800
12.	Gates (2 X 6' X 6', 9 ga. chain link)	1,700
13.	Lighting (4 X 25', steel poles & bases)	7,200
14.	Medical screening exam (6 people X 2 exams X $430/exam)	5,200
15.	Worker Training	1,000
16.	Site safety plan	5,000
17.	Personnel sampling pumps (4 X $20/day X 5 days)	400
18.	Personnel sampling analysis (10 X $400/sample)	4,000
19.	Excavation (50,000 c.y. X $7.50/c.y.)*	375,000
20.	Move to pad (30,000 c.y. X $0.45/c.y.)	13,500
21.	Load to hauler (20,000 c.y. X $0.45/c.y.)	9,000
22.	Excavation observation (16 hr/day X $50/hr X 66 days)	52,800
23.	Soil analysis - PNAs ($45/sample X 25/day X 66 days)	74,300
24.	Soil analysis - Volitiles ($30/sample X 25/day X 66 days)	49,500
25.	Confirmation & calibration of field tests ($1,000/test X 30 tests)	30,000
26.	Transportation to Class I fill (1500 loads @ 16 hrs/load X $65/hr)	1,560,000
27.	Class I landfill charges (23,900 c.y. X $250/c.y.)	5,950,000
28.	Decontamination Activities - Trucks & Equipment ($200/day X 60 days)	12,000
29.	Level D Protection ($15/person/day X 60 days X 5 persons)	4,500
30.	Level C Protection ($50/person/day X 60 days X 2 persons)	6,000
31.	Screening equipment - OVA & Explosimeter ($250/day X 60 days)	15,000
32.	Plastic sheeting in tunnel ($0.10/s.f. X 40,000 s.f.)	4,000
33.	Sand bedding in tunnel ($5/c.y. X 400 c.y.)	2,000
35.	Side closure	25,000
	Subtotal	$ 8,297,800
	Contingencies @ 15%	1,244,670
	Administrative @ 20%	1,659,560
	TOTAL ESTIMATED COST	$11,202,030

*Excavation costs represent increased costs of tunnel excavation due to reduction in output by 33% to allow screening of 50,000 cubic yards of soil. Estimate based on normal tunnel excavation cost of $22.40/cubic yards.

TABLE 11. ESTIMATED COSTS FOR OFFSITE DISPOSAL AT DEDICATED LANDFILL

	Cost Element	Cost
1.	Waste identification and excavation at site*	$ 787,800
2.	Land purchase (5 ac. X $1000,000/ac.)	500,000
3.	Geophysical evaluation of disposal site	100,000
4.	Site permitting	150,000
5.	Installation of groundwater monitoring wells (6 X $10,000)	60,000
6.	Site excavation - load to hauler (35,000 c.y. X $3.66/c.y.)	128,100
7.	Transport spoils to Class III fill (2190 loads X 4 hr/load X $65/hr)	569,400
8.	Spoil disposal at Class III fill (35,000 c.y. X $2.50/c.y.)	87,500
9.	Install double liner & leak detection system (40,000 s.f. X $5/s.f.)	200,000
10.	Security fencing (6' X 1800', 9 ga. chain link)	59,500
11.	Gates (4 X $900 ea.)	3,600
12.	Site utilities hookup	10,000
13.	Lighting	5,000
14.	Office trailor (50' X 12')	19,900
15.	Office supplies	2,000
16.	Personal hygeine & decon facilities	10,000
17.	Emergency equipment	1,000
18.	Dust control water sprayers	900
19.	Steam cleaner	4,000
20.	Medical screening exam (3 persons X 2 exams X $430/exam)	2,600
21.	Personnel sampling pumps (3 X $20/day X 5 days)	300
22.	Personnel sampling analysis (15 X $400/sample)	6,000
23.	Site supervision ($50/hr X $10/hr X 60 days)	30,000
24.	Supervisor's assistant ($35/hr X 10 hr/day X 60 days)	21,000
25.	Waste transport to landfill (1,500 loads @ 4 hrs X load X $65/hr)	390,000
26.	Waste movement and placement ($3,300/day X 60 days)	198,000
27.	Groundwater sampling (64 sample trip X $600/sample)	38,400
28.	Groundwater analyses (384 samples X $750/sample)	288,000
29.	Cover construction	100,000
30.	Postclosure care (30 years X $4,000/yr)	120,000
	Subtotal	$ 3,968,000
	Contingencies @ 25%	992,000
	Administrative @ 35%	1,388,800
	TOTAL ESTIMATED COST	$ 6,348,800

*Costs for waste identification and excavation are taken from Table 10 by subtracting waste transport and disposal costs from the subtotal costs. All other costs in this table refer to use of a dedicated landfill.

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APPENDIX A

SITE BORING LOGS
DEVELOPED BY EARTH TECHNOLOGY
AND WOODWARD-CLYDE CONSULTANTS

The Earth Technology Corporation

BORING LOG

Project Name: Metro Rail Transit

Project Number: 87-600-0002 Field Log of Boring Number: BH-01 Sheet 1 of 2

Boring Location: BH-01 700 N. Vignes Street		Elevation and Datum: 279	
Drilling Agency: Drill Line	Driller: Greg Deluca, John Hale	Date Started: 10/2/86	Date Finished: 10/2/86
Drilling Equipment: B-53		Completion: Depth (feet) 44 feet	Rock Depth: (feet) 40'
Method of Drilling: Hollow Stem Auger Dia. 6"		Number of Samples: 8 / Dist.:	Undist.: 7 / Core:
Borehole Size:		Water Depth (ft): 29.5 / First:	Compl.: / 24 hrs.
Type of Perforation Backfill: #3 Monterey Sand Pack		Logged By:	Checked by:
Type of Seal: 5% bentonite cement grout		Barbara Fontes B.F	Allison Urbon

Depth (feet)	Description	Graphic Log: Lithology	Graphic Log: OVA (ppm)	Samples: Number	Samples: Type	Samples: Blow Count	Samples: Drilling Rate/Time	Remarks
								Baseline OVA Reading @ 1.6ppm
	Dry, brown, silty fine to medium size grain sand with some small gravel	SP/SM FILL	-					Surface soil may be fill material
5	4'-5.5' Dry, light brown, silty fine - medium size grain sand	SM	1.2	1		3/6/8		
10	9'-10.5' Dry, light brown, silty fine - medium size grain sand with clay lense	SM/SC	2.4	2		3/6/9		Clay is very plastic and the lense is very thin
15	14'-15.5' Dry, light brown, silty fine - medium size grain sand with pea size gravel	SP	1.6	3		19/29/50		
								Cobble gravel at 16 feet
20	19'-20.5' Same as above	SP	1.6	4		20/50		
								Very hard drilling at 21.5 feet
25	24'-25.5' Moist, light brown, fine - medium size grain sand with gravel & occasional cobble	SP/GW	5.8	5		38/50		
30	29'-30.5' Wet, gray, fine-medium grain size sand. Groundwater encountered at approximately 29.5 feet.	SP	1.6	6		-		

The Earth Technology Corporation

BORING LOG

Project name: Metro Rail Transit

Project Number: 87-600-0002 Field Log of Boring Number: BH-01 Sheet 2 of 2

Depth (feet)	Description	Graphic Log: Lithology	Graphic Log: OVA (ppm)	Samples: Number	Samples: Type	Samples: Blow Count	Samples: Drilling Rate/Time	Remarks
35	34'- 35.5' Wet, gray, medium - coarse; to medium-fine grain size sand	SP	3.0	7		-		Quartz sand
40	39'-40.5' No recovery - Cobble gravel	GW						Water sample collected at 40 feet
45	44' Hit boulder							
50								
55								
60								TEMP. = 28.0°C pH = 6.44 σ = 1700 μmho
65								
70								

The Earth Technology Corporation

BORING LOG

Project Name: Metro Rail Transit

Project Number: 87-600-0002 Field Log of Boring Number: BH-02 Sheet 1 of 2

Boring Location: BH-02 700 North Vignes		Elevation and Datum: 279	
Drilling Agency: Drill Line	Driller: Greg Deluca, John Hale	Date Started: 10/3/86	Date Finished: 10/3/86
Drilling Equipment: B-53		Completion: Depth (feet) 35 feet	Rock Depth: (feet)
Method of Drilling: Hollow Stem Auger Dia. 6"		Number of Samples: 8 Dist.:	Undist.: 7 Core:
Borehole Size:		Water Depth (ft): 30 First:	Compl.: 24 hrs.
Type of Perforation Backfill: #3 Monterey Sand Pack		Logged By:	Checked by:
Type of Seal: 5% bentonite cement grout		Barbara Fontes BF	Allison Urbon

Depth (feet)	Description	Graphic Log: Lithology	Graphic Log: OVA (ppm)	Samples: Number	Samples: Type	Samples: Blow Count	Samples: Drilling Rate/Time	Remarks
								Baseline OVA Reading at 2.1ppm
	Dry, brown, silty fine to medium size grain sand with some small gravel	SP(SM) FILL					10:00	Surface soil may be fill material
5	4'-5.5' Dry, light brown, silty fine - medium size grain sand with clay lense	SP(SC)	2.1	1		4/7/7		Clay is very plastic and the lense is very thin
10	9'-10.5' Dry, light brown, silty fine - medium size grain sand	SP	2.1	2		9/11/14		Cobble gravel at 13 feet
15	14'-15.5' Dry, light brown, silty fine - medium size grain sand with pea size gravel		2.1	3		8/12/29		
20	19'-20.5' Dry, light brown, fine - coarse grain size sand with gravel	SP	1.5	4		17/		Hitting occasional cobble
	22'-23.5' Cobble gravel	GW						
25	24'-25.5' Moist, brown, fine, medium, coarse grain size sand with gravel	SP	1.5	5		15/20/35		Quartz sand - quartz is yellow stained
30	29'-30.5' Wet, brown, fine-medium-coarse grain size sand. Groundwater encountered at approximately 35 feet		2.0	6		4/7/19		Sample contained a very thin lense of plastic like clay

The Earth Technology Corporation

BORING LOG

Project name: Metro Rail Transit

Project Number: 87-600-0002 Field Log of Boring Number: BH-02 Sheet 2 of 2

Depth (feet)	Description	Graphic Log: Lithology	Graphic Log: OVA (ppm)	Samples: Number	Samples: Type	Samples: Blow Count	Samples: Drilling Rate/Time	Remarks
35	34'-035.5' Wet, gray, coarse sand	SP	5.2	7			12:30	Quartz sand with Felspar
40								Monitoring well installed
45								
50								
55								
60								TEMP. = 24.7°C pH = 6.35 σ = 1650 μmho
65								
70								

The Earth Technology Corporation

BORING LOG

Project Name: Metro Rail Transit

Project Number: 87-600-0002 Field Log of Boring Number: BH-03 Sheet 1 of 1

Boring Location: This borehole does not exist.			Elevation and Datum:		
Drilling Agency:	Driller:		Date Started:	Date Finished:	
Drilling Equipment:			Completion: Depth (feet)	Rock Depth: (feet)	
Method of Drilling:			Number of Samples: Dist.:	Undist.:	Core:
Borehole Size:			Water Depth (ft): First:	Compl.:	24 hrs.
Type of Perforation Backfill:			Logged By:	Checked by:	
Type of Seal:					

Depth (feet)	Description	Graphic Log: Lithology	Graphic Log: OVA (ppm)	Samples: Number	Samples: Type	Samples: Blow Count	Samples: Drilling Rate/Time	Remarks
5								Borehole BH-03 does not exist.
10								
15								
20								
25								
30								

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BORING LOG

Project Name: Metro Rail Transit

Project Number: 87-600-002 Field Log of Boring Number: BH-04 Sheet 1 of 2

Boring Location: BH-04 Traffic Island - Santa Ana off-ramp		Elevation and Datum: 278.5	
Drilling Agency: Drill Line	Driller: Greg Deluca, John Hale	Date Started: 10/2/86	Date Finished: 10/2/86
Drilling Equipment: B-53		Completion: Depth (feet) 57 feet	Rock Depth: (feet)
Method of Drilling: Hollow Stem Auger Dia. 6"		Number of Samples: 8 / Dist.:	Undist.: 7 / Core:
Borehole Size:		Water Depth (ft): -28. / First:	Compl.: / 24 hrs.
Type of Perforation Backfill: #3 Monterey Sand Pack		Logged By: Barbara Fontes BF	Checked by: Allison Urbon
Type of Seal: 5% bentonite cement grout			

Depth (feet)	Description	Graphic Log: Lithology	Graphic Log: OVA (ppm)	Samples: Number	Samples: Type	Samples: Blow Count	Samples: Drilling Rate/Time	Remarks
								Baseline OVA Reading @ 2.0ppm
	0-0.5' Black asphalt	AS						
	0.5' Dry, brown silty fine-medium grain size sand	SP FILL						
5	4'-5.5' Dry, dark brown, to light brown silty fine - medium grain size sand	SP	2.0	1		6/7/9	2:41	
10	9'-10.5' Dry, light brown, silty fine - medium grain size sand with some gravel	SP	2.0	2		4/3/4	2:46	
		- - ?-						
15	14'-15.5' No recovery		2.0	*3		13/19/24	3:00	Large size gravel was stuck in the sampler shoe. Unidentified odor coming from the borehole
	Cobble gravel	GW						
20	19'-20.5' No recovery		2.0	*4				* OVA readings were obtained from cuttings advancing up the augers
		- - ?-						
25	24'-25.5' Moist, light brown, fine - medium grain size sand	SP	2.0	5		-	3:18	Not enough recovery for a laboratory sample
	28' Groundwater encountered at approximately 28 feet.							
	29'-30.5' Wet, gray, fine - coarse sand	SP	2.5	6		15/29/48	3:25	
30								

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BORING LOG

Project name: Metro Rail Transit

Project Number: 87-600-0002 Field Log of Boring Number: BH-04 Sheet 2 of 2

Depth (feet)	Description	Graphic Log: Lithology	Graphic Log: OVA (ppm)	Samples: Number	Samples: Type	Samples: Blow Count	Samples: Drilling Rate/Time	Remarks
35	34'-35.5' Same as above	SP	2.0	7		43/40/50	3:37	
	36.0' Cobble	GW						
40	39'-40.5' No recovery					4/4/11	3:48	Thunder, lightning & rain Received 1.4 inches in approx. 2 hours. Did not attempt to obtain any more soil samples. Assuming surface runoff in the borehole from the rain
45								
50								
55								
60								Did not obtain below data equipment down due to the rain
65								TEMP. = X pH = X σ = X
70								

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BORING LOG

Project Name: Metro Rail Transit

Project Number: 87-600-0002 Field Log of Boring Number: BH-05 Sheet 1 of 1

Boring Location: BH-05 Denny's parking lot adjacent to Fwy off-ramp		Elevation and Datum: 277.5	
Drilling Agency: Drill Line	Driller: Greg Deluca, John Hale	Date Started: 9/26/86	Date Finished: Could not penetrate
Drilling Equipment: B-53		Completion: Depth (feet)	Rock Depth: (feet)
Method of Drilling: Hollow Stem Auger Dia. 6"		Number of Samples: 1 / Dist.:	Undist.: 1 / Core:
Borehole Size:		Water Depth (ft): / First:	Compl.: / 24 hrs.
Type of Perforation Backfill: #3 Monterey Sand Pack		Logged By:	Checked by:
Type of Seal: 5% bentonite cement grout		Barbara Fontes BF	Allison Urbon

Depth (feet)	Description	Graphic Log: Lithology	Graphic Log: OVA (ppm)	Samples: Number	Samples: Type	Samples: Blow Count	Samples: Drilling Rate/Time	Remarks
0	0-0.5' Black asphalt	AS						Rebar at 3 feet, moved hole apx. 6' east. Brick was also encountered at 3 feet.
	0.5' Dry, brown medium - coarse grain size sand with pea size gravel, and a thin lense of plastic like clay	SP FILL						
5	4'-5.5' Dry, brown, fine - medium size sand	SP	-	1		9/11/12		H_2S in hole (18") = 1ppm
								Concrete at 10 feet
10	Borehole incompleted after two attempts							
15								
20								
25								
30								

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BORING LOG

Project Name: Metro Rail Transit

Project Number: 83-600-0002 Field Log of Boring Number: BH-05 (E) Sheet 1 of 2

Boring Location: West side of Denny's driveway		Elevation and Datum:	
Drilling Agency: Drill Line	Driller: G. Deluca, J. Hale	Data Started: 11/24/86	Data Finished: 11/24/86
Drilling Equipment: B-53		Completion: Depth (feet) 45	Rock Depth: (feet)
Method of Drilling: Hollow Stem Auger Dia.. 6"		Number of Samples: 8 / Dist.:	Undist.: 7 / Core:
Borehole Size:		Water Depth (ft): 25 / First:	Compl.: / 24 hrs.
Type of Perforation Backfill: #3 Monterey Sand Pack		Logged By: Barbara Fontes BF	Checked by: Allison Urbon
Type of Seal: 5% bentonite cement grout			

Depth (feet)	Description	Graphic Log: Lithology	Graphic Log: OVA (ppm)	Samples: Number	Samples: Type	Samples: Blow Count	Samples: Drilling Rate/Time	Remarks
0	0-0.5' Black asphalt	AS						Encountered brick fragments while drilling at apx. 4'
		FILL						
5	4.0-5.5' Dry, brown, clayey, silty sand.	SP		1	/	24/39/28	11:21	
10	9.0-10.5' Dry, brown, fine-medium grain size sand, well sorted	SP		2	/	20/10/8	10:30	
15	14.0-15.5' Dry, brown, fine-medium grain size sand, well sorted. Gravel @ 15'	SP		3	/	39/50	11:36	
20	19.0-20.5' Moist, mediumgrain size sand, well sorted - to wet sand @ 20'	SP		4	/	16/40/50	11:40	
25	24.0-25.5' Wet, gray, fine-medium grain sand, well sorted, w/black oily substance w/rainbow colored sheen. Groundwater encountered at approximately 25 feet.	SP		5	/	34/50	12:01	
30								No 30' sample was taken

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BORING LOG

Project name: Metro Rail Transit

Project Number: 87-600-0002 Field Log of Boring Number: BH-05 (E) Sheet 2 of 2

Depth (feet)	Description	Graphic Log: Lithology	Graphic Log: OVA (ppm)	Samples: Number	Samples: Type	Samples: Blow Count	Samples: Drilling Rate/Time	Remarks
35	34.0-35.5' Wet, brown, fine-medium grain sand, well sorted, w/black oily substance w/rainbow colored sheen.	SP		6	/	28/50	12:24	
40								No 40' sample was taken
45	44.0-45.5' Same as above	SP		7	/	50/50	12:30	
50								
55								
60								Temp. = 26.5 °C pH = 6.8 σ = 1500 μmhos
65								
70								

The Earth Technology Corporation

BORING LOG

Project Name: Metro Rail Transit

Project Number: 87-600-0002 Field Log of Boring Number: BH-06 Sheet 1 of 2

Boring Location: BH-06 Denny's parking lot - rear		Elevation and Datum: 277	
Drilling Agency: Drill Line	Driller: Greg Deluca / John Hale	Date Started: 9/25/86	Date Finished: 9/25/86
Drilling Equipment: B-53		Completion: Depth (feet) 55 feet	Rock Depth: (feet)
Method of Drilling: Hollow Stem Auger Dia. 6"		Number of Samples: 29 Dist.:	Undist.: 8 Core:
Borehole Size:		Water Depth (ft): 30 First:	Compl.: 24 hrs.
Type of Perforation Backfill: #3 Monterey Sand Pack		Logged By:	Checked by:
Type of Seal: 5% bentonite cement grout		Barbara Fontes BF	Allison Urbon

Depth (feet)	Description	Graphic Log: Lithology	Graphic Log: OVA (ppm)	Samples: Number	Samples: Type	Samples: Blow Count	Samples: Drilling Rate/Time	Remarks
								Baseline OVA reading @ 2.0ppm
	0-0.5' Black asphalt	AS					10:20	
	0.5' Dry, brown medium-coarse grain size sand with pea size gravel.	SP FILL						
5	4'-5.5' Dry, brown, silty fine - medium grain size sand with a thin lense of plastic like clay	SP/SC	4	1		4/5/6		Very fine layer of black crunching material ≃ .4" thick.
10	9'-10.5' Dry, light brown, coarse sand with small size gravel	SP	4	2		20/40/43		
15	14'-15.5 Change in color to dark brown. Material same as above and is moist		4	3		17/40/50		
20	19-20.5 Dry, red-brown, coarse sand with small size gravel.	SP	3	4		30/38/40		
25	24'-25.5' Very moist, gray, coarse sand with small size gravel		7	5		20/40/43		
30	29'-30.5' Wet, dark gray, fine - medium grain size sand, w/very thin clay lense	SP/SC	32-18	6		7/20/50		Sample is coated with clear colored oily like film.

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BORING LOG

Project name: Metro Rail Transit

Project Number: 87-600-0002 Field Log of Boring Number: BH-06 Sheet 2 of 2

Depth (feet)	Description	Graphic Log: Lithology	Graphic Log: OVA (ppm)	Samples: Number	Samples: Type	Samples: Blow Count	Samples: Drilling Rate/Time	Remarks
	Groundwater encountered at approximately 29 feet.	SP						
35	34'-35.5' Wet, light gray, fine - medium grain size sand		9	7		23/50		
		GW						
40	39'-40.5' Same as above			-		7/15/38		
	41'-42' Cobble							
45	44'-45.5 Wet, light gray, fine - medium grain size sand. At 45.5 feet the sand is very fine	SP	8	8		13/27/50		Sand contains abundant mica at 45.5 feet and the sand becomes very fine. OVA reading in the hole is 4ppm
50	49'-50.5' No recovery							
55								
60								
65								
70								

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BORING LOG

Project Name: Metro Rail Transit

Project Number: 87-600-0002 Field Log of Boring Number: BH-06A Sheet 1 of 2

Boring Location: BH-06A rear parking lot at Denny's		Elevation and Datum: 277	
Drilling Agency: Drill Line	Driller: Greg Deluca / John Hale	Date Started: 9/26/86	Date Finished: 9/26/86
Drilling Equipment: B-53		Completion: Depth (feet) 35.5	Rock Depth: (feet)
Method of Drilling: Hollow Stem Auger Dia. 6"		Number of Samples: 8 / Dist.:	Undist.: 7 / Core:
Borehole Size:		Water Depth (ft): 27.5 / First:	Compl.: / 24 hrs.
Type of Perforation Backfill: #3 Monterey Sand Pack		Logged By:	Checked by:
Type of Seal: 5% bentonite cement grout		Barbara Fontes BF	Allison Urbon

Depth (feet)	Description	Graphic Log: Lithology	Graphic Log: OVA (ppm)	Samples: Number	Samples: Type	Samples: Blow Count	Samples: Drilling Rate/Time	Remarks
								Baseline OVA reading at 2ppm
0	0-0.5' Black asphalt.	AS					11:00	
	0.5' Dry, brown, medium course grain size sand	SP						
		FILL						
5	4'-5.5' Dry, brown, medium - coarse grain size sand to fine sand		2	1		5/7/19	11:22	
		SP						
10	9'-10.5' Dry, light brown, medium - coarse grain size sand		3	2		9/16/24		Last 6" of sample is dark brown, silty coarse sand
	13' Hit large cobble							
		GW						
15	14'-15.5' Dry, light brown to gray sand w/ cobble		3	3		50 for 4"		
20	19 ' - 20.5' Dry, brown, medium - coarse grain size sand with pea size gravel	SP	3	4		20/50		
	23' Cobble gravel							
25	24'-25.5' Moist, light brown, medium - course grain size sand Groundwater encountered at approximately 27.5 feet.		2	5		24/50		
30	29'-30.5' Wet, gray, medium - coarse grain size sand to fine grain size sand		16	6		26/24/50		Quartz sand "salt & pepper"

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BORING LOG

Project name: Metro Rail Transit

Project Number: 87-600-0002 Field Log of Boring Number: BH-06A Sheet 2 of 2

Depth (feet)	Description	Graphic Log: Lithology	Graphic Log: OVA (ppm)	Samples: Number	Samples: Type	Samples: Blow Count	Samples: Drilling Rate/Time	Remarks
35	34'-35.5' Wet, gray, medium grain size sand	SP	12	7	⧸	17/26/32		Sand is well sorted
40								
45								
50								
55								
60								
65								
70								

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BORING LOG

Project Name: Metro Rail Transit

Project Number: 87-600-0002 Field Log of Boring Number: BH-07 (H) Sheet 1 of 2

Boring Location: Adjacent to Denny's & Howard Street		Elevation and Datum: 277	
Drilling Agency: Drill Line	Driller: Greg Deluca, John Hale	Data Started: 11/20/86	Data Finished: 11/20/86
Drilling Equipment: B-53		Completion: Depth (feet) 45	Rock Depth: (feet)
Method of Drilling: Hollow Stem Auger Dia. 6"		Number of Samples: 8 / Dist.:	Undist.: 7 / Core:
Borehole Size:		Water Depth (ft): 29.5 / First:	Compl.: / 24 hrs.
Type of Perforation Backfill: #3 Monterey Sand Pack		Logged By: Barbara Fontes BF	Checked by: Allison Urbon
Type of Seal: 5% bentonite cement grout			

Depth (feet)	Description	Graphic Log: Lithology	Graphic Log: OVA (ppm)	Samples: Number	Samples: Type	Samples: Blow Count	Samples: Drilling Rate/Time	Remarks
0	Dry, brown, fine-medium grain size silty sand w/grass and roots	SP FILL					9:00	OVA set at 2ppm BG OVA @ 5ppm near rig
5	4.0-5.5' Dry, brown, fine-medium grain size silty sand w/brick fragments and grass	SP	BG	1		7/13/13	9:25	Encountered brick fragments in cuttings
10	9.0-10.5' Same as above for top 9", then dry light brown, fine-course grain size sand, poorly sorted	SW	BG	2		6/5/8	9:28	
15	14.0-15.5' Same as above, w/pea size gravel	SW	BG	3		15/30/49	9:31	OVA - BG in hole
20	19.0-20.5' Same as above	SW	BG	4		20/50	9:48	
25	24.0-25.5' Dry, gray, fine-coarse grain size sand w/pea gravel	SW	BG	5		14/50	9:53	OVA = BG in hole 28' hit clear oily substance which cling to the sampler.
30	29.0-30.5' Wet, gray, medium-coarse grain size quartz sand, well sorted (uniformly graded)	SP	4	6		22/50	10:01	

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BORING LOG

Project name: Metro Rail Transit

Project Number: 87-600-0002 Field Log of Boring Number: BH-07 (H) Sheet 2 of 2

Depth (feet)	Description	Graphic Log: Lithology	Graphic Log: OVA (ppm)	Samples: Number	Samples: Type	Samples: Blow Count	Samples: Drilling Rate/Time	Remarks
	Groundwater encountered at approximately 29.5 feet.							
35	34.0-35.5' No recovery			7		50	10:10	
	Cobble gravel							
40	39/0-40.5' Wet, gray, coarse grain size quartz sand	SP	3	8		50	10:48	
45	44.0-45.5' No recovery							Water sample at 11:44
50	Note: Encountered during previous attempts at less than 5 feet below the surface: Rebar Concrete Pipes							
55								
60								
65								Temp. = 26.0 °C pH = 6.5 σ = 1820 μmhos
70								

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BORING LOG

Project Name: Metro Rail Transit

Project Number: 87-600-0002 Field Log of Boring Number: BH-08 A Sheet 1 of 1

Boring Location: BH-08 Corner lot - Ramirez & Howard St.		Elevation and Datum: 277	
Drilling Agency: Drill Line	Driller: Greg Deluca, John Hale	Date Started: 9/29/86	Date Finished: not complete
Drilling Equipment: B-53		Completion: Depth (feet) 15	Rock Depth: (feet)
Method of Drilling: Hollow Stem Auger Dia. 6"		Number of Samples: 2 / Dist.:	Undist.: 1 / Core:
Borehole Size:		Water Depth (ft): — / First:	Compl.: / 24 hrs.
Type of Perforation Backfill: #3 Monterey Sand Pack		Logged By:	Checked by:
Type of Seal: 5% bentonite cement grout		Barbara Fontes BF	Allison Urbon

Depth (feet)	Description	Graphic Log: Lithology	Graphic Log: OVA (ppm)	Samples: Number	Samples: Type	Samples: Blow Count	Samples: Drilling Rate/Time	Remarks
0	Grass, glass, roots, dry, brown silty sand with some small gravel, pieces of brick	SP FILL	-				10:30	Note: 1. went 0 - ≃10' when monitoring equipment failed.
5	4'-5.5' Dry, dark brown to brown silty medium-coarse grain size sand w/ gravel	SP		1		13/9/9		2. 10/1 moved hole and hit rebar at 3' Borehole B 3. 10/1 moved hole and hit rebar at apx 3' Borehole C
10	9'-10.5' Same as above - no recovery			-				4. 10/1 redrilled in old hole which was not sealed Borehole A
	12'-15' Black, oily, viscous substance	?					11:15	5. Did not collect a soil sample at 10' because of cross contamination potential 6. At 15' - OVA ≃ 2-ppm & fluctuating (btm. is +23 ppm) reading in the borehole
15								7. May have hit underground tank or a storage sump. Did not want to go through a tank bottom & contaminate clean sub-surface soil. Terminated the boring at 15 feet
20								8. After pulling augers, OVA readings (in the borehole) fluctuated greatly up to 380ppm
25								
30								

The Earth Technology Corporation

BORING LOG

Project Name: Metro Rail Transit

Project Number: 87-600-0002 Field Log of Boring Number: BH-08 D Sheet 1 of 2

Boring Location: BH-08D ~ 10 feet northwest of BH-08A		Elevation and Datum: 277	
Drilling Agency: Drill Line	Driller: Greg Deluca, John Hale	Date Started: 10/8/86	Date Finished: 10/9/86
Drilling Equipment: B-53		Completion: Depth (feet) 60	Rock Depth: (feet)
Method of Drilling: Hollow Stem Auger Dia. 6"		Number of Samples: 10 Dist.:	Undist.: 9 Core:
Borehole Size:		Water Depth (ft): 29 First:	Compl.: 24 hrs.
Type of Perforation Backfill: #3 Monterey Sand Pack		Logged By: Barbara Fontes BF	Checked by: Allison Urbon
Type of Seal: 5% bentonite cement grout			

Depth (feet)	Description	Graphic Log: Lithology	Graphic Log: OVA (ppm)	Samples: Number	Samples: Type	Samples: Blow Count	Samples: Drilling Rate/Time	Remarks
								Baseline OVA Reading at 2ppm
	Dry; brown, silty fine-medium grain size sand w/small gravel grass and roots, pieces of brick	SP					10:10	
		FILL						
	4' - 5.5' Same as above		3	1		14/11/14	10:18	OVA reading 4 ppm in borehole
5		SP						
10	9'-10.5' Dry, brown, silty fine-medium grain size sand with gravel to coarse yellow brown sand with small size gravel		4	2		9/11/13		
15	14'-15.5' Dry, brown, silty fine-medium grain size sand with small gravel & occasional cobble		5	3		45/30/30		
	16.0' Cobble	GW						
20	19'-20.5' Dry, brown, silty fine-medium grain size sand with small gravel		5.4	4		36/50	10:41	OVA reading 6ppm in borehole
		SP						
25	24'-25.5' Same as above		7	5		35/50	10:50	OVA is drifting
	29'-30.5' Black tar-like viscous substance Groundwater encountered at approximately 29 feet.	??		6		50/50	11:09	
30								

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BORING LOG

Project name: Metro Rail Transit

Project Number: 87-600-0002 Field Log of Boring Number: BH-08 D Sheet 2 of 2

Depth (feet)	Description	Graphic Log: Lithology	Graphic Log: OVA (ppm)	Samples: Number	Samples: Type	Samples: Blow Count	Samples: Drilling Rate/Time	Remarks
35	34'-35.5' Wet, gray, medium-coarse grain size sand	SP	7.4	7		50 for 6"	11:20	
40	39'-40.5' Same as above			8		-	12:07	Quartz sand
45	44'-45.5' Same as above	SP		9		10/19/50	2:28	
50	49'-50.5' Wet, coarse grain size black & white sand					-	- 9:45	10/9/86 No recovery
55	54'-55.5' Same as above					-	9:50	No recovery
60	59'-60.5' Same as above	SP				-	10:30	No recovery
65	Note: Encountered in previous attemps less than 5 feet below the surface: Concrete and rebar							Temp. = 27.1° pH = 7.10 σ = 2200 μmho
70								

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BORING LOG

Project Name: Metro Rail Transit

Project Number: 87-600-0002 Field Log of Boring Number: BH-09 (A) Sheet 1 of 2

Boring Location: Between Center & Howard in field		Elevation and Datum: 278	
Drilling Agency: Drill Line	Driller: G. Deluca, J. Hale	Data Started: 11/19/86	Data Finished: 11/19/86
Drilling Equipment: B-53		Completion: Depth (feet) 50'	Rock Depth: (feet)
Method of Drilling: Hollow Stem Auger Dia. 6"		Number of Samples: 8 / Dist.:	Undist.: 7 / Core:
Borehole Size:		Water Depth (ft): 30 / First:	Compl.: / 24 hrs.
Type of Perforation Backfill: #3 Monterey Sand Pack		Logged By: Barbara Fontes BF	Checked by: Allison Urbon
Type of Seal: 5% bentonite cement grout			

Depth (feet)	Description	Graphic Log: Lithology	Graphic Log: OVA (ppm)	Samples: Number	Samples: Type	Samples: Blow Count	Samples: Drilling Rate/Time	Remarks
	Dry, brown, silty sand with small gravel, roots	SP FILL						8:00-10:14 stand by Hit large cobble at 2.5 to 4 feet
5	4.0-5.5' No recovery, cobble							Evidence of brick road at apx. 4 - 5 feet.
10	9.0-10.5' Dry, dark borwn, fine-medium grain size silty sand	SP	2	1	⧸	3/6/7	10:38	
15	14.0-15.5' Dry, dark brown, fine-medium grain size silty sand with ground brick	SP	1.6	2	⧸	10/13/8	10:50	BG OVA set at 20ppm OVA reading at rig = 30ppm
20	19.0-20.5' No recovery - hit rock	GP ?			⧸		10:59	No OVA recovery
25	24.0-25.5' Dry, dark brown, fine-medium grain size silty sand with blackish substance	SM	1	4	⧸	33/50	11:14	OVA @ 4ppm BG OVA is drifting
30	29.0-30.5' Same as above Groundwater encountered at approximately 30 feet.	SM	5	5	⧸	50	11:23	Oily rainbow sheen on H_2O & sampler (ctd.)

BENZ(e)ACEPHENANTHRYLENE

CAS RN: 205992 NIOSH #: CU 1400000
mf: $C_{20}H_{12}$; mw: 252.32

mp: 168°.

SYNS:

3,4-BENZ(E)ACEPHENANTHRYLENE
3,4-BENZFLUORANTHENE
BENZO(B)FLUORANTHENE
2,3-BENZFLUORANTHENE
2,3-BENZOFLUORANTHENE

TOXICITY DATA: 3

skn-mus TDLO:88mg/kg: CARC
sce-ham-ipr 900 mg/kg/24H
skn-mus TDLo:72 mg/kg/60W-I:ETA
scu-mus TDLo:72 mg/kg/9W-I:ETA

CODEN:

ARGEAR 50,226,80
MUREAV 66,65,79
CANCAR 12,1194,59
AICCA6 19,490,63

Carcinogenic Determination: Animal Positive IARC** 3,69,73.

Toxicology Review: ACRSAJ 7,475,63; 85DHAX Pc,4,72. "NIOSH Manual of Analytical Methods" VOL 1 183.

THR: MUT data. An exper CARC, ETA.

Disaster Hazard: When heated to decomp it emits acrid smoke and irr fumes.

BENZ(a)ANTHRACENE

CAS RN: 56553 NIOSH #: CV 9275000
mf: $C_{18}H_{12}$; mw: 228.30

Colorless leaflets or plates. bp: 400°, mp: 160°.

SYNS:

BENZANTHRACENE
1,2-BENZ(A)ANTHRACENE
1,2-BENZANTHRENE
BENZOANTHRACENE
1,2-BENZOANTHRACENE
BA
1,2-BENZANTHRACENE
1,2-BENZANTHRAZEN (GERMAN)
BENZANTHRENE
BENZO(A)ANTHRACENE
BENZO(A)PHENANTHRENE
BENZO(B)PHENANTHRENE
2,3-BENZOPHENANTHRENE
2,3-BENZPHENANTHRENE
NAPHTHANTHRACENE
TETRAPHENE

TOXICITY DATA: 3

dnd-sal:tes 5 ug/1H-C
dns-rat:lvr 100 umol/L
skn-mus TDLo:18 mg/kg:NEO
scu-mus TDLo:2 mg/kg:ETA
imp-mus TDLo:80 mg/kg:CAR
skn-mus TD:18 mg/kg:ETA
skn-mus TD:360 mg/kg/56W-I:ETA
skn-mus TD:240 mg/kg/1W-I:NEO
ivn-mus LDLo:10 mg/kg

CODEN:

BIJOAK 110,159,68
ENMUDM 3,11,81
CNREA8 38,1699,78
CNREA8 15,632,55
BJCAAI 22,825,68
CNREA8 38,1705,78
CNREA8 11,892,51
BJCAAI 9,177,55
JNCIAM 1,225,40

Carcinogenic Determination: Animal Positive IARC** 3,45,73. *Toxicology Review:* AEHLAU 23,6,71; ACRSAJ 7,475,63; 85DHAX Pc,4,72. "NIOSH Manual of Analytical Methods" VOL 1 183. Reported in EPA TSCA Inventory, 1980. EPA TSCA 8(a) Preliminary Assessment Information Proposed Rule FEREAC 45,13646,80.

THR: MUT data. An exper NEO, ETA, CARC. It is found in oils, waxes, smoke, food, drugs. HIGH acute ivn.

Disaster Hazard: When heated to decomp it emits acrid smoke and irr fumes.

BENZENE

CAS RN: 71432 NIOSH #: CY 1400000
mf: C_6H_6; mw: 78.12

Clear colorless liquid. mp: 5.51°, bp: 80.093°-80.094°, flash p: 12°F (CC), d: 0.8794 @ 20°, autoign. temp.: 1044°F, lel: 1.4%, uel: 8.0%, vap. press: 100 mm @ 26.1°, vap. d: 2.77, ulc: 95-100.

SYNS:

(6)ANNULENE	COAL NAPHTHA
BENZEEN (DUTCH)	CYCLOHEXATRIENE
BENZEN (POLISH)	FENZEN (CZECH)
BENZOL	MINERAL NAPHTHA
BENZOLENE	MOTOR BENZOL
BENZOLO (ITALIAN)	NCI-C55276
BICARBURET OF HYDROGEN	PHENYL HYDRIDE
CARBON OIL	PYROBENZOLE

TOXICITY DATA: 3	CODEN:
skn-rbt 15 mg/24H open MLD	AIHAAP 23,95,62
eye-rbt 88 mg MOD	AMIHAB 14,387,56
eye-rbt 2 mg/24H SEV	28ZPAK -,23,72
cyt-rat-scu 12 gm/kg/12D-I	GTPZAB 17(3),24,73
mnt-mus-ipr 500 uL/kg	ENMUDM 2,43,80
cyt-mus-orl 100 uL/kg	ENMUDM 2,43,80
cyt-mus-ipr 100 uL/kg	ENMUDM 2,43,80
dlt-mus-ipr 5 mg/kg	TPKVAL 15,30,79
cyt-rbt-scu 8400 mg/kg	PSDTAP 15,275,74
scu-mus TDLo:2700 mg/kg/(13D preg):TER	AMBNAS 17,285,70
ihl-hmn TCLo:100 ppm/10Y-I:CAR	TRBMAV 37,153,78
orl-rat TDLo:52 gm/kg/52W-I:CAR	MELAAD 70,352,79
skn-mus TDLo:1200 gm/kg/49W-I:NEO	BJCAAI 16,275,62
scu-mus TDLo:600 mg/kg/17W-I:ETA	KRANAW 9,403,32
par-mus TDLo:670 mg/kg/19W-I:ETA	KLWOAZ 12,109,33
ihl-hmn TC:400 ppm/8Y-I:ETA	BLOOAW 52,285,78
ihl-man TC:2100 mg/m3/4Y-I:CAR	NEJMAG 271,872,64
orl-rat TD:10 gm/kg/52W-I:CAR	MELAAD 70,352,79
orl-hmn TDLo:130 mg/kg:CNS	AIIYGAJ 31,336,1897
ihl-hmn LCLo:20000 ppm/5M	29ZUA8 -,-,53
ihl-hmn TCLo:210 ppm:BLD	27ZXA3 -,341,63
ihl-rat TCLo:670 mg/m3/24H (15D pre/1-22D preg)	HYSAAV 33,327,68
ihl-rat TCLo:56600 ug/m3/24H (1-22D preg)	HYSAAV 33,112,68
ihl-rat TCLO:50 ppm/24H (7-14D preg)	JHEMA2 24,363,80
ihl-rat TCLO:150 ppm/24H (7-14D preg)	JHEMA2 24,363,80
scu-mus TDLo:1100 mg/kg (12D preg)	TOXID9 1,125,81
scu-mus TDLo:2700 mg/kg/(13D preg) TFX:TER	AMBNAS 17,285,70
orl-mus TDLo:9 gm/kg (6-15D preg)	TJADAB 19,41A,79
orl-mus TDLo:12 gm/kg (6-15D preg)	TJADAB 19,41A,79
orl-rat TD:10 gm/kg/52W-I TFX:CAR	MELAAD 70,352,79
ihl-hmn TCLo:100 ppm:CNS	INMEAF 17,199,48
unk-man LDLo:194 mg/kg	85DCAI 2,73,70
orl-rat LD50:3800 mg/kg	TXAPA9 19,699,71
ihl-rat LC50:10000 ppm/7H	28ZRAQ -,113,60
ipr-rat LDLo:1150 mg/kg	TXAPA9 1,156,59
orl-mus LD50:4700 mg/kg	HYSAAV 32,349,67
ihl-mus LC50:9980 ppm	JIHTAB 25,366,43
ipr-mus LD50:990 ug/kg	AGGHAR 18,109,60
orl-dog LDLo:2000 mg/kg	HBAMAK 4,1313,35
ihl-dog LCLo:146000 mg/m3	HBTXAC 1,324,56
ihl-cat LCLo:170000 mg/m3	HBTXAC 1,324,56
ivn-rbt LDLo:88 mg/kg	JTEHD6 -(Suppl.2),45,77
ipr-gpg LDLo:527 mg/kg	HBTXAC 1,42,56
scu-frg LDLo:1400 mg/kg	HBAMAK 4,1313,35
ihl-mam LCLo:20000 ppm/5M	AEPPAE 138,65,28

Aquatic Toxicity Rating: TLm96:100-10 ppm WQCHM* 2,-,74. Carcinogenic Determination: Human Suspected IARC** 7,203,74.

TLV: Air: 10 ppm DTLVS* 4,37,80. *Toxicology Review:* ARPAAQ 11,434,31; EVHPAZ 11,163,75; AEHLAU 22,373,71; PAREAQ 4,1,52; FNSCA6 2,67,73; MUREAV 47(2),75,78; AMSVAZ 118,354,44; ZHPMAT 166,113,78; JTEHD6 -(suppl.2),69,77; PHRPA6 41,1357,26; CTOXAO 11,531,77; BNYMAM 54, 413,78; KRANAW 9,403,32; 27ZTAP 3,22,69. OSHA Standard: Air: TWA 10 ppm; CL 25 ppm; Pk 50 ppm/10M/8H (SCP-U) FEREAC 39,23540,74. DOT: Flammable Liquid, Label: Flammable Liquid FEREAC 41,57018,76. Occupational Exposure to Benzene recm std: Air: CL 10 ppm/60M NTIS**. Currently Tested by NTP for Carcinogenesis by Standard Bioassay Protocol as of December 1980. "NIOSH Manual of Analytical Methods" VOL 1 127, VOL 3 S311. Reported in EPA TSCA Inventory, 1980. EPA TSCA 8E NO:12770027-Followup Sent as of April, 1979.

THR: Poisoning occurs most commonly through inhal of the vapor, though benzene can penetrate the skin, and poison in that way. Locally, benzene has a comparatively strong irr effect, producing erythema and burning, and, in more severe cases, edema and even blistering. Exposure to high conc of the vapor (3000 ppm or higher) may result from failure of equipment or spillage. Such exposure, while rare in industry, may result in acute poisoning, characterized by the narcotic action of benzene on the CNS. The anesthetic action of benzene is similar to that of other anesthetic gases, consisting of a preliminary stage of excitation followed by depression and, if exposure is continued, death through respiratory failure. The chronic, rather than the acute form, of benzene poisoning is important in industry. It is a recog leukemogen. There is no specific blood picture occurring in cases of chronic benzol poisoning. The bone marrow may be hypoplastic, normal, or hyperplastic, the changes reflected in the peripheral blood. Anemia, leucopenia, macrocytosis, reticulocytosis, thromocytopenia, high color index, and prolonged bleeding time may be present. Cases of myeloid leukemia have been reported. For the supervision of the worker, repeated blood examinations are necessary, including hemoglobin determinations, white and red cell counts and differential smears. Where a worker shows a progressive drop in either red or white cells, or where the white count remains below 5,000 per cu mm or the red count below 4.0 million per cu mm, on two successive monthly examinations, he should be immediately removed from exposure. Following absorption of benzene, elimination is chiefly through the lungs, when fresh air is breathed. The portion that is absorbed is oxidized, and the oxidation products are combined with sulfuric and glycuronic acids and eliminated in the urine. This may be used as a diagnostic sign. Benzene

has a definite cumulative action, and exposure to relatively high conc is not serious from the point of view of causing damage to the blood-forming system, provided the exposure is not repeated. On the other hand, daily exposure to conc of 100 ppm or less will usually cause damage if continued over a protracted period of time. In acute poisoning, the worker becomes confused and dizzy, complains of tightening of the leg muscles and of pressure over the forehead, then passes into a stage of excitement. If allowed to remain in exposure, he quickly becomes stupefied and lapses into coma. In non-fatal cases, recovery is usually complete and no permanent disability occurs. In chronic poisoning the onset is slow, with the symptoms vague; fatigue, headache, dizziness, nausea and loss of appetite, loss of weight and weakness are common complaints in early cases. Later, pallor, nosebleeds, bleeding gums, menorrhagia, petechiae and purpura may develop. There is great individual variation in the signs and symptoms of chronic benzene poisoning. Benzene is a common air contaminant. Exper MUT, CARC, TER, ETA, NEO.

Fire Hazard: Dangerous, when exposed to heat or flame; can react vigorously with oxidizing materials, such as BrF_5, Cl_2, CrO_3, O_2NClO_4, O_2, O_3, perchlorates, ($AlCl_3$ + $FClO_4$), (H_2SO_4 + permanganates), K_2O_2, ($AgClO_4$ + acetic acid), Na_2O_2.

Spontaneous Heating: No.

Explosion Hazard: Mod, when its vapors are exposed to flame. Use with adequate ventilation.

Disaster Hazard: Dangerous, highly flammable.

To Fight Fire: Foam, CO_2, dry chemical.

Incomp: diborane.

For further information see Vol. 2, No. 4 and Vol. 3, No. 3 of *DPIM Report.*

BENZO(k)FLUORANTHENE

CAS RN: 207089 NIOSH #: DF 6350000
mf: $C_{20}H_{12}$; mw: 252.32

SYN: 11,12-BENZO(K)FLUORANTHENE

TOXICITY DATA: 3 CODEN:
skn-mus TDLo:2820 mg/kg/47W-I:ETA CANCAR 12,1194,59
scu-mus TDLo:72 mg/kg/9W-I:ETA AICCA6 19,490,63

"NIOSH Manual of Analytical Methods" VOL 1 183,184.
THR: An exper ETA.
Disaster Hazard: When heated to decomp it emits acrid smoke and irr fumes.

BENZO(ghi)PERYLENE

CAS RN: 191242 NIOSH #: DI 6200500
mf: $C_{22}H_{12}$; mw: 276.34

SYN: 1,12-BENZOPERYLENE

TOXICITY DATA: CODEN:
mma-sat 2 ug/plate/48H FCTXAV 17,141,79

"NIOSH Manual of Analytical Methods" VOL 1 183.
THR: MUT data.
Disaster Hazard: When heated to decomp it emits acrid smoke and irr fumes.

3ENZO(a)PYRENE

CAS RN: 50328 NIOSH #: DJ 3675000

nf: $C_{20}H_{12}$; mw: 252.32

Yellow crystals insol in water, sol in benzene, toluene, ;ylene. mp: 179°, bp: 312° @ 10 mm.

SYNS:

ENZO(D,E,F)CHRYSENE	3,4-BENZPYREN (GERMAN)
,4-BENZOPIRENE (ITALIAN)	BENZ(A)PYRENE
,4-BENZOPYRENE	3,4-BENZ(A)PYRENE
,7-BENZOPYRENE	3,4-BENZYPYRENE

TOXICITY DATA: 3

	CODEN:
lnd-omi 3 umol/L	PNCCA2 -,39,65
lnd-sal:spr 3 gm/L	BIPMAA 5,477,67
ind-sal:tes 5 ug/11I-C	BIJOAK 110,159,68
ind-hmn:oth 1500 nmol/L	TCMUD8 1,3,80
ini-hmn:hla 7 umol/L/11I-C	JEPTDQ 2(1),65,78
nsc-hmn:oth 100 nmol/L	CRNGDP 1,765,80
ind-rat:oth 1500 nmol/L	TCMUD8 1,3,80
fa-rat/sat 10 mg/kg	ENMUDM 1,155,79
ce-rat:lvr 1 umol/L	MUREAV 91,467,81
nsc-rat-unk 300 ug/kg	MUREAV 77,165,80
nt-mus-scu 100 mg/kg	EXPEAM 36,297,80
lt-mus-orl 80 mg/kg	ARTODN 38,99,77
tr-mus:fbr 10 mg/L	PAACA3 21,126,80
fa-mus/sat 100 mg/kg	CNREA8 38,4478,78
yt-mus-orl 100 mg/kg	MUREAV 85,299,81
ce-mus:emb 1 umol/L	ENMUDM 2,245,80
ma-mus/lng 25 mg/kg	PSEBAA 158,269,78
tr-ham:lng 10 ug/L	TOLED5 1000(Sp. Iss. I),92,80
tr-ham:kdy 80 ug/L	BJCAAI 37,873,78
tr-ham:fbr 1 mg/L	NATUAS 264,360,76
tr-ham-par 1 mg/L	PNASA6 56,672,66
yt-ham-ipr 200 mg/kg	TOLED5 2,277,78
ce-ham:lng 1 ug/L	JCINAO 64,1245,79
nsc-ham-ipr 200 mg/kg	TOLED5 2,277,78
nsc-ham:ovr 500 ug/L	CBINA8 34,1,81
nsc-ham:fbr 1 mg/L	NATUAS 264,360,76
nsc-ham:emb 780 ug/L	CALEDQ 8,203,80
ind-mam:kdy 1 mmol/L	JTEHD6 6,333,80
ins-rbt-skn 100 ug/L	PAACA3 21,94,80
ce-rbt-skn 30 ug/L	PAACA3 21,94,80
rl-rat TDLo:1000 mg/kg/(preg) TFX:TER	EXPEAM 20,224,64
rl-rat TDLo:40 mg/kg (14D preg)	NSAPCC 272,89,72
rl-rat TDLo:1000 mg/kg/ (preg):TER	EXPEAM 20,224,64
or-mus TDLo:240 mg/kg/(11-15D preg):TER	AMTUA3 7,3,70
cu-mus TDLo:240 mg/kg/(11-15D preg):TER	PSEBAA 135,84,70
il-hmn TCLo:70 ng/m3/Y-C:ETA	BJCAAI 14(3),397,60
rl-rat TDLo:160 mg/kg/6D-C:CAR	TOLED5 6,167,80
or-rat TDLo:16 mg/kg:ETA	BJCAAI 12,65,58
cu-rat TDLo:455 ug/kg/60D-I:NEO	CBINA8 29,159,80
/n-rat TDLo:39 mg/kg/6D-I:ETA	CNREA8 29,506,69
ns-rat TDLo:5 mg/kg:ETA	VPITAR 30,31,71
ce-rat TDLo:22 mg/kg:ETA	CNREA8 29,1927,69
r-rat TDLo:68 mg/kg/15W-I:CAR	85AGAF -,480,76
rl-mus TDLo:2310 mg/kg/11W-C:ETA	PSEBAA 130,146,69
kn-mus TDLo:240 mg/kg/30W-I:CAR	ZKKOBW 89,113,77
cu-mus TDLo:1000 ug/kg:ETA	TRBMAV 29,109,71
or-rat TDLo:60 mg/kg (16-18D preg)	BNEOBV 38,291,80
rl-mus TDLo:100 mg/kg (7-16D preg)	TJADAB 19,37A,79
rl-mus TDLo:100 mg/kg (MGN)	BIREBV 24,183,81
rl-mus TDLo:1600 mg/kg (7-16D preg)	BIREBV 24,183,81
rl-mus TDLo:100 mg/kg (7-16D preg)	BIREBV 24,183,81
qr-mus TDLo:300 mg/kg (16-18D preg)	JTEHD6 6,569,80
qr-mus TDLo:200 mg/kg (7D preg)	TJADAB 20,365,79
ma-rat TDLo:2400 ug/kg TFX:CAR	NTIS** DOE/EV/03140-5
da-mus TDLo:25 ng/kg/110W-I TFX:CAR	ARGEAR 50,266,80
qr-mus TDLo:10 mg/kg TFX:NEO	ARTODN Suppl.4,74,80
qr-mus TDLo:300 mg/kg (16-18D preg) TFX:CAR	JTEHD6 6,569,80
kn-mus TDLo:480 mg/kg (11-15D preg) TFX:CAR	PSEBAA 135,84,70
kn-mus TDLo:160 mg/kg (18D preg) TFX:NEO	BEXBAN 84,1025,77
pr-dog TDLo:819 mg/kg/26W-I TFX:ETA	JJIND8 65,921,80
mp-dog TDLo:651 mg/kg/21W-C TFX:ETA	JJIND8 65,921,80
rn-rbt TDLo:30 mg/kg (25D preg) TFX:NEO	BEXBAN 85,369,78
rn-rbt TD:30 mg/kg/(25D preg) TFX:NEO	BEXBAN 85,369,78
rn-mus TDLo:10 mg/kg:ETA	JNCIAM 1,225,40
kn-mus TDLo:160 mg/kg/(18D preg):NEO	BEXBAN 84,1025,77
rr-mus TDLo:400 mg/kg/10W-I:ETA	GISAAA 44(8),42,79
mp-mus TDLo:200 mg/kg:CAR	BJCAAI 39,761,79
ak-mus TDLo:80 mg/kg/8D-I:ETA	BEBMAE 88(11),592,79
rc-mus TDLo:200 mg/kg:CAR	ONCOBS 37,77,80
cu-mky TDLo:40 mg/kg:ETA	PSEBAA 127,594,68
in-rbt TDLo:17 mg/kg/57W-I:ETA	HSZPAZ 236,79,35
rn-rbt TDLo:30 mg/kg/(25D preg):NEO	BEBMAE 85,369,78
rr-rbt TDLo:145 mg/kg/2Y-I:ETA	GANNA2 71,197,80
el-ham TDLo:420 mg/kg/21W-I:ETA	ZEKBAI 65,56,62
cu-ham TDLo:4000 ug/kg:ETA	CNREA8 32,360,72
rr-ham TDLo:360 mg/kg/36W-I:CAR	CNREA8 32,28,72
mp-frg TDLo:45 mg/kg:ETA	EXPEAM 20,143,64
rr-ham TD:208 mg/kg/44D-I:NEO	IJCNAW 25,301,80
kn-mus TD:21 mg/kg/45W-I:NEO	PNASA6 73,243,76
rr-rat TD:200 mg/kg/15W-I:CAR	31BYAP -,199,74
kn-mus TD:14 mg/kg/28W-I:NEO	CNREA8 37,2608,77
rr-ham TD:104 mg/kg/52W-I:NEO	PEXTAR 24,162,79
mp-mus TD:14 mg/kg:NEO	AJPAA4 16,287,40
cu-ham TD:20 mg/kg:ETA	NATUAS 144,377,39
rn-rbt TD:30 mg/kg/(25D preg):NEO	BEXBAN 85,369,78
kn-mus TD:61 mg/kg/60W-I:NEO	CNREA8 64,617,80
cu-mus TD:160 mg/kg:NEO	BEXBAN 84,1025,77
cu-rat LD50:50 mg/kg	ZEKBAI 69,103,67
pr-mus LDLo:500 mg/kg	TXAPA9 23,288,72
rn-frg LDLo:11 mg/kg	CNREA8 24,1969,64

Carcinogenic Determination: Animal Positive IARC** 3,91,73. *Toxicology Review:* 32XPAD -,49,75; ACRSAJ 7,475,63; MUREAV 39,257,77; ZHPMAT 166,144,78; BNYMAM 54,413,78; PEXTAR 5,157,64; 85CVA2 5,257,70; 85DHAX Pc,4,72; NTIS** CONF-691001. "NIOSH Manual of Analytical Methods" VOL 1 183, 184, 186, 206, 251. Reported in EPA TSCA Inventory, 1980. EPA TSCA 8(a) Preliminary Assessment Information Proposed Rule FERREAC 45, 13646,80.

THR: An exper TER, ETA, CARC, NEO via various routes. HIGH acute scu tox in rats. A common air contaminant of water, food and smoke. MUT data.

BIS(2-ETHYLHEXYL)PHTHALATE

CAS RN: 117817 NIOSH #: TI 0350000
mf: $C_{24}H_{38}O_4$; mw: 390.62

SYNS:

BIS(2-ETHYLHEXYL)-1,2-BENZENEDICARBOXYLATE
DI(2-ETHYLHEXYL)ORTHOPHTHALATE
DI(2-ETHYLHEXYL)PHTHALATE
DI-SEC-OCTYL PHTHALATE
DOP
2-ETHYLHEXYL PHTHALATE
NCI-C52733
OCTOIL

TOXICITY DATA: 3-2-1	CODEN:
skn-rbt 500 mg/24H MLD	28ZPAK -,48,72
eye-rbt 500 mg	AJOPAA 29,1363,46
eye-rbt 500 mg/24H MLD	28ZPAK -,48,72
ipr-rat TDLo:30 gm/kg/(5-15D preg):TER	JPMSAE 61,51,72
orl-mus TDLo:7500 mg/kg/(8D preg):TER	TJADAB 14,259,76
orl-man TDLo:143 mg/kg:GIT	JIHTAB 27,130,45
orl-rat LD50:31 gm/kg	UCDS** 7/20/67
ipr-rat LD50:30700 mg/kg	JIHTAB 27,130,45
ivn-rat LD50:250 mg/kg	TXAPA9 45,230,78
unk-rat LD50:37000 mg/kg	GTPZAB 24(3),25,80
orl-mus LD50:30 gm/kg	TJADAB 14,259,76
ipr-mus LD50:14 gm/kg	JPMSAE 55,158,66
unk-mus LD50:37000 mg/kg	GTPZAB 24(3),25,80
orl-rbt LD50:34 gm/kg	EVHPAZ 4,3,73
skn-rbt LD50:25 gm/kg	JIHTAB 27,130,45
skn-gpg LD50:10 gm/kg	EVHPAZ 4,3,73
unk-gpg LD50:37000 mg/kg	GTPZAB 24(3),25,80
ihl-mam LC50:30000 mg/m3	GTPZAB 24(3),25,80
orl-rat TDLo:35 mg/kg (14D male/14D pre)	FCTXAV 15,389,77
orl-rat TDLo:8400 ug/kg (7D male)	TXAPA9 53,35,80
orl-rat TDLo:17200 mg/kg (MGN)	NEZAAQ 31,507,76
orl-rat TDLo:43 gm/kg (MGN)	NEZAAQ 31,507,76
ipr-rat TDLo:10 gm/kg (5-15D preg)	JPMSAE 61,51,72
ipr-rat TDLo:5 gm/kg (5-15D preg)	JPMSAE 61,51,72
orl-mus TDLo:1 gm/kg (7D preg)	JEPTDQ 4,533,80
orl-mus TDLo:1260 mg/kg (1-18D preg)	ENVRAL 22,245,80
orl-mus TDLo:3420 mg/kg (1-18D preg)	ENVRAL 22,245,80
orl-mus TDLo:7200 mg/kg (1-18D preg)	ENVRAL 22,245,80

TLV: Air: 5 mg/m3 DTLVS* 4,159,80. *Toxicology Review:* EVHPAZ (3),73,73; RREVAH 54,1,75; JOCMA7 15(10),808,73; CMIVAS 10(3),49,73; ESKHA5 93,1,75; TXAPA9 45,1,78. OSHA Standard: Air: TWA 5 mg/m3 (SCP-D) FEREAC 39,23540,74. NTP Carcinogenesis Bioassay Completed as of December 1980. "NIOSH Manual of Analytical Methods" Vol 1 S40. Reported in EPA TSCA Inventory, 1980. EPA TSCA 8(a) Preliminary Assessment Information Proposed Rule FERREAC 45,13646,80.

THR: An exper TER, GIT (man). Possible hmn CARC. HIGH ivn; LOW orl, ipr, unk, skn; MLD skn, eye irr.

Disaster Hazard: When heated to decomp it emits acrid smoke.

For further information see Di-(2-Ethylhexyl)Phthalate, Vol. 1, No. 7 and Vol. 2, No. 2 of *DPIM Report.*

CARBON DISULFIDE

CAS RN: 75150 NIOSH #: FF 6650000
mf: CS_2; mw: 76.13

Clear, colorless liquid, nearly odorless when pure. mp: −110.8°, bp: 46.5°, lel = 1.3%, uel = 50%, flash p: −22°F (CC), d: 1.261 @ 20°/20°, autoign. temp.: 257°F, vap. press: 400 mm @ 28°, vap. d: 2.64.

SYNS:

CARBON BISULFIDE
CARBONE (SUFURE DE) (FRENCH)
CARBONIO (SOLFURO DI) (ITALIAN)
CARBON SULFIDE
DITHIOCARBONIC ANHYDRIDE
KOHLENDISULFID (SCHWEFELKOHLENSTOFF) (GERMAN)
KOOLSTOFDISULFIDE (ZWAVELKOOLSTOF) (DUTCH)
NCI-C04591
SCHWEFELKOHLENSTOFF (GERMAN)
SULPHOCARBONIC ANHYDRIDE
WEGLA DWUSIARCZEK (POLISH)

TOXICITY DATA: 3	CODEN:
ihl-rat TCLo:50 mg/m3/8H/(1-21D preg) TFX:TER	TOLED5 2,129,78
ihl-rat TCLo:100 mg/m3/8H (1-22D preg)	TOLED5 2,129,78
ihl-rat TCLo:100 mg/m3/8H (1-21D preg)	TJADAB 14,374,76
ihl-rat TCLo:50 mg/m3/8H (1-21D preg)	TJADAB 14,375,76
ihl-mus TCLo:2000 mg/m3/2H (1-21D preg)	BEXBAN 68,1158,69
mmo-sat 100 uL/plate	NIOSH* 5AUG77
ihl-rat TCLo:50 mg/m3/8H/(1-21D preg):TER TOLED5 2,129,78	
orl-hmn LDLo:14 mg/kg	32ZWAA 8,225,74
ihl-hmn LCLo:4000 ppm/30M	29ZWAE -,118,68
unk-man LDLo:186 mg/kg	85DCAI 2,73,70
ipr-gpg LDLo:400 mg/kg	AIHAAP 35,21,74
ihl-mam LCLo:2000 ppm/5M	AEPPAE 138,65,28

Aquatic Toxicity Rating: TLm96:1000-100 ppm WQCHM* 2,-,74.

TLV: Air: 10 ppm (skin) DTLVS* 4,70,80. *Toxicology Review:* AHJOA2 83,100,72; 31ZNAA 2,365,73; AIHAAP 35(2),55,74; KHZDAN 16(2),208,73; CMTVAS 10(3),49,73. OSHA Standard: Air: TWA 20 ppm; CL 30; Pk 100/30M (SCP-R) FEREAC 39, 23540,74. DOT: Flammable Liquid, Label: Flammable Liquid FEREAC 41,57018,76. Occupational Exposure to Carbon Disulfide recm std: Air: TWA 1 ppm; CL 10 ppm/15M NTIS**. NTP Carcinogenesis Bioassay Completed; No Report-Data Insufficient. "NIOSH Manual of Analytical Methods" VOL 1 179, VOL 3 S248. Reported in EPA TSCA Inventory, 1980.

THR: MUT data. An exper TER. HIGH orl, unk, ipr. MOD ihl. An insecticide. The chief toxic effect is on the CNS, acting as a narcotic and anesthetic in acute poisoning with death following from respiratory failure. The anesthetic action is much more powerful than that of chloroform. In chronic poisoning, the effect on the nervous system is one of central and peripheral damage, which may be permanent if the damage has been severe. Sensory symptoms usually precede motor involvement. A secondary anemia may be caused. In acute poisoning, early excitation of the CNS resembling alcoholic intoxication occurs, followed by depression, with stupor, restlessness, unconsciousness, and possibly death. If recovery occurs, the patient usually passes through the after-stage of narcosis, with nausea, vomiting, headache, etc. In chronic poisoning, the picture is that of involvement of the nervous system, with neuritis and disturbance of vision being the commonest early changes. Sensory changes such as a crawling sensation in the skin, sensations of heaviness and coldness, and visually, "veiling" of objects so that they appear indistinct, are noticed first. Often there is pain in the affected parts, particularly the limbs. These symptoms are followed by gradually increasing loss of strength. Wasting of the muscles may occur. Mental symptoms vary from simple excitation or depression and irritability in the mild cases to mental deterioration, Parkinsonian paralysis, and even insanity. These changes are accompanied by insomnia, loss of memory, and personality changes. Chronic fatigue is a very common complaint. A fumigant. An eye irr @ 30 ppm.

Fire Hazard: Dangerous, when exposed to heat, flame, sparks or friction.

Spontaneous Heating: No.

Explosion Hazard: Severe; when exposed to heat or flame, reacts violently with Al, Cl_2, azides, CsN_3, ClO, ethylamine diamine, ethylene imine, F_2, $Pb(N_3)_2$, LiN_3, NO, N_2O_4, (H_2SO_4 + permangates), K, KN_3, RbN_3, NaN_3 Zn.

Disaster Hazard: Dangerous; when heated to decomp, emits highly tox fumes of SO_x; can react vigorously with oxidizing materials.

To Fight Fire: Water, CO_2, dry chemical, fog, mist.

Incomp: Air, rust; halogens; metal azides; metals; oxidants.

For further information see Vol. 1, No. 2 and Vol. 3, No. 5 of *DPIM Report.*

CHRYSENE. Syn: *1,2-benzphenathrene.* Crystals, slightly sol in ether, alcohol and glacial acetic acid, insol in water. $C_{18}H_{12}$, mw: 228.2, d: 1.274 @ 20°/4°, mp: 254°, bp: 448°.

THR = HIGH via sc and dermal and probably inhal routes. An exper (+) neo and carc. [*3, 11, 23*] A polycyclic hydrocarbon air pollutant.

DI-n-BUTYL PHTHALATE

CAS RN: 84742 NIOSH #: TI 0875000
mf: $C_{16}H_{22}O_4$; mw: 278.38

Oily liquid, mild odor. bp: 340°, fp: −35°, flash p: 315°F (CC), d: 1.047-1.049 @ 20°/20°, autoign. temp.: 757°F, vap. d: 9.58.

SYNS:

O-BENZENEDICARBOXYLIC ACID, DIBUTYL ESTER
BENZENE-O-DICARBOXYLIC ACID DI-N-BUTYL ESTER
DIBUTYL-1,2-BENZENEDICARBOXYLATE
DIBUTYL PHTHALATE

TOXICITY DATA: 3	CODEN:
ipr-rat TDLo:874 mg/kg/(5-15D preg) TFX:TER	JPMSAE 61,51,72
orl-rat TDLo:8400 ug/kg (7D male)	TXAPA9 53,35,80
ipr-rat TDLo:1017 mg/kg (5-15D preg)	JPMSAE 61,51,72
ipr-rat TDLo:305 mg/kg (5-15D preg)	JPMSAE 61,51,72
orl-mus TDLo:1440 mg/kg (1-18D preg)	ENVRAL 22,245,80
orl-mus TDLo:12 gm/kg (1-18D preg)	ENVRAL 22,245,80
orl-mus TDLo:38 gm/kg (1-18D preg)	ENVRAL 22,245,80
ihl-rat LC50:7900 ug/m3	GTPZAB 17(10),51,73
orl-mus LD50:5282 ug/kg	GTPZAB 17(10),51,73
ihl-mus LC50:2100 ug/m3	GTPZAB 17(10),51,73
cyt-ham:fbr 30 mg/L/24H	MUREAV 48,337,77
ipr-rat TDLo:874 mg/kg/(5-15D preg):TER	JPMSAE 61,51,72
orl-hmn TDLo:140 mg/kg:EYE	SMWOAS 84,1243,54
orl-rat LD50:12000 mg/kg	SPEADM 74-1,-,74
ipr-rat LD50:3050 mg/kg	JPMSAE 61,51,72
unk-rat LD50:10000 mg/kg	GTPZAB 24(3),25,80
ipr-mus LD50:3570 mg/kg	JSCCA5 28,667,77
unk-mus LD50:10000 mg/kg	GTPZAB 24(3),25,80
unk-gpg LD50:10000 mg/kg	GTPZAB 24(3),25,80
ihl-mam LC50:9620 mg/m3	GTPZAB 24(3),25,80

Aquatic Toxicity Rating: TLm96:1000-100 ppm WQCHM* 4,-,74.

TLV: Air: 5 mg/m3 DTLVS* 4,124,80. *Toxicology Review:* RREVAH 54,1,75; EVHPAZ 4,3,73; CMTVAS 10(3),49,73; ESKHA5 93,1,75; 27ZTAP 3,28,69. OSHA Standard: Air: TWA 5 mg/m3 (SCP-D) FEREAC 39,23540,74. "NIOSH Manual of Analytical Methods" VOL 2 S33. Reported in EPA TSCA Inventory, 1980. EPA TSCA 8(a) Preliminary Assessment Information Proposed Rule FERREAC 45,13646,80.

THR: MUT data. An exper TER. A hmn EYE. MOD ipr. LOW orl, unk, ihl. See esters, phthalic acid and butyl alcohol.

Fire Hazard: Slight, when exposed to heat or flame; can react with oxidizing materials. Violent reaction with Cl_2.

To Fight Fire: CO_2, dry chemical.

Incomp: Chlorine.

1,2-DICHLOROETHANE

mf: $C_2H_4Cl_2$; mw: 98.96

Lel = 6.2%; uel = 15.9%; flash p: 55.4°F.

Incomp: Dinitrogen tetraoxide; metals.
For further information see Vol. 1, No. 4 of *DPIM Report.*

DIBENZ(a,h)ANTHRACENE

CAS RN: 53703 NIOSH #: HN 2625000
mf: $C_{22}H_{14}$; mw: 278.36

SYNS:
1,2,5,6-DIBENZANTHRACEEN (DUTCH)
1,2:5,6-DIBENZANTHRACENE
DIBENZO(A,H)ANTHRACENE

TOXICITY DATA: 3	CODEN:
mma-sat 10 ug/plate	PNASA6 72,5135,75
mrc-esc 25 ug/well	MUREAV 46,53,77
sln-dmg-par 5 mmol/L	EJGCA9 4,400,75
mmo-nsc 500 ppm	ANYAA9 71,1072,58
das-hmn:fbr 1 mg/L	CNREA8 38,2091,78
das-hmn:hla 100 nmol/L	CNREA8 38,2621,78
dnd-mus:lvr 6 umol/L	JNCIAM 62,947,79
dnd-mus-skn 1 gm/L	CNREA8 27,1678,67
mma-ham:lng 56400 nmol/L	MUREAV 46,27,77
otr-ham:emb 2500 ug/L	CNREA8 32,1391,72
dnd-ham:fbr 5 mg/L/24H	BCPCA6 20,1297,71
cyt-ham:fbr 1 mmol/L	PJACAW 53,46,77
sce-ham-ipr 900 mg/kg/24H	MUREAV 66,65,79
msc-ham:lng 1 mg/L	PNASA6 73,188,76
dnd-mam:lym 2 nmol/L	JMOBAK 5,521,62
scu-rat TD:2400 ug/kg/50D-I:NEO	85DLAB -,-,75
orl-mus TDLo:360 mg/kg/43W-I:ETA	VRRAAT 20,276,38
skn-mus TDLo:1200 mg/kg/50W-I:CAR	14JTAF -,275,64
scu-mus TDLo:78 ug/kg:NEO	JNCIAM 3,503,43
ivn-mus TDLo:10 mg/kg:ETA	JNCIAM 1,225,40
imp-mus TDLo:80 mg/kg:CAR	BJCAAI 11,212,57
scu-gpg TDLo:250 mg/kg/24D-I:ETA	AKBNAE 51,112,38
ivn-gpg TDLo:30 mg/kg:ETA	JNCIAM 13,705,52
ims-pgn TDLo:6 mg/kg:CAR	JNCIAM 32,905,64
irn-frg TDLo:12 mg/kg:NEO	CNREA8 24,1969,64
imp-mus TD:14 mg/kg:NEO	AJPAA4 16,287,40
scu-mus TD:16 mg/kg:NEO	JNCIAM 44,641,70
scu-rat TD:450 ug/kg:ETA	BAFEAG 30,66,42
imp-mus TD:200 mg/kg:NEO	AJCAA7 36,201,39
skn-mus TD:6 ug/kg:NEO	CNREA8 20,1179,60
scu-mus TD:20 mg/kg:ETA	CNREA8 22,78,62
skn-mus TD:400 mg/kg/40W-I:NEO	CNREA8 22,78,62
imp-mus TD:100 mg/kg:CAR	BMBUAQ 14,147,58
scu-rat TD:135 mg/kg/9W-I:NEO	PSEBAA 68,330,48
scu-mus TD:400 mg/kg/10W-I:NEO	IJCNAW 2,500,67
ivn-mus LDLo:10 mg/kg	JNCIAM 1,225,40
dnd-sal:tes 5 ug/1H-C	BIJOAK 110,159,68
dnd-hmn:emb 360 nmol/L	CBINA8 22,257,78
otr-ham:kdy 25 ug/L	TOLED5 7,143,80
dnd-ham:emb 360 nmol/L	CBINA8 22,257,78
dnd-ham:kdy 5 mg/L	BCPCA6 20,1297,71

Carcinogenic Determination: Animal Positive IARC** 3,178,73. *Toxicology Review:* AEHLAU 23,6,71; MUREAV 39,257,77. Reported in EPA TSCA Inventory, 1980. EPA TSCA 8(a) Preliminary Assessment Information Proposed Rule FERREAC 45,13646,80.

TIIR: MUT data. An exper CARC, NEO, ETA. HIGH ivn.

Disaster Hazard: When heated to decomp it emits acrid smoke and irr fumes.

ETHYL BENZENE

CAS RN: 100414 NIOSH #: DA 0700000
mf: C_8H_{10}; mw: 106.18

Colorless liquid, aromatic odor. Misc in alcohol and ether, insol in NH_3; sol in SO_2. bp: 136.2°, fp: −94.9°, flash p: 59°F, d: 0.8669 @ 20°/4°, autoign. temp.: 810°F, vap. press: 10 mm @ 25.9°, vap. d: 3.66, lel = 1.2%, uel = 6.8%.

SYNS:

AETHYLBENZOL (GERMAN)
ETHYLBENZEEN (DUTCH)
ETHYLBENZOL
ETILBENZENE (ITALIAN)
ETYLOBENZEN (POLISH)
NCI-C56393
PHENYLETHANE

TOXICITY DATA: 2-1	CODEN:
skn-rbt 15 mg/24H open MLD	AIHAAP 23,95,62
eye-rbt 100 mg	AJOPAA 29,1363,46
ihl-rat TCLo:97 ppm/7H (15D preg)	BATTL* JAN,81
ihl-rat TCLo:985 ppm/7H (1-19D preg)	BATTL* JAN,81
ihl-rat TCLo:96 ppm/7H (1-19D preg)	BATTL* JAN,81
ihl-rbt TCLo:99 ppm/7H (1-18D preg)	BATTL* JAN,81
ihl-hmn TCLo:100 ppm/8H TFX:IRR	AIHAAP 31,206,70
orl-rat LD50:3500 mg/kg	AMIHAB 14,387,56
ihl-rat LCLo:4000 ppm/4H	AIHAAP 23,95,62
skn-rbt LD50:5000 mg/kg	FCTXAV 13,681,75
ihl-gpg LCLo:10000 ppm	PHRPA6 45,1241,30

Aquatic Toxicity Rating: TLm96: 100-10 ppm WQCHM* 2,-,74.

TLV: Air: 100 ppm DTLVS* 4,176,80. OSHA Standard: Air: TWA 100 ppm (skin) (SCP-C) FEREAC 39, 23540,74. DOT: Flammable Liquid, Label: Flammable Liquid FEREAC 41,57018,76. Selected by NTP Carcinogenesis Bioassay as of December 1980. "NIOSH Manual of Analytical Methods" VOL 2 S29. Reported in EPA TSCA Inventory, 1980. EPA TSCA 8(a) Preliminary Assessment Information Proposed Rule FERREAC 45,13646,80.

THR: MOD via irr to skn, eyes, mu mem and via oral and inhal routes. The liquid is an irr to the skn and mu mem. A conc of 0.1% of the vapor in air is an irr to the eyes of hmns, and a conc of 0.2% is extremely irr at first, then causes dizziness, irr of the nose and throat and a sense of constriction of the chest. Exposure of guinea pigs to 1% conc has been reported as causing ataxia, loss of consciousness, tremor of the extremities and finally death through respiratory failure. The pathological findings were congestion of the brain and lungs, with edema. No data are available regarding the effect of chronic exposure. An exper TER.

Erythema and inflammation of the skin may result from contact of the skn with the liquid. Exposure to the vapor causes lachrymation and irr of the nose and throat, dizziness, and a sense of constriction of the chest. The irr properties are sufficient to cause workers to leave an atmosphere containing 0.5% of the vapor.

Fire Hazard: Dangerous, when exposed to heat or flame; can react vigorously with oxidizing materials.

Spontaneous Heating: No.

Disaster Hazard: Dangerous; keep away from heat and open flame.

To Fight Fire: Foam, CO_2, dry chemical.

For further information see Vol. 2, No. 6 of *DPIM Report.*

FLUORANTHENE

CAS RN: 206440 NIOSH #: LL 4025000
mf: $C_{16}H_{10}$; mw: 202.26

A polycyclic hydrocarbon. Colorless solid. mp: 120°, bp: 367°, vap. press: 0.01 mm @ 20°.

SYNS:
BENZO(JK)FLUORENE
IDRYL
1,2-(1,8-NAPHTHYLENE)BENZENE

TOXICITY DATA: 3	CODEN:
mma-sat 100 mg/L/72H	FCTXAV 17,141,79
skn-mus TDLo:280 mg/kg/58W-I TFX:ETA	JNCIAM 56,1237,76
orl-rat LD50:2000 mg/kg	AIHAAP 23,95,62
ivn-mus LD50:100 mg/kg	CSLNX* NX#00205
skn-rbt LD50:3180 mg/kg	AIHAAP 23,95,62

"NIOSH Manual of Analytical Methods" VOL 1 183, 184. Reported in EPA TSCA Inventory, 1980. EPA TSCA 8(a) Preliminary Assessment Information Proposed Rule FERREAC 45,13646,80.

THR: An exper ETA. HIGH ivn. MOD oral and skin. MUT data.

Fire Hazard: Slight, when exposed to heat or flame.

Disaster Hazard: When heated to decomp it emits acrid smoke and fumes.

FLUORINE

CAS RN: 7782414 NIOSH #: LM 6475000
mf: F_2; mw: 38.00

Pale yellow gas., mp: −218°, bp: −187°, d: 1.14 @ −200° 1.108 @ −188°, vap. d: 1.695.

SYNS:

BIFLUORIDEN (DUTCH)
FLUOR (DUTCH, FRENCH, GERMAN, POLISH)
FLUORINE (DOT)
FLUORO (ITALIAN)
FLUORURES ACIDE (FRENCH)
FLUORURI ACIDI (ITALIAN)
SAEURE FLUORIDE (GERMAN)

TOXICITY DATA: 3	CODEN:
eye-hmn 25 ppm/5M MLD	AIHAAP 29,11,68
eye-rat 140 ppm/30M	AIHAAP 29,11,68
eye-mus 467 ppm/5M	AIHAAP 29,11,68
eye-dog 68 ppm/1H	AIHAAP 29,11,68
ihl-rat LC50:185 ppm/1H	AIHAAP 29,11,68
ihl-mus LC50:150 ppm/1H	AIHAAP 29,11,68
ihl-rbt LC50:270 ppm/30M	AIHAAP 29,11,68
ihl-gpg LC50:170 ppm/1H	AIHAAP 29,11,68

TLV: Air: 1 ppm DTLVS* 4,197,80. *Toxicology Review:* JAVMA4 164(3),277,74; FOREAE 7,313,42; KOTTAM 11(11),1300,75; CLCHAU 19,361,73; AJMEAZ 38,409,65; IECHAD 26,791,34. OSHA Standard: Air: TWA 0.1 ppm (SCP-V) FEREAC 39,23540,74. DOT: Nonflammable Gas, Label: Poison and Oxidizer FEREAC 41,57018,76. Reported in EPA TSCA Inventory, 1980. EPA TSCA 8(a) Preliminary Assessment Information Proposed Rule FERREAC 45,13646,80. EPA TSCA 8E No. 02780042—File Closed as of April, 1979.

THR: HIGH irr to skn, eyes, mu mem, via oral and inhal routes. See also fluorides. A most powerful caustic irr to skn, eyes, mu mem.

Fire and Explosion Hazard: Dangerous. Reacts violently with many materials.

Incomp: Ammonia; cesium heptafluoro propoxide; covalent halides; cyanoguanidine; halocarbons; hexalithium disilicide; hydrocarbons; hydrofluoric acid; hydrogen; seleninyl fluoride; hydrogen sulfide; ice; nitric acid; nonmetal oxides; non-metals; oxygen; sodium acetate; sodium bromate; sodium dicyanamides; water; most organic matter, H-containing molecules, oxides of S, N, P, alkali metals and alkaline earths. It reacts violently with halogens and halogen acids, P, S, hydrazine, ClO_2; C; coke; charcoal; cyanamide; cyanides; KNO_3; (PbO + glycerol); CCl_4; silicides; silicates; alkenes; alkyl benzenes; CS_2; $Cr(OCl)_2$; B; Al; Tl; Sn; Sb; Te; Se; S; P; As; natural gas; liquid air; perfluoropropionyl fluoride; phenol formaldehyde resin; polyamides; polychloroprene; polyethylene; polyvinyl chloride acetate; polyurethane. Many reacts go on even at <−160°.

Disaster Hazard: Highly dangerous; when heated it emits highly tox fumes; will react with water or steam to produce heat and tox and corrosive fumes.

For further information see Vol. 1, No. 4 and Vol. 3, No. 4 of *DPIM Report.*

HEXONE

CAS RN: 108101 NIOSH #: SA 9275000
mf: $C_6H_{12}O$; mw: 100.18

Clear liquid. bp: 118°, lel = 1.4%, uel = 7.5%, flash p: 62.6°F, d: 0.803, fp: −80.2°, autoign. temp.: 858°F, vap. press: 16 mm @ 20°, d: 3.45.

SYNS:

ISOBUTYL-METHYLKETON (CZECH)
ISOBUTYL METHYL KETONE
ISOPROPYLACETONE
KETONE, ISOBUTYL METHYL
METHYL-ISOBUTYL-CETONE (FRENCH)
METHYLISOBUTYLKETON (DUTCH, GERMAN)
METHYL ISOBUTYL KETONE
METYLOIZOBUTYLOKETON (POLISH)
4-METHYL-PENTAN-2-ON (DUTCH, GERMAN)
2-METHYL-4-PENTANONE
4-METHYL-2-PENTANON (CZECH)
4-METHYL-2-PENTANONE
METILISOBUTILCHETONE (ITALIAN)
4-METILPENTAN-2-ONE (ITALIAN)

TOXICITY DATA: 3-2

eye-hmn 200 ppm/15M
skn-rbt 500 mg/24H MOD
eye-rbt 40 mg SEV
ihl-mus LC50:23300 mg/m3
ihl-hmn TCLo:200 ppm:IRR
orl-rat LD50:2080 mg/kg
ihl-rat LCLo:4000 ppm/15M
orl-mus LDLo:2850 mg/kg
ipr-mus LD50:268 mg/kg

CODEN:

JIHTAB 28,262,46
28ZPAK -,42,72
UCDS** 4/25/58
GTPZAB 17(10),51,73
SHELL* -,57,57
UCDS** 4/25/58
AMIHBC 4,119,51
GTPZAB 11,52,73
SCCUR* -,7,61

Aquatic Toxicity Rating: TLm96:over 1000 ppm WQCHM* 4,-,74.

TLV: Air: 50 ppm DTLVS* 4,283,80. *Toxicology Review:* 27ZTAP 3,95,69. OSHA Standard: Air: TWA 100 ppm (SCP-A) FEREAC 39,23540,74. Occupational Exposure to Ketones recm std: Air: TWA 200 mg/m3 NTIS**. "NIOSH Manual of Analytical Methods" VOL 2 S18. Reported in EPA TSCA Inventory, 1980. EPA TSCA 8(a) Preliminary Assessment Information Proposed Rule FERREAC 45,13646,80.

THR: A skn, eye irr. A hmn ihl IRR. HIGH ipr; MOD orl, ihl. MOD via oral and inhal routes and HIGH irr to eyes and mu mem. Narcotic in HIGH conc. See also ketones.

Fire Hazard: Dangerous, when exposed to heat, flame or oxidizers. Violent reaction with potassium *tert*-butoxide.

Explosion Hazard: Mod, in the form of vapor when exposed to heat or flame.

Disaster Hazard: Dangerous; keep away from heat and open flame; can react vigorously with reducing materials.

To Fight Fire: Alcohol foam, CO_2, dry chemical.

Incomp: Air; potassium-t-butoxide.

INDENO(1,2,3-cd)PYRENE

CAS RN: 193395 NIOSH #: NK 9300000
mf: $C_{22}H_{12}$; mw: 276.34

SYNS:
2,3-PHENYLENEPYRENE 2,3-O-PHENYLENEPYRENE

TOXICITY DATA: 3 CODEN:
mma-sat 3 ug/plate/48H FCTXAV 17,141,79
scu-mus TDLo:72 mg/kg/9W-I:CAR AICCA6 19,490,63

Carcinogenic Determination: Animal Positive IARC** 3,229,73. *Toxicology Review:* 85DHAX Pc,4,72. Reported in EPA TSCA Inventory, 1980. EPA TSCA 8(a) Preliminary Assessment Information Proposed Rule FERREAC 45,13646,80.

THR: An exper CARC. MUT data.

Disaster Hazard: When heated to decomp it emits acrid smoke and fumes.

2-METHYLNAPHTHALENE

CAS RN: 91576 NIOSH #: QJ 9635000
mf: $C_{11}H_{10}$; mw: 142.21

Solid, insol in water, sol in alc and ether. d: 1.0058 @ 20°/4°, bp: 241.1°, mp: 34.58°.

SYN: BETA-METHYLNAPHTHALENE

TOXICITY DATA: 1 CODEN:
orl-rat LDLo: 5000 mg/kg 28ZRAQ -,55,60

Reported in EPA TSCA Inventory, 1980. EPA TSCA 8(a) Preliminary Assessment Information Proposed Rule FERREAC 45,13646,80

THR: LOW orl.

Disaster Hazard: When heated to decomp it emits acrid smoke and fumes.

NAPHTHALENE

CAS RN: 91203 NIOSH #: QJ 0525000
mf: $C_{10}H_8$; mw: 128.18

Aromatic odor, white, crystalline, volatile flakes. mp: 80.1°, bp: 217.9°, flash p: 174°F (OC), d: 1.162, lel = 0.9%, uel = 5.9%, vap. press: 1 mm @ 52.6°, vap. d: 4.42. Autoign temp: 1053°F (567°C); sol in alc, benzene. Insol in water; very sol in ether, CCl_4, CS_2 hydronaphthalenes, in fixed and volatile oils.

SYNS:

CAMPHOR TAR
MOTH BALLS
MOTH FLAKES
NAFTALEN (POLISH)
NAPHTHALINE
NAPHTHENE
NCI-C52904
TAR CAMPHOR
WHITE TAR

TOXICITY DATA: 3	CODEN:
ipr-rat TDLo:5925 mg/kg (1-15D preg)	TXAPA9 48,A35,79
skn-rbt 495 mg open MLD	UCDS** 1/11/68
eye-rbt 100 mg MLD	BIOFX* 16-4/70
scu-rat TDLo:3500 mg/kg/12W-I:ETA	APAVAY 329,141,56
orl-chd LDLo:100 mg/kg	28ZRAQ -,228,60
unk-man LDLo:74 mg/kg	85DCAI 2,73,70
orl-rat LD50:1780 mg/kg	BIOFX* 16-4/70
ipr-mus LD50:150 mg/kg	NTIS** AD691-490
scu-mus LD50:969 mg/kg	TOIZAG 20(5/6),772,73
ivn-mus LD50:100 mg/kg	CSLNX* NX#00203
orl-dog LDLo:400 mg/kg	HBAMAK 4,1289,35
orl-cat LDLo:1000 mg/kg	HBAMAK 4,1289,35
orl-rbt LDLo:3 gm/kg	HBAMAK 4,1289,35
orl-mam LD50:1000 mg/kg	FMCHA2 -,D213,80

Aquatic Toxicity Rating: TLm96:10-1 ppm WQCHM* 3,-,74. *TLV:* Air: 10 ppm DTLVS* 4,293,80. *Toxicology Review:* 38ZNAA 1(1),93,71; JOPDAB 59,1,61; 27ZTAP 3,30,69. OSHA Standard: Air: TWA 10 ppm (SCP-T) FEREAC 39,23540,74. DOT-ORM-A, Label: None FEREAC 41,57018,76. Currently Tested by NTR for Carcinogenesis by Standard Bioassay Protocol as of Sept 1980. "NIOSH Manual of Analytical Methods" VOL 3 S292. Reported in EPA TSCA Inventory, 1980.

THR: MOD orl and HIGH ipr, ivn. An exper ETA. May be used as an insecticide. Systemic reactions include nausea, headache, diaphoresis, hematuria, fever, anemia, liver damage, vomiting, convulsions and coma. Poisoning may occur by ing of large doses, inhal or skn absorption.

Fire Hazard: Mod, when exposed to heat or flame; reacts with oxidizing materials. Reacts violently with CrO_3.

Spontaneous Heating: No.

Explosion Hazard: Mod, in the form of dust, when exposed to heat or flame.

To Fight Fire: Water, CO_2, dry chemical.

Incomp: Dinitrogen pentaoxide.

PHENANTHRENE

CAS RN: 85018 NIOSH #: SF 7175000
mf: $C_{14}H_{10}$; mw: 178.24

Solid or monoclinic crystals. mp: 100°, bp: 339°, d: 1.179 @ 25°, vap. press: 1 mm @ 118.3°, vap. d: 6.14. Insol in water; sol in CS_2 benzene, hot alcohol; very sol in ether.

SYN: PHENANTHREN (GERMAN)

TOXICITY DATA: 3	CODEN:
dnd-sal:spr 3 gm/L	BIPMAA 5,477,67
dnd-sal:tes 5 ug/1H-C	BIJOAK 110,159,68
dnd-ham:kdy 5 mg/L	BCPCA6 20,1297,71
mma-sat 100 ug/plate	APSXAS 17,189,80
dnd-ham:fbr 5 mg/L/24H	BCPCA6 20,1297,71
cyt-ham:lng 40 mg/L/27H	MUREAV 66,277,79
sce-ham-ipr 900 mg/kg/24H	MUREAV 66,65,79
sce-ham:fbr 10 umol/L	JNCIAM 58,1635,77
skn-mus TDLo:71 mg/kg:NEO	JNCIAM 50,1717,73
skn-mus TD:22 gm/kg/10W-I:ETA	BJCAAI 10,363,56
orl-mus LD50:700 mg/kg	HYSAAV 29,19,64
ivn-mus LD50:56 mg/kg	CSLNX* NX#00190

"NIOSH Manual of Analytical Methods" VOL 1 206. Reported in EPA TSCA Inventory, 1980. EPA TSCA 8(a) Preliminary Assessment Information Proposed Rule FERREAC 45,13646,80.

THR: MUT data. An exper NEO, ETA. HIGH ivn. MOD orl. A hmn skn photosensitizer. A slight fire hazard.

To Fight Fire: water, foam, CO_2, dry chemical.

Disaster Hazard: When heated to decomp it emits acrid smoke and fumes.

PYRENE

CAS RN: 129000 NIOSH #: UR 2450000
mf: $C_{16}H_{10}$; mw: 202.26

Colorless solid, solutions have a slight blue color, insol in water, fairly sol in organic solvents. (a condensed ring hydrocarbon), mp: 156°, d: 1.271 @ 23°, bp: 404°.

SYNS:

BENZO(DEF)PHENANTHRENE PYREN (GERMAN)

TOXICITY DATA: 3	CODEN:
dnd-esc 10 umol/L	PNCCA2 -,39,65
dnd-sal:spr 3 gm/L	BIPMAA 5,477,67
dnd-sal:tes 5 ug/1H-C	BIJOAK 110,159,68
skn-rbt 500 mg/24H MOD	28ZPAK -,26,72
mma-sat 140 umol/L/2H	CNREA8 39,4152,79
mse-rat:emb 10 mg/L	JTEHD6 4,79,78
otr-ham:emb 10 mg/L	CNREA8 31,1118,71
cyt-ham:emb 10 mg/L	CNREA8 31,1118,71
dnd-mam:lym 100 umol	BIPMAA 9,689,70
skn-mus TDLo:10 gm/kg/3W-I:ETA	BJCAAI 10,363,56

"NIOSH Manual of Analytical Methods" VOL 1 183,184. Reported in EPA TSCA Inventory, 1980.

THR: MUT data. A skn irr. An exper ETA.

Disaster Hazard: When heated to decomp it emits acrid smoke and fumes.

STYRENE

CAS RN: 100425 NIOSH #: WL 3675000
mf: C_8H_8; mw: 104.16

Colorless, refractive, oily liquid; mp: −31°, bp: 146°, lel = 1.1%, uel = 6.1%, flash p: 88°F, d: 0.9074 @ 20°/4°, autoign. temp.: 914°F, vap. d: 3.6, fp: −33°, ulc: 40-50. Very slightly sol in water; misc in alc, ether.

SYNS:

CINNAMENE
CINNAMENOL
NCI-C02200
PHENYLETHENE
PHENYLETHYLENE
STIROLO (ITALIAN)
STYREEN (DUTCH)
STYREN (CZECH)
STYROL (GERMAN)
VINYLBENZEN (CZECH)
VINYLBENZENE
VINYLBENZOL

TOXICITY DATA: 3	CODEN:
skn-hmn 500 mg nse	INMEAF 17,199,48
skn-rbt 500 mg open MLD	UCDS** 12/13/63
skn-rbt 100% MOD	AMIHAB 14,387,56
eye-rbt 18 mg	AJOPAA 29,1363,46
mma-sat 1 umol/plate	MUREAV 56,147,77
cyt-hmn:lym 300 ppm/72H	MUREAV 58,277,78
hma-mus/smc 1 gm/kg	MUREAV 40,317,76
cyt-ham:lng 250 mg/L/27H	MUREAV 66,277,79
orl-mus TDLo:164 gm/kg/78W-C TFX:ETA	NCITR* NCI-CG-TR-185,79
ihl-hmn LCLo:10000 ppm/30M	29ZWAE -,77,68
ihl-hmn TCLo:600 ppm TFX:IRR	AMIHAB 14,387,56
ihl-hmn TCLo:376 ppm TFX:CNS	DTLVS* 3,235,71
orl-rat LD50:5000 mg/kg	AMIHAB 14,387,56
ihl-rat LCLo:5000 ppm/8H	JIHTAB 24,295,42
orl-mus LD50:316 mg/kg	NCILB* NIH-NCI-E-C-72-3252
ipr-mus LD50:660 mg/kg	ARZNAD 19,617,69
ivn-mus LD50:90 mg/kg	ARZNAD 19,617,69
ihl-gpg LCLo:12 mg/m3/14H	JIHTAB 24,295,42
sce-hmn:lym 1 mmol/L	CRNGDP 1,357,80
sce-mus-ihl 46400 ug/kg/4D-I	TXAPA9 55,37,80
sce-mus-ihl 125 ppm/4D-I	APTOD9 19,A34,80
ihl-rat TCLo:300 ppm/7H (6-15D preg)	TXCYAC 11,335,78
ihl-mus TCLo:500 ppm/6H (6-16D preg)	APTOA6 47,127,80
ihl-ham TCLo:1000 ppm/6H (6-18D preg)	APTOA6 47,127,80

Aquatic Toxicity Rating: TLm96:100-10 ppm WQCHM* 4,-,74.

TLV: Air: 50 ppm DTLVS* 4,373,80. *Toxicology Review:* EVHPAZ 11,115,75; EVHPAZ 11,163,75; CMTVAS 10(3),49,73; CBINA8 22,117,78; 27ZTAP 3,135,69. OSHA Standard: Air: TWA 100 ppm; CL 200; Pk 600/5M/3H (SCP-C) FEREAC 39,23540,74. NCI Carcinogenesis Bioassay Completed; Results Indefinite: Mouse (NCITR* NCI-CG-TR-185,79). NCI Carcinogenesis Bioassay Completed; Results Negative: Rat (NCITR* NCI-CG-TR-185,79). "NIOSH Manual of Analytical Methods" VOL 1 127, VOL 2 S30. Reported in EPA TSCA Inventory, 1980. EPA TSCA 8(a) Preliminary Assessment Information Proposed Rule FERREAC 45,13646,80.

THR: MUT data. A skn, eye irr. An exper ETA; ± CARC; HIGH orl, ivn; MOD ipr, ihl; A hmn IRR, CNS. It can cause irr, violent itching of the eyes @ 200 ppm, lachrymation, and severe human eye injuries. Its toxic effects are usually transient and result in irr and possible narcosis. It is not considered a very toxic material, because under ordinary conditions it does not vaporize sufficiently to reach a conc that can kill animals, such as rats and guinea pigs, in a few min. Exper have found that 10,000 ppm was dangerous to animal life in from 30-60 min, 2,500 ppm was dangerous to life in 8 hrs, while 1,300 ppm was the high amount which was found to cause no serious systemic disturbances in 8 hrs. However, all animals exposed to these amounts did evidence eye and nasal irr, while those exposed to 2,500 ppm or more showed varying degrees of weakness and stupor, followed by incoordination, tremors and unconsciousness. To produce this unconsciousness required 10 hrs at a conc of 2,500 ppm. From a study to determine the chronic effects of this material, it was discovered that rats exposed to 1,300 ppm for from 7-8 hrs/day, 5 days/week, for 26 weeks, showed evidence and definite signs of eye and nasal irr and appeared unkempt, though they made a normal gain in weight and presented no significant microscopic tissue changes or changes in the blood picture. Twelve rabbits exposed to 1,300 ppm for the same period of time showed similar results with one unexplained exception.

Fire Hazard: Dangerous, when exposed to flame, heat or oxidants.

Explosion Hazard: Reacts violently with chlorosulfonic acid; oleum; H_2SO_4; O_2; alkali metal-graphite.

Disaster Hazard: Dangerous, upon exposure to heat or flame; on decomp, emits acrid fumes; can react vigorously with oxidizing materials.

Treatment and Antidotes: Personnel who show symptoms of irr or beginning narcosis due to exposure to this material should be removed from exposure and the symptoms will disappear. If the symptoms persist, consult a physician.

To Fight Fire: Foam, CO_2, dry chemical.

For further information see Vol. 1, No. 8 and Vol. 2, No. 6 of *DPIM Report.*

TOLUENE

CAS RN: 108883 NIOSH #: XS 5250000
mf: C_7H_8; mw: 92.15

Colorless liquid, benzol-like odor. Flammable. mp: −95° to −94.5°, bp: 110.4°, flash p: 40°F (CC), ulc: 75-80, lel = 1.27%, uel = 7%, d: 0.866 @ 20°/4°, autoign. temp.: 896°F, vap. press: 36.7 mm @ 30°, vap. d: 3.14. Insol in water; sol in acetone; misc in absolute alc, ether, chloroform.

SYNS:

METHYLBENZENE	TOLUEEN (DUTCH)
METHYLBENZOL	TOLUEN (CZECH)
NCI-C07272	TOLUOL
PHENYLMETHANE	TOLUOLO (ITALIAN)

TOXICITY DATA: 3	CODEN:
cyt-rat-scu 12 gm/kg/12D-I	GTPZAB 17(3),24,73
ihl-rat TCLo:1500 mg/m3/24H (1-8D preg)	TXCYAC 11,55,78
ihl-rat TCLo:1000 mg/m3/24H (7-14D preg)	FMORAO 28,286,80
orl-mus TDLo:9 gm/kg (6-15D preg)	TJADAB 19,41A,79
orl-mus TDLo:15 gm/kg (6-15D preg)	TJADAB 19,41A,79
orl-mus TDLo:30 gm/kg (6-15D preg)	TJADAB 19,41A,79
ihl-mus TCLo:500 mg/m3/24H (6-13D preg)	TXCYAC 11,55,78
unk-rat LD50:6900 mg/kg	GISAAA 45(12),64,80
unk-mus LD50:2000 mg/kg	GISAAA 45(12),64,80
eye-hmn 300 ppm	JIHTAB 25,282,43
skn-rbt 435 mg MLD	UCDS** 7/23/70
eye-rbt 870 ug MLD	UCDS** 7/23/70
eye-rbt 2 mg/24H SEV	28ZPAK -,23,72
cyt-rat-ihl 610 mg/m3/16W-I	GISAAA 42(1),32,77
ihl-hmn TCLo:200 ppm:CNS	JAMAAP 123,1106,43
ihl-man TCLo:100 ppm:PSY	WEHSAL 9,131,72
orl-rat LD50:5000 mg/kg	AMIHAB 19,403,59
ihl-rat LCLo:4000 ppm/4H	AIHAAP 30,470,69
ipr-rat LDLo:800 mg/kg	TXAPA9 1,156,59
ihl-mus LC50:5320 ppm/8H	JIHTAB 25,366,43
ipr-mus LD50:1120 ug/kg	AGGHAR 18,109,60
skn-rbt LD50:14 gm/kg	UCDS** 7/23/70
scu-frg LDLo:920 mg/kg	AEPPAE 130,250,28

Aquatic Toxicity Rating: TLm96: 100-10 ppm WQCHM* 4,-,74.

TLV: Air: 100 ppm DTLVS* 4,400,80. *Toxicology Review:* AEHLAU 22,373,71; CTOXAO 11(5),549,77; FNSCA6 2,67,73; MUREAV 47(2),75,78; CTOXAO 11(5),549,77; 27ZTAP 3,144,69. OSHA Standard: Air: TWA 200 ppm; CL 300; Pk 500/10M (SCP-V) FEREAC 39,23540,74. DOT: Flammable Liquid, Label: Flammable Liquid FEREAC 41,57018,76. Occupational Exposure to Toluene recm std: Air: TWA 100 ppm; CL 200 ppm/10M NTIS**. Currently Tested by NTP for Carcinogenesis by Standard Bioassay Protocol as of December 1980. Reselected by NTP Carcinogenesis Bioassay as of December 1980. "NIOSH Manual of Analytical Methods" VOL 1 127, VOL 3 S343. Reported in EPA TSCA Inventory, 1980. EPA TSCA 8(a) Preliminary Assessment Information Proposed Rule FERREAC 45,13646,80. EPA TSCA 8E No. 02780079P-Followup Sent as of April, 1979.

THR: MUT data. A skn, eye irr. A hmn CNS, PSY. MOD ihl, ipr, scu; HIGH ipr; LOW orl, skn. Toluene is derived from coal tar, and commercial grades usually contain small amounts of benzene as an impurity. Acute poisoning, resulting from exposures to high conc of the vapors, are rare with toluene. Inhal of 200 ppm of toluene for 8 hrs may cause impairment of coordination and reaction time; with higher conc (up to 800 ppm) these effects are increased and are observed in a shorter time. In the few cases of acute toluene poisoning reported, the effect has been that of a narcotic, the workman passing through a stage of intoxication into one of coma. Recovery following removal from exposure has been the rule. An occasional report of chronic poisoning describes an anemia and leucopenia, with biopsy showing a bone marrow hypoplasia. These effects, however, are less common in people working with toluene, and they are not as severe.

Exposure to conc up to 200 ppm produces few symptoms. At 200-500 ppm, headache, nausea, eye irr, loss of appetite, a bad taste, lassitude, impairment of coordination and reaction time are reported, but are not usually accompanied by any laboratory or physical findings of significance. With higher conc, the above complaints are increased and in addition, anemia, leucopenia and enlarged liver may be found in rare cases.

A common air contaminant.

Fire Hazard: Slight, when exposed to heat, flame or oxidizers.

Explosion Hazard: Mod, when exposed to flame or reacted with (H_2SO_4 + HNO_3), N_2O_4, $AgClO_4$, BrF_3, UF_6.

Disaster Hazard: Mod dangerous; when heated it emits irr fumes; can react vigorously with oxidizing materials.

To Fight Fire: Foam, CO_2, dry chemical.

For further information see Vol. 2, No. 1 of *DPIM Report.*

XYLENE

CAS RN: 1330207 NIOSH #: ZE 2100000
mf: C_8H_{10}; mw: 106.18

SYNS:

DIMETHYLBENZENE
KSYLEN (POLISH)
XILOLI (ITALIAN)
XYLENEN (DUTCH)
XYLOL
XYLOLE (GERMAN)

TOXICITY DATA: 3-2-1 CODEN:

ihl-rat TCLo:1000 mg/m3/24H (9-14D preg) TXCYAC 11,55,78
eye-hmn 200 ppm JIHTAB 25,282,43
skn-rbt 100% MOD AMIHAB 14,387,56
skn-rbt 500 mg/24H MOD 28ZPAK -,24,72
eye-rbt 87 mg MLD AMIHAB 14,387,56
eye-rbt 5 mg/24H SEV 28ZPAK -,24,72
ihl-hmn TCLo:200 ppm:IRR JIHTAB 25,282,43
ihl-man LCLo:10000 ppm/6H BMJOAE 3,442,70
orl-rat LD50:4300 mg/kg AMIHAB 14,387,56
ihl-rat LC50:5000 ppm/4H NPIRI* 1,123,74
scu-rat LD50:1700 mg/kg NPIRI* 1,123,74
ipr-mus LD50:1570 ug/kg AGGHAR 18,109,60
ipr-gpg LDLo:2000 mg/kg AIHAAP 35,21,74
ipr-mam LDLo:2000 mg/kg AJHYA2 7,276,27

Aquatic Toxicity Rating: TLm96:100-10 ppm WQCHM* 2,-,74.

Toxicology Review: 27ZTAP 3,153,69. OSHA Standard: Air: TWA 100 ppm (SCP-U) FEREAC 39,23540,74. Occupational Exposure to Xylene recm std: Air: TWA 100 ppm; CL 200 ppm/10M NTIS**. "NIOSH Manual of Analytical Methods" VOL 1 127, VOL 3 S318. Reported in EPA TSCA Inventory, 1980. EPA TSCA 8(a) Preliminary Assessment Information Proposed Rule FERREAC 45,13646,80.

THR: A hmn eye irr; A skn eye irr. A hmn IRR and MOD ipr, scu, ihl; LOW orl.

Disaster Hazard: When heated to decomp it emits acrid smoke and fumes.

XYLENE

CAS RN: 1330207 NIOSH #: ZE 2190000

A clear liquid. bp: 138.5°, flash p: 100°F (TOC), d: 0.864 @ 20°/4°, vap. press: 6.72 mm @ 21°. Composition as nonaromatics .07%, toluene 14%, ethyl benzene 19.27%, p-xylene 7.84%, m-xylene 65.01%, o-xylene 7.63%, C9 and aromatics .04% (TXAPA9 33,543,75)

SYNS:

AROMATIC HYDROCARBONS, MIXED
NCI-C55232

TOXICITY DATA: 2 CODEN:

ihl-rat LC50:6700 ppm/4H TXAPA9 33,543,75

Currently Tested by NTP for Carcinogenesis by Standard Bioassay Protocol as of December 1980. Reported in EPA TSCA Inventory, 1980. EPA TSCA 8E No. 12770025—Status Report Prepared as of April, 1979.

THR: MOD via inhal and oral routes. Some temporary corneal effects are noted, as well as some conjunctival irr by instillation. Irr can start @ 200 ppm. Very little dermal toxicity.

Fire Hazard: Mod, in the presence of heat or flame; can react with oxidizing materials.

To Fight Fire: Foam, CO_2, dry chemical.

Disaster Hazard: When heated to decomp it emits acrid smoke and fumes.

APPENDIX E

CORRESPONDENCE REGARDING REGULATORY REQUIREMENTS

South Coast
AIR QUALITY MANAGEMENT DISTRICT
9150 FLAIR DRIVE, EL MONTE, CA 91731 (818) 572-6200

8?-00106

ITEM # 15,060
FILE #

January 6, 1987

Copies to: R. J. Alvarez
N. Tahir
J. Stagnaro
J. Monsees
M. Palacek
H. Chaffee
HL

Mr. James E. Crawley, P.E.
Director of Engineering
Transit Facilities
Southern California Rapid Transit District
425 South Main Street
Los Angeles, CA 90013

Dear Mr. Crawley:

Reference is made to your letter of December 29, 1986, outlining your understanding of the conclusions reached during your December 22, 1986, meeting with Stacey Ebiner and Mohsen Nazemi of the District. We concur with your understanding of the permit requirements with respect to the four alternatives under consideration. Under our existing regulations, the following alternatives would not require a permit from the District:

1. Excavation and land farming on adjacent property.
2. Excavation and disposal to a Class I facility.
3. On-site encapsulation.

However, you would have to comply with all of the applicable prohibitory rules including Rule 402 (Nuisance) and Rule 403 (Fugitive Dust) during the implementation of any of these options. The incineration alternative would require a permit.

Regardless of the alternative you select for handling the contaminated soil, the District is very interested in working with you to help ensure that the project is conducted in an environmentally sound manner in order to minimize potential emissions. Please provide the District a copy of your draft plan for handling the contaminated soil at least two months prior to implementing it so you can incorporate any comments we have in your clean up efforts.

If you have any questions, please call Mrs. Stacey Ebiner at (818) 572-6318.

Very truly yours,

Sanford M. Weiss
Director of Engineering

FEL

RTD

DEC 10 1986

86-05070

December 5, 1986
File: U.0

RECEIVED
DEC 08 1986
D.C.C.

Colonel Fred Butler
Corps of Engineers
300 North Los Angeles Street
Los Angeles, CA 90053

Subject: Groundwater Discharge from Metro Rail Construction

Dear Colonel Butler:

Metro Rail facilities in the vicinity of Union Station will be constructed using cut-and-cover methods. Because the transit facilities are below the water table, groundwater must be pumped continuously throughout the construction period of approximately three years. Upon completion, pumping will cease and the groundwater will resume its natural elevation. The peak groundwater discharge that will result from construction of the three Metro Rail contract units at Union Station is estimated to be approximately 25 mgd. The site discharges will be piped directly to the City of Los Angeles storm drains in Macy and Ducommun Streets which discharge to the Los Angeles River Channel.

Recent pump tests at Union Station revealed that the groundwater may have total dissolved solid (TDS) levels as high as 2000 ppm and hydrogen sulfide levels up to 50 ppm. The District has requested that the California Regional Water Quality Control Board issue NPDES permits for discharge of the groundwater to the Los Angeles River (see my letter dated September 30, 1986 to R. Ghirelli - copy attached). At the suggestion of the Regional Board's staff, the District discussed the proposed discharges with the Central and West Basin Water Replenishment District, the sole downstream user of water from the river. The Replenishment District has indicated that, if RTD will fund the purchase of water to replace that lost from the river when TDS exceeds allowable levels, it has no objections to the groundwater discharge (see attached letter dated November 12, 1986 from John G. Joham, Jr.). The District agrees in principle to the execution of an agreement suggested by the Replenishment District. In response to the Regional Board's concerns over the hydrogen sulfide, the District is presently investigating possible treatment alternatives and modeling the H_2S impact on water and air quality. It is not anticipated that the construction discharges will have any impact upon the river channel structure.

The District has been advised that the Los Angeles County Department of Public Works act on the Corps' behalf with regard to the operation of the Los Angeles River. The County has advised the District that it will have no objections to the discharge of groundwater from Metro Rail construction sites to the river provided that the Regional Water Quality Control Board's requirements are met.

The District is concerned that Metro Rail construction be in compliance with the requirements of all regulatory agencies. To assure compliance, it is requested that the Corps advise the District of its regulations pertinent to the groundwater discharge that must be met. Since bid opening of Contract Unit A141, the first construction contract at Union Station, is scheduled for January 6, 1987, an early response would be appreciated.

Sincerely,

James E. Crawley, P.E.
Director of Engineering
Transit Facilities

Attachments
cc: R. Ghirelli, CRWQCB
J. Joham Jr., CWBWRD
T. Tidemanson, LA County

MRTC INCOMING ROUTING

NAME	INFO	ACTION
H. Chaliff	✓	
A. Dale		
B. Goodwin		
M. Kenney	✓	
K. Murthy	✓	
G. Cafer		
J. Monsees	✓	

Action by _____ SIGNATURE _____ DATE

RTD

September 30, 1986

Mr. Robert Ghirelli
California Regional Water Quality Control Board
Los Angeles Region
107 South Broadway, Room 4027
Los Angeles, CA 90012-4596

Subject: Revised Permit Application for
Metro Rail Project

Dear Mr. Ghirelli:

On November 15, 1985, the District submitted for the Board's consideration, an application for an NPDES permit for the initial segment of the Metro Rail Project (MOS-1). The permit is required to discharge groundwater from Metro Rail construction sites and also to later discharge surface run-off that may enter the completed transit facilities.

As a result of recent groundwater tests, the District has determined that the levels of total dissolved solids, hydrogen sulfide and other chemicals in the groundwater near Union Station exceed those levels indicated in the original permit application. In addition, the tests indicated that estimated discharge flow rates will be less than the values previously calculated. Therefore, we have revised the appropriate pages of the NPDES permit application to reflect this new data and have enclosed copies of the revised pages for substitution into the District's application.

The District discussed the revised data with Mr. Nelson Wong of your staff on September 18, 1986. As a result of those discussions, we understand the following conditions apply to the District's application:

- The groundwater total dissolved solids (TDS) level indicated by the pump tests initially may be as high as 2000 ppm. However, because the proposed discharge points are within the reach of the Los Angeles River where the channel is fully lined, the TDS discharge will not create a serious concern.

- The Board's discharge criterion for hydrogen sulfide does not specify an allowable limit but may vary depending upon the potential public nuisance that discharge might cause.

There are three Metro Rail construction contract units that are affected by this application revision where substantial quantities of groundwater discharge are anticipated as follows:

- A130 - Yard Leads and Transfer Zone
- A135 - Union Station - Stage I
- A141 - Line Section, Union Station to 5th/Hill Street - Civic Center Station - Stage I

Four alternative methods have been examined for the dewatering and possible treatment of groundwater discharge into the Los Angeles River. A schematic plan, showing each of the four alternatives and indicating the limit of each construction contract, has been enclosed for your information. A description of these alternatives and the estimated cost of each are provided below:

Alternative 1: Wells only (Base Case)

This alternative would utilize a conventional soldier pile and timber lagging support system with a series of deep wells installed in close proximity to the proposed Metro Rail facilities. The wells would be connected to a common "header" pipe, pumped and discharged directly into the City of Los Angeles storm drain in Macy Street. Surface flows would be prohibited to minimize any potentially objectionable odor. The estimated cost of this alternative is as follows:

Contract	Estimated Cost
A-130	$ 3,030,000
A-135	3,400,000
A-141	1,550,000
Total Estimated Cost	$ 7,980,000

Alternative 2: Wells and Treatment

This alternative is similar to Alternative 1 except that the groundwater would first be treated and pumped into settling pond to reduce the level of hydrogen sulfide prior to discharge into the storm drain system. The estimated cost of this alternative is as follows:

Contract	Estimated Cost	Real Estate Cost
A-130	$ 7,800,000	$ ---
A-135	9,600,000	550,000
A-141	7,480,000	2,480,000
	$ 24,880,000	$ 3,030,000
Total Estimated Cost		$ 27,910,000

Alternative 3: Slurry Wall/Wells/Treatment

This alternative would reduce the amount of groundwater to be treated by the use of an impervious slurry wall. The groundwater would be treated and pumped into a settling pond to reduce the level of hydrogen sulfide prior to discharge into the storm drain system. The estimated cost of this alternative is as follows:

Contract	Estimated Cost	Real Estate Cost
A-130	$ 18,470,000	$ —
A-135	12,660,000	180,000
A-141	7,910,000	1,870,000
	$ 39,040,000	$ 2,050,000

Total Estimated Cost . . . . . $ 41,090,000

Alternative 4: Wells/Injection

This alternative would utilize deep dewatering wells connected to a common "header" pipe to remove the groundwater to a site remote from the Union Station area where the groundwater would be reinjected into the aquifer. The estimated cost of this alternative is as follows:

Contract	Estimated Cost
A-130	$ 6,800,000
A-135	7,650,000
A-141	6,050,000

Total Estimated Cost . . . . . $ 20,500,000

The total estimated additional cost to implement Alternatives 2, 3, or 4 ranges from approximately $13 million to $33 million more than the Base Case - Alternative 1. Based on this analysis, it is considered economically infeasible to treat or otherwise limit the volume of groundwater that is anticipated from these three construction contracts. Additionally, it would be impractical to acquire easements necessary to construct and operate the treatment ponds required for Alternative 2 and 3 in the vicinity of Union Station.

As a result of this analysis, the District had concluded that the only feasible means of groundwater disposal is direct discharge to the Los Angeles River as described in Alternative 1. It is requested that you consider the District's revised permit application and issue the NPDES permits required for Metro Rail construction.

Construction of Contract A-141 is scheduled to begin in January, 1987. So that the requirements of the NPDES permit may be incorporated in the contract documents, it is requested that the District's permit application be considered on the agenda for the Board's November meeting.

Please call me should you have any questions concerning the District's application.

Sincerely,

James E. Crawley, P.E.
Director of Engineering
Transit Facilities

Attachments

cc: Nelson Wong, CRWQCB
Delwyn Biagi, BOS
Bruce Rollo, BOE

TRAL AND WEST BASIN
WATER REPLENISHMENT DISTRICT
7430 EAST FLORENCE AVENUE
DOWNEY, CALIFORNIA 90240-3699
TELEPHONE (213) 927-2611 • (213) 773-5790

November 12, 1986

Mr. James E. Crawley
Director of Engineering
Southern California Rapid
Transit District
425 South Main Street
Los Angeles, CA 90013

SUBJECT: Discharge to Los Angeles River

Dear Mr. Crawley:

In response to our meeting of November 7, 1986, I am submitting a proposed solution to reduction in ground water spreading which would be caused by the proposed discharge of up to 20 million gallons per day of unusable quality water from your Metro Rail Construction Project into the Los Angeles River.

The Central and West Basin Water Replenishment District funds the purchase of water for ground water replenishment in the southern portion of Los Angeles County. These funds are largely obtained from assessments placed on ground water extractions. The use of these funds has allowed the operating agencies to replenish the ground water and eliminate an annual overdraft condition.

One source of ground water replenishment within the District is located at Dominguez Gap Spreading Grounds. This project, located near Carson Boulevard and the Los Angeles River diverts water from the low-flow channel of the Los Angeles River into spreading basins. The grounds have been in existence since 1958 and the amount spread has averaged approximately 900 acre feet per year. The intake facilities are equipped with an electrical conductivity meter which automatically causes the influent gate to close when the TDS in the low flow channel exceeds 700 mg/l of total dissolved solids. Under most flow conditions in the Los Angeles River, the addition of 25 mgd at the reported total dissolved solids of 2,000 mg/l would prevent spreading. The spreading limitation of 700 mg/l is based on historic operating criteria and limitations formally adopted by the Replenishment District Board in Resolution No. 79-220.

With respect to the proposed discharge for construction of the Metro Rail Project the Replenishment District proposes the following to mitigate the loss of water:

1. During times that the proposed discharge is occurring and the flow in the Los Angeles River exceeds 700 mg/l total dissolved solids causing discontinuation of spreading at Dominguez Gap Spreading Grounds, the Rapid Transit District pay to the Replenishment District an amount of money sufficient to purchase that amount of imported water for injection at the Dominguez Gap Barrier. This cost would be the price established each fiscal year by Metropolitan Water District for treated interruptible water plus $2.00 per acre foot for Replenishment District administrative costs. For 1986-87 this would amount to $188 per acre foot. Measurement for payment would be based on an estimated monthly spreading rate of 75 acre feet per month.

2. The above would also apply should specific constituents in the discharge cause a discontinuation of spreading at Dominguez Gap.

3. Approval by the Regional Board would be conditioned on the execution of a contract between the Rapid Transit District and the Replenishment District to implement the mitigating procedure.

4. The Flood Control District would certify monthly any periods in which they were not able to spread because of quality exceeding 700 mg/l of total dissolved solids.

5. Copies of water quality date required by the Regional Board be furnished in a timely manner to the Flood Control District and to the Replenishment District.

We would appreciate receiving a copy of water quality analyses of the water which is proposed for your discharge. We note that sulfides are indicated to be a problem at the point of discharge. We do not believe that sulfides will represent a problem for

spreading of the water as the spreading grounds are located several miles downstream from the point of discharge and we expect that aeration and oxidation will effectively remove the sulfides before spreading as would other treatment which my be required by the Regional Board.

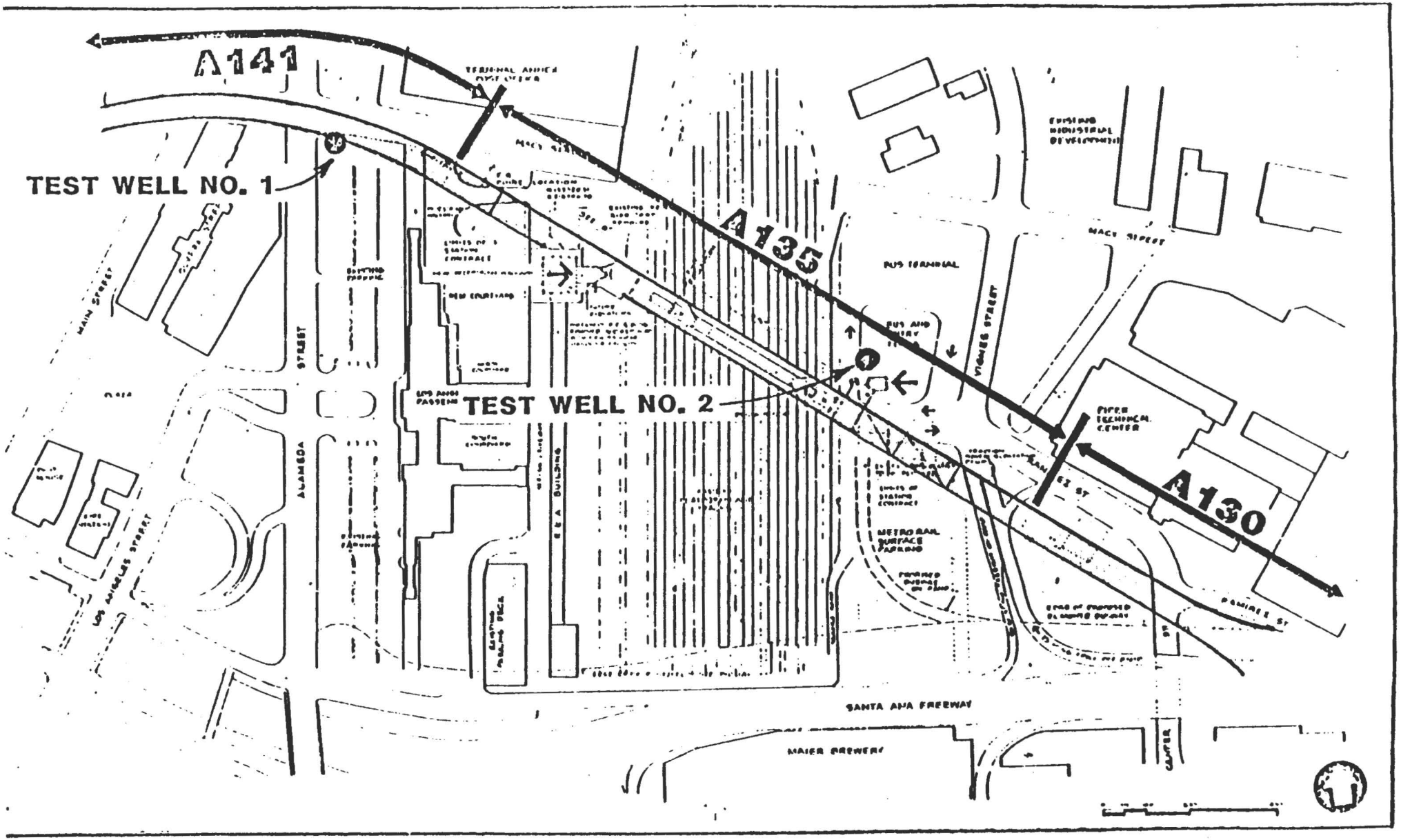
The Replenishment District understands the complexity of the discharge problems you face and hopes to find a feasible solution with respect to our operations.

Very truly yours,

John G. Doham, Jr.
General Manager

JGD:js

cc: Bookman Edmonston Engineer, Inc.
Donald Nichols, LA County Department of Public Works



Southern California Rapid Transit District

Metro Rail Project

12/3/86

GROUND WATER
UNION STATION VICINITY

RTD

December 9, 1986
File: U.0

Mr. John G. Joham, Jr.
General Manager
Central and West Basin Water
Replenishment District
7439 East Florence Avenue
Downey, CA 90240-3699

Subject: Groundwater Discharges from Metro Rail Construction

Dear Mr. Joham:

In its letter to the Southern California Rapid Transit District (SCRTD) dated November 12, 1986, the Replenishment District proposed that SCRTD provide funds for the purchase of water to mitigate loss of water from the Los Angeles River that the Replenishment District may experience as a result of construction of the Metro Rail Project.

The SCRTD will enter into an agreement to reimburse the Replenishment District at times when the total dissolved solids (TDS) discharge from Metro Rail construction does not conform to State standards and increases the TDS in the river water above a level of 700 mg/l causing discontinuation in the use of river water at the Dominguez Gap Spreading Grounds. The amount of the reimbursement shall allow the Replenishment District to purchase quantities of imported water from the Metropolitan Water District equivalent to that lost from the River.

With this letter, we have enclosed a report on groundwater conditions in the vicinity of Union Station. This contains the water quality analyses which you requested. In this regard, we note from your letter that it is the TDS levels and not the hydrogen sulfide in the groundwater at Union Station which represents a problem for the Replenishment District.

The SCRTD appreciates the Replenishment District's concern that an acceptable solution be found to the Union Station groundwater discharge. We will work with you and your staff to develop a mutally acceptable agreement.

Sincerely,

James E. Crawley, P.E.
Director of Engineering
Transit Facilities

Enclosure
cc: Jack R. Witz, Chairman, CRWQCB
Robert P. Ghirelli, Exe. Officer, CRWQCB
Richard A. Rhone, Bookman-Edmonston Engineering
Delwyn Biagi, Bureau of Sanitation
T. Tidemanson, L.A. County

State of California

Resources Agency

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD, LOS ANGELES REGION

ORDER NO. _____

NPDES NO. CA0059714

WASTE DISCHARGE REQUIREMENTS

FOR

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICTS
CONSTRUCTION: Metro Rail Project - MOS-1

The California Regional Water Quality Control Board, Los Angeles Region, finds:

1. Southern California Rapid Transit District (RTD), a public corporation, has filed a report of waste discharge, and has applied for waste discharge requirements and a National Pollutant Discharge Elimination System (NPDES) permit.

2. RTD is constructing, and will subsequently operate the initial phase of the minimal operable segment (MOS-1) of the Metro Rail facility at downtown Los Angeles. The MOS-1 segment will span from about Alameda and 7th Streets to Wilshire and Alvarado Streets. Wastewater streams up to 40.4 million gallons per day (mgd) will be generated during construction. RTD proposes to discharge these wastes streams to the City of Los Angeles' storm drain systems (nine outfalls) which flow to either the Los Angeles River or Ballona Creek, both are waters of the United States, above the tidal prism.

3. The report of waste discharge describes the discharges during construction of the MOS-1 segment. The wastewaters during construction consists of ground water from dewatering operations, excavation seepages, stormwater inflows, and equipment, tunnel, and station washdowns. Construction discharges reportedly will be for a period of 36 months.

TENTATIVE

The different discharge points are described below:

Outfall No.	Discharges[1] (Thousand Gallons) Ground Water	Storm Water	Washdowns	TOTAL	Receiving Water	Facility Segment
001	15,000.0	72.6	8.0	15,080.6	LAR[2]	East Portal & Crossover Const.
002	15,000.0	20.2	8.0	15,028.2	LAR	Union Station & Crossover Const.
003	10,000.0	16.0	8.0	10,024.0	LAR	Union Station to 5th/Hill Tunnel
004	0.6	24.0	8.0	32.6	LAR	Civic Center Station Const.
005	13.2	28.8	8.0	50.0	LAR	5th/Hill Station Const.
006	32.2	16.0	8.0	56.2	LAR	5th/Hill 7th/Flower Tunnel
007	9.7	20.4	8.0	38.1	LAR	7th/Flower Station
008	2.3	16.0	8.0	26.3	Ballona Creek	7th/Flower to Wilshire/Alvarado Tunnel
009	8.0	25.0	8.0	41.0	Ballona Creek	Wilshire/Alvarado Station Const.
TOTAL	40,064.0	239.0	72.0	40,377.0		

[1] Maximum Estimated Flow

[2] Los Angeles River

4. The major flow during construction will be from groundwater dewatering operations around Union Station, where the cut-and-cover method of construction will be used. The maximum groundwater flow from this area (Discharge Serial Nos. 001, 002, and 003) is estimated at 40 mgd, with an average flow of 15 mgd.

5. The report of waste discharge indicates that the quality of the ground water that would be discharged is poor. Analytical results of ground water samples show high concentrations of the following constituents:

Sulfides	65 mg/l
Total dissolved solids	2,000 mg/l
Oil and grease	10 mg/l
Biological Oxygen Demand	90 mg/l
Phthalates	11 ug/l
Phenol	5 ug/l
Pentachlorophenol	50 ug/l

TENTATIVE

Analyses for other organic priority pollutants showed none detectable or below action levels.

6. Dry weather flow at the Los Angeles River (measured near Firestone Blvd.) averages about 31 mgd for water years 1983-84 and 1984-85. The quality of the dry weather flow is as follows:

Total Dissolved Solids	- 482 to 740 (average about 700) mg/l
Dissolved Oxygen	- 8.2 to 19./0 mg/l
pH	- 8.1 to 8.8

7. The major impacts the proposed discharge (Discharge Serial Nos. 001, 002 and 003) would have on the Los Angeles River are:

A. Sulfides

(1) Nuisance Problem - The main concern is the low odor threshold of hydrogen sulfide (H_2S) which is 0.66 micrograms per cubic meter (ug/m^3) in the atmosphere.

RTD reports that an emission rate of 20 pounds per day at the discharge point would result in 0.65 ug/m^3 for one mile, 100 meters high. This emission rate is equivalent to about 1.5 mg/l of sulfides.

(2) Water Quality Degradation - At the discharge point, the ground water discharge will decrease the dissolved oxygen in the receiving water because of the biological oxygen demand by the sulfides. Without any treatment of the groundwater, staff anticipates that certain sections of the river could be depleted of oxygen. In addition, sulfides are toxic to fresh water aquatic organisms (0.5 - 1.0 mg/l).

(3) Damage to storm drains and flood control structures - RTD reports it has master contracts with the City of Los Angeles and the County of Los Angles regarding reimbursements to the City and/or the County for costs of repairs and/or replacements of damaged structures resulting from the discharge. RTD and the City or County would inspect the structures before and after the discharge to determine the damages incurred.

RTD is also working with the U.S. Corps of Engineers regarding discharges to the Los Angeles River Channel.

B. Total Dissolved Solids (TDS) - The proposed discharge will contain an average TDS concentration of 2000 mg/l which exceeds the water quality objectives (1500 mg/l) contained in the Los Angeles River

TENTATIVE

Basin Plan. In addition, downstream of the discharge, the Los Angeles County Department of Public Works diverts water to the Dominguez Gap Recharge Basin, which is operated by the Central and West Basins Water Replenishment Districts (CWBWRD). Water is diverted for ground water recharge only if the TDS concentration is less than 700 mg/l. RTD is working with CWBWRD on an agreement for RTD to reimburse CWBWRD the cost of imported water for groundwater recharge whenever the TDS concentration of RTD discharges is over the Los Angeles Basin Plan limits and increases the TDS concentration of the river water to be over 700 mg/l.

8. RTD proposes to treat the ground water to remove sulfides prior to discharge to the Los Angeles River. Treatment will consist of hydrogen peroxide oxidation of sulfides to sulfur, and flotation and sedimentation to remove suspended solids. Sludge will be hauled to a legal disposal site.

Prior

Sulfates

Sulfuric acid

9. The Board adopted a revised Water Quality Control Plan for the Los Angeles River Basin on November 27, 1978. The Plan contains water quality objectives for the Los Angeles River and Ballona Creek. The requirements contained in this Order, as they are met, will be in conformance with the goals of the Plan.

10. The beneficial uses of the Los Angeles River are: ground water recharge non-contact-water recreation, and (within the tidal prism) water contact and non-contact water recreation, industrial service suppply, ocean commercial and sport fishing, preservation of rare and endangered species, marine habitat, and saline water habitat.

The beneficial use of Ballona Creek is: non-contact water recreation. The beneficial uses of Ballona Creek tidal prism are: water contact recreation, non-contact water recreation, ocean commercial and sport fishing, preservation of rare and endangered species, marine habitat, shellfish harvesting, and saline water habitat.

11. The issuance of waste discharge requirements for this discharge is exempt from the provisions of Chapter 3 (commencing with Section 21100) of Division 13 of the Public Resources Code in accordance with Water Code Section 13389.

12. Effluent limitation standards established pursuant to Section 301 of the Federal Clean Water Act and amendments thereto are applicable to the discharge.

The Board has notified the discharger, and interested agencies and persons of its intent to prescribe waste discharge requirements for this discharge and has provided them with an opportunity to submit their written views and recommendations.

TENTATIVE

The Board in a public hearing heard and considered all comments pertaining to the discharge and to the tentative requirements.

This Order shall serve as a National Pollutant Discharge Elimination System permit pursuant to Section 402 of the Federal Clean Water Act, or amendments thereto, and shall take effect at the end of ten days from the date of its adoption, provided the Regional Administrator, EPA, has no objections.

IT IS HEREBY ORDERED, that Southern California Rapid Transit District, in order to meet the provisions contained in Division 7 of the California Water Code and regulations adopted thereunder, and the provisions of the Federal Clean Water Act and regulations and guidelines adopted thereunder, shall comply with the following:

I. Effluent Limitations

a. Wastes discharged shall be limited to those described herein, as proposed.

b. The discharge of effluent containing constituents in excess of the following limits is prohibited:

Constituent	Units	Discharge Limitations 30-Day Average	Daily Maximum
~~Settleable~~ Total Suspended Solids	mg/l	50	150
	lbs/day[1]	16,847	50,540
~~Total dissolved~~ Settleable solids	ml/l	0.1	0.3
~~BOD (20°C)~~	mg/l	20	60
	lbs/day[1]	6,739	20,216
Oil and Grease	mg/l	10	15
	lbs/day[1]	3,369	5,054
Sulfides	mg/l	1.0	2.5
Total dissolved solids[2]	mg/l	——	1,500[3]
Phenols	mg/l	——	1.0
	lbs/day[1]	337	337
Pentachlorophenol	ug/l	——	30

[1] Based on a maximum flow of 40.4 mgd.

[2] This limit does not apply to Discharge Serial Nos. 008 and 009 (Ballona Creek).

[3] This limit may be exceeded for Discharge Serial Nos. 001 through 007 provided no water is diverted from the Los Angeles River for recharge at Dominguez Gap Recharge Basin.

TENTATIVE

c. The toxicity of the effluent shall be such that the average survival in undiluted effluent for any three (3) consecutive 96-hour static or continuous flow bioassay tests shall be at least 90%, with no single test producing less than 70% survival.

d. The wastes discharged shall not contain odor-producing constituents in concentrations that will cause nuisance.

II. Receiving Water Limitations

a. The waste discharged shall not cause the pH of the receiving water to be less than 6.5 nor more than 8.5

b. The waste discharge shall not cause the dissolved oxygen of the receiving waters to be less than 5.0 mg/l.

III. Requirements and Provisions

This Order includes the attached "Standard Provisions and General Monitoring and Reporting Requirements."

IV. Expiration Date

This Order expires on January 10, 1990.

The discharger must file a Report of Waste Discharge in accordance with Title 23, California Administrative Code, not later than 180 days in advance of such date, as application for issuance of new waste discharge requirements.

I, Robert P. Ghirelli, Executive Officer, do hereby certify that the foregoing is a full, true and correct copy of an Order adopted by the California Regional Water Quality Control Board, Los Angeles Region on January 26, 1987.

ROBERT P. GHIRELLI, D.Env.
Executive Officer

WD:sml

TENTATIVE

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LOS ANGELES REGION

MONITORING AND REPORTING PROGRAM NO. ____

FOR

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
(Construction: Metro Rail Project - MCS-1)
(CA0059714)

The discharger shall implement this monitoring program within 60 days of the effective date of this Order. The first monitoring report under this program is due by April 1, 1987.

Monitoring reports shall be submitted monthly by the first day of the second month following each monthly sampling period.

EFFLUENT MONITORING

A sampling station shall be established for each point of discharge and shall be located where representative samples of that effluent can be obtained. In the event that wastes streams from sources are combined for treatment or discharge, representative sampling stations shall be established to insure that the quantity of each pollutant or pollutant property attributable to each waste source regulated by effluent limitations is accounted for. This Board shall be notified in writing of any changes in the sampling stations once established, or in the methods for determining the quantities of the pollutants in the individual waste streams.

In addition to the sampling stations at the point of discharge from the sulfide treatment facility, a sampling station at each point of discharge at the Los Angeles River and Ballona Creek shall be established.

The following shall institute the effluent monitoring program:

			Minimum Frequency of Analyses	
Constituent	Units	Type of Sample	Discharge Serial Nos. 001,002,003	Discharge Serial Nos. 004 Through 009
Waste flow	gal/day ?	---	daily	daily one flow
pH	pH units	continuous	----	----
Temperature	°F	continuous	----	----
Sulfides	mg/l	grab	daily	~~daily~~ quarterly
Oil and Grease	mg/l	grab	monthly	quarterly
BOD_5(20°C)	mg/l	grab	monthly	quarterly
Suspended Solids	mg/l	grab	monthly	quarterly
Settleable Solids	mg/l	grab	monthly	quarterly
Phenols	mg/l	grab	monthly	quarterly
Chlorinated Phenols	ug/l	grab	monthly	quarterly
Pentachlorophenols	ug/l	grab	monthly	quarterly

Sampling sta @ ea

TENTATIVE

Constituent	Units	Type of Sample	Minimum Frequency of Analyses: Discharge Serial Nos. 001,002,003	Minimum Frequency of Analyses: Discharge Serial Nos. 004 Through 009
Turbidity	NTU	grab	monthly	quarterly
Total Dissolved Solids[1]	mg/l	grab	monthly	quarterly
Phthalates	ug/l	grab	monthly	quarterly
Toxicity[2]	% survival	grab	quarterly[3]	semiannual[4]

[1] Not applicable to Discharge Serial Nos. 008 and 009.

[2] By the method specified in "Guidelines for Performing Static Acute Toxicity Fish Bioassays in Municipal and Industrial Wastewaters" - July 1976 (California State Water Resources Control Board and Department of Fish and Game). Submission of bioassay results should include the information noted on page 31 of the "Guidelines". The fathead minnow (Pimephales promelas) may be used as the test species instead of the golden shiner (Notemigonus crysoleucas).

[3] If the results of the quarterly toxicity test yields a survival of less than 90%, then the frequency of analyses shall increase to monthly until at least three test results have been obtained and full compliance with Effluent Limitation IC has been demonstrated, after which the frequency of analyses shall revert to quarterly.

[4] If the results of the semiannual toxicity test yields a survival of less than 90%, then the frequency of analyses shall increase to bi-monthly until at least three test results have been obtained and full compliance with Effluent Limitation IC has been demonstrated, after which the frequency of analyses shall revert to semiannually.

RECEIVING WATER MONITORING AND SAMPLING

The discharger shall file with this Board, not later than 90 days after receipt of this Order, a "Receiving Water Monitoring and Sampling Plan" for the Executive Officer's approval. The plan shall give the locations of the sampling stations - one upstream and one downstream (just after the dilution zone) of the discharge outfalls, and one before the tidal prism for each of the Los Angeles River and Ballona Creek.

The approved monitoring and sampling stations may be revised by the Executive Officer in the future, as necessary, based on the results of the monitoring.

TENTATIVE

Southern California
Rapid Transit District
Monitoring & Reporting
Program No.

The following constitute the receiving water monitoring:

1. The receiving water shall be sampled (grab) at each sampling station and analyzed for pH daily when the pH of the effluent is less than 6.5 or more than 8.5.

2. The receiving water shall be sampled (grab) at each sampling station and analyzed for the following:

	Units	Frequency	
		Los Angeles River	Ballona Creek
Total Dissolved Solids	mg/l	monthly	quarterly
Sulfides	mg/l	daily	daily ← ? ½ day
Phenols	mg/l	monthly	quarterly
Pentachlorophenols	ug/l	monthly	quarterly
Phthalates	ug/l	monthly	quarterly

no sulfide in discharge

Monitoring OF PRIORITY POLLUTANTS

The discharger shall obtain representative samples at the effluent sampling stations within the first month of discharge at Discharge Serial Nos. 004, 005, 006, 007, 008 and 009, and analyze the samples for all the Environmental Protection Agency's Priority Pollutants (see p. T-3a). Sampling and analyses for all discharge points shall be repeated on an annual basis.

The results of the analyses shall be included in the monitoring report following the initial sampling. Annual analyses shall be included in the Annual Report.

Ordered by: _____
ROBERT P. GHIRELLI, D.Env.
Executive Officer

Date: January 26, 1987

WD:sml

TENTATIVE

PRIORITY POLLUTANTS

etals

ntimony
rsenic
eryllium
admium
hromium
opper
ead
ercury
ickel
Selenium
Silver
Thallium
Zinc

Miscellaneous

Cyanide
Asbestos*

*Not required unless specifically requested.

Pesticides

Aldrin
Chlordane
Dieldrin
4, 4' - DDT
4, 4' - DDE
4, 4' - DDD
Alpha Endosulfan
Beta Endosulfan
Endosulfan Sulfate
Endrin
Endrin Aldehyde
Heptachlor
Heptachlor Epoxide
Alpha BHC
Beta BHC
Gamma BHC
Delta BHC
Toxaphene
PCB 1016
PCB 1221
PCB 1232
PCB 1242
PCB 1248
PCB 1254
PCB 1260

Method 608

Base/Neutral Extractibles

Acenaphthene
Benzidine
1, 2, 4 - Trichlorobenzene
Hexachlorobenzene
Hexachloroethane
Bis (2-Chloroethyl) Ether
2 - Chloronaphthalene
1, 2 - Dichlorobenzene
1, 3 - Dichlorobenzene
1, 4 - Dichlorobenzene
3, 3' - Dichlorobenzidine
2, 4 - Dinitrotoluene
2, 6 - Dinitrotoluene
1, 2 - Diphenylhydrazine
Fluoranthene
4 - Chlorophenyl Phenyl Ether
4 - Bromophenyl Phenyl Ether
Bis (2 - Chloroisopropyl) Ether
Bis (2 - Chloroethoxy) Methane
Hexachlorobutadiene
Hexachlorocyclopentadiene
Isophorone
Naphthalene
Nitrobenzene
N - Nitrosodimethylamine
N - Nitrosodi - N - Propylamine
N - Nitrosodiphenylamine
Bis (2 - Ethylhexyl) Phthalate
Butyl Benzyl Phthalate
Di - N - Butyl Phthalate
Di - N - Octyl Phthalate
Diethyl Phthalate
Dimethyl Phthalate
Benzo (A) Anthracene
Benzo (A) Pyrene
Benzo (B) Fluoranthene
Benzo (K) Fluoranthene
Chrysene
Acenaphthylene
Anthracene
1, 12 - Benzoperylene
Fluorene
Phenanthrene
1, 2, 5, 6 - Dibenzanthracene
Indeno (1, 2, 3 - CD) Pyrene
Pyrene
TCDD

Method 625

Acid Extractibles

2, 4, 6 - Trichlorophenol
P - Chloro - M - Cresol
2 - Chlorophenol
2, 4 - Dichlorophenol
2, 4 - Dimethylphenol
2 - Nitrophenol
4 - Nitrophenol
2, 4 - Dinitrophenol
4, 6 - Dinitro - O - Cresol
Pentachlorophenol
Phenol

Method 625

Volatile Organics

Acrolein
Acrylonitrile
Benzene
Carbon Tetrachloride
Chlorobenzene
1, 2 - Dichloroethane
1, 1, 1 - Trichloroethane
1, 1 - Dichloroethane
1, 1, 2 - Trichloroethane
1, 1, 2, 2 - Tetrachloroethane
Chloroethane
Chloroform
1, 1 - Dichloroethylene
1, 2 - Trans Dichloroethylene
1, 2 - Dichloropropane
1, 2 - Dichloropropylene
Ethylbenzene
Methylene Chloride
Methyl Chloride
Methyl Bromide
Bromoform
Bromodichloromethane
~~Trichlorofluoromethane~~
~~Dichlorodifluoromethane~~
Dibromochloromethane
Tetrachloroethylene
Toluene
Trichloroethylene
Vinyl Chloride
~~Bis (chloroethyl) Ether~~
2 - Chloroethyl Vinyl Ether

Method 624

TENTATIVE

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LOS ANGELES REGION

STANDARD PROVISIONS AND GENERAL MONITORING AND
REPORTING REQUIREMENTS

A. General Requirements

1. Neither the disposal nor any handling of waste shall cause pollution or nuisance.

2. Wastes discharged shall not contain any substances in concentrations toxic to human, animal, plant, or aquatic life.

3. This discharge shall not cause a violation of any applicable water quality standard for receiving waters adopted by the Regional Board or the State Water Resources Control Board as required by the Federal Clean Water Act and regulations adopted thereunder. If more stringent applicable water quality standards are promulgated or approved pursuant to Section 303 of the Federal Clean Water Act, or amendments thereto, the Board will revise and modify this Order in accordance with such more stringent standards.

4. Wastes discharged shall not contain visible oil or grease, and shall not cause the appearance of grease, oil or oily slick, or persistent foam in the receiving waters or on channel banks, walls, inverts or other structures.

5. Wastes discharged shall not increase the natural turbidity of the receiving waters at the time of discharge.

6. Wastes discharged shall not cause the formation of sludge deposits.

7. Wastes discharged shall not damage flood control structures or facilities.

8. Oil or oily material, chemicals, refuse, or other pollutionable materials shall not be stored or deposited in areas where they may be picked up by rainfall and carried off of the property or discharged to surface waters. Any spill of such materials shall be contained and removed immediately.

9. The pH of wastes discharged shall at all times be within the range 6.0 to 9.0.

10. The temperature of wastes discharged shall not exceed 100°F.

11. The discharge of any radiological, chemical, or biological warfare agent or high level radiological waste is prohibited.

TENTATIVE

12. Effluent limitation standards established pursuant to Section 301 of the Federal Clean Water Act and amendments thereto are applicable to the discharge.

B. General Provisions

1. The requirements prescribed herein do not authorize the commission of any act causing injury to the property of another, nor protect the discharger from his liabilities under federal, state, or local laws, nor guarantee the discharger a capacity right in the receiving waters.

2. These requirements do not exempt the operator of the waste disposal facility from compliance with any other laws, regulations, or ordinances which may be applicable; they do not legalize this waste disposal facility, and they leave unaffected any further restraint on the disposal of wastes at this site which may be contained in other statutes or required by other agencies.

3. The discharger must comply with all of the terms, requirements and conditions of this Order. Any violation of this Order constitutes a violation of the Clean Water Act, its regulations and the California Water Code, and is grounds for enforcement action, Order termination, Order revocation and reissuance, denial of an application for reissuance; or a combination thereof.

4. A copy of these waste discharge specifications shall be maintained at the discharge facility so as to be available at all times to operating personnel.

5. Any discharge of wastes at any point(s) other than specifically described in this Order is prohibited, and constitutes a violation of the Order.

6. The Regional Board, EPA, and other authorized representatives shall be allowed:

   (a) Entry upon premises where a regulated facility or activity is located or conducted, or where records are kept under the conditions of this Order;

   (b) Access to copy any records that are kept under the conditions of this Order;

   (c) to inspect any facility, equipment (including monitoring and control equipment), practices, or operations regulated or required under this Order; and

TENTATIVE

(d) To photograph, sample, and monitor for the purpose of assuring compliance with this Order, or as otherwise authorized by the Clean Water Act and the California Water Code.

7. If the discharger wishes to continue an activity regulated by this Order after the expiration date of this Order, the discharger must apply for and obtain a new Order.

8. The discharger shall comply with effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants within the time provided in the regulations that establish these standards or prohibitions, even if this Order has not yet been modified to incorporate the requirement. If a toxic effluent standard or prohibition is established for a toxic pollutant which is present in the discharge authorized herein and such standard or prohibition is more stringent than any limitation upon such pollutant in this Order, the Board will revise or modify this Order in accordance with such toxic effluent standard or prohibition and so notify the discharger.

9. After notice and opportunity for a hearing, this Order may be terminated or modified for cause, including, but not limited to:

(a) Violation of any term or condition contained in this Order;

(b) Obtaining this Order by misrepresentation, or failure to disclose all relevant facts;

(c) A change in any condition that requires either a temporary or permanent reduction or elimination of the authorized discharge.

10. In the event the discharger is unable to comply with any of the conditions of this Order due to:

(a) breakdown of waste treatment equipment;

(b) accidents caused by human error or negligence; or

(c) other causes such as acts of nature,

the discharger shall notify the Executive Officer by telephone as soon as he or his agents have knowledge of the incident and confirm this notification in writing within two weeks of the the telephone notification. The written notification shall include pertinent information explaining reasons for the non-compliance and shall indicate what steps were taken to correct the problem and the dates thereof, and what steps are being taken to prevent the problem from recurring.

11. If there is any storage of hazardous or toxic materials or hydrocarbons at this facility and if the facility is not manned at all times, a 24-hour emergency response telephone number shall be prominently posted where it can easily be read from the outside.

12. The discharger shall take all reasonable steps to minimize or prevent any discharge that has a reasonable likelihood of adversely affecting human health or the environment.

13. The discharger shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) that are installed or used by the discharger to achieve compliance with this Order. Proper operation and maintenance includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities or similar systems that are installed by a discharger only when necessary to achieve compliance with the conditions of this Order.

14. This Order may be modified, revoked and reissued, or terminated for cause. The filing of a request by the discharger for a modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not stay any condition of this Order.

15. This Order does not convey any property rights of any sort, or any exclusive privilege.

16. The discharger shall furnish, within a reasonable time, any information the Regional Board or EPA may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this Order. The discharger shall also furnish to the Regional Board, upon request, copies of records required to be kept by this Order.

17. All applications, reports, or information submitted to the Regional Board shall be signed:

    (a) In the case of corporations, by a principal executive officer at least of the level of vice-president or his duly authorized representative, if such representative is responsible for the overall operation of the facility from which discharge originates;

    (b) In the case of a partnership, by a general partner;

    (c) In the case of a sole proprietorship, by the proprietor;

    (d) In the case of municipal, state or other public facility, by either a principal executive officer, ranking elected official, or other duly authorized employee.

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18. The discharger shall notify the Board of;

    (a) new introduction into such works of pollutants from a source which would be a new source as defined in Section 306 of the Federal Clean Water Act, or amendments thereto, if such source were discharging pollutants to the waters of the United States,

    (b) new introductions of pollutants into such works from a source which would be subject to Section 301 of the Federal Clean Water Act, or amendments thereto, if substantial change in the volume or character of pollutants being introduced into such works by a source introducing pollutants into such works at the time the waste discharge requirements were adopted.

    Notice shall include a description of the quantity and quality of pollutants and the impact of such change on the quantity and quality of effluent from such publicly owned treatment works. A substantial change in volume is considered an increase of ten percent in the mean dry-weather flow rate. The discharger shall forward a copy of such notice directly to the Regional Administrator.

19. The discharger shall notify the Board not later than 120 days in advance of implementation of any plans to alter production capacity of the product line of the manufacturing, producing or processing facility by more than ten percent. Such notification shall include estimates of proposed production rate, the type of process, and projected effects on effluent quality. Notification shall include submittal of a new report of waste discharge and appropriate filing fee.

20. The discharger shall give advance notice to the Regional Board as soon as possible of any planned physical alterations or additions to the facility or of any planned changes in the facility or activity that may result in noncompliance with requirements.

21. The discharger shall file with the Board a report of waste discharge at least 120 days before making any material change or proposed change in the character, location or volume of the discharge.

22. All existing manufacturing, commercial, mining, and silvicultural dischargers must notify the Regional Board as soon as they know or have reason to believe:

    (a) that any activity has occurred or will occur that would result in the discharge of any toxic pollutant that is not limited in this Order, if that discharge will exceed the highest of the following "notification levels:"

TENTATIVE

(i) One hundred micrograms per liter (100 ug/l);

(ii) Two hundred micrograms per liter (200 ug/l) for acrolein and acrylonitrile; five hundred micrograms per liter (500 ug/l) for 2,4-dinitrophenol and 2-methyl-4,6-dinitrophenol; and one milligram per liter (1 mg/l) for antimony;

(iii) Five (5) times the maximum concentration value reported for that pollutant in the permit application; or

(iv) The level established by the Regional Board in accordance with 40 CFR 122.44(f).

(b) that they have begun or expect to begin to use or manufacture as an intermediate or final product or byproduct any toxic pollutant that was not reported in their application.

23. Bypass (the intentional diversion of waste streams from any portion of a treatment facility) is prohibited. The Regional Board may take enforcement action against the discharger for bypass unless:

(a) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage. (Severe property damage means substantial physical damage to property, damage to the treatment facilities that causes them to become inoperable, or substantial and permanent loss of natural resources that can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.);

(b) There were no feasible alternatives to bypass, such as the use of auxiliary treatment facilities, retention of untreated waste, or maintenance during normal periods of equipment down time. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass that could occur during normal periods of equipment downtime or preventive maintenance; and

(c) The discharger submitted a notice at least ten days in advance of the need for a bypass to the Regional Board.

The discharger may allow a bypass to occur that does not cause effluent limitations to be exceeded, but only if it is for essential maintenance to assure efficient operation. In such a case, the above bypass conditions are not applicable.

The discharger shall submit notice of an unanticipated bypass as required in E-16.

24. A discharger that wishes to establish the affirmative defense of an upset in an action brought for noncompliance shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

    (a) an upset occurred and that the discharger can identify the cause(s) of the upset;

    (b) the permitted facility was being properly operated at the time of the upset;

    (c) the discharger submitted notice of the upset as required in E-16; and

    (d) the discharger complied with any remedial measures required.

    No determination made before an action for noncompliance, such as during administrative review of claims that noncompliance was caused by an upset, is final administrative action subject to judicial review.

    In any enforcement proceeding, the discharger seeking to establish the occurrence of an upset has the burden of proof.

25. This Order is not transferable to any person except after notice to the Regional Board. In the event of any change in name, ownership, or control of these waste disposal facilities, the discharger shall notify this Board of such change and shall notify the succeeding owner or operator of the existence of this Order by letter, copy of which shall be forwarded to the Board. The Regional Board may require modification or revocation and reissuance of the Order to change the name of the discharger and incorporate such other requirements as may be necessary under the Clean Water Act.

C. Enforcement

1. The California Water Code provides that any person who violates a waste discharge requirement or a provision of the California Water Code is subject to civil penalties of up to $5,000 per day, $10,000 per day, or $25,000 per day of violation, or when the violation involves the discharge of pollutants, is subject to civil penalties of up to $10 per gallon per day or $20 per gallon per day of violation; or some combination thereof, depending on the violation, or upon the combination of violations.

    Violation of any of the provisions of the NPDES program or of any of the provisions of this Order may subject the violator to any of the penalties described herein, or any combination thereof, at the discretion of the prosecuting authority; except that only one kind of penalty may be applied for each kind of violation.

TENTATIVE

2. The Federal Clean Water Act (CWA) provides that any person who violates a permit condition implementing sections 301, 302, 306, 307, or 308 of the CWA is subject to a civil penalty not to exceed $10,000 per day of such violation. Any person who willfully or negligently violates permit conditions implementing these sections of the CWA is subject to a fine of not less than $2,500 nor more than $25,000 per day of violation, or by imprisonment for not more than 1 year, or both.

3. The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this Order shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than six months per violation, or by both.

4. It shall not be a defense for a discharger in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this Order.

5. The Clean Water Act provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this Order, including monitoring reports or reports of compliance or noncompliance shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than 6 months per violation, or by both.

D. Monitoring Requirements

1. Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity.

2. The discharger shall retain records of all monitoring information, including all calibration and maintenance monitoring instrumentation, copies of all reports required by this Order, and records of all data used to complete the Report of Waste Discharge and application for this Order, for a period of at least three years from the date of the sample, measurement, report, or application. This period may be extended by request of the Regional Board or EPA at any time and shall be extended during the course of any unresolved litigation regarding this discharge.

3. Records of monitoring information shall include:

   (i) The date, exact place, and time of sampling or measurements;

   (ii) The individual(s) who performed the sampling or measurements;

TENTATIVE

(iii) The date(s) analyses were performed;

(iv) The individual(s) who performed the analyses;

(v) The analytical techniques or methods used; and

(vi) The results of such analyses.

4. All sampling, sample preservation, and analyses must be conducted according to test procedures under 40 CFR Part 136, unless other test procedures have been specified in this Order.

5. All chemical, bacteriological, and bioassay analyses shall be conducted at a laboratory certified for such analyses by the State Water Resources Control Board or approved by the Executive Officer .

6. The discharger shall calibrate and perform maintenance procedures on all monitoring instruments and equipment to insure accuracy of measurements, or shall insure that both activities will be conducted.

7. The discharger shall have, and implement, an acceptable written quality assurance (QA) plan for laboratory analyses. The annual monitoring report required in E-8 shall also summarize the QA activities for the previous year. Duplicate chemical analyses must be conducted on a minimum of ten percent (10%) of the samples, or at least one sample per sampling period, whichever is greater. A similar frequency shall be maintained for analyzing spiked samples.

When requested by the Board or EPA, the discharger will participate in the NPDES discharge monitoring report QA performance study. The discharger must have a success rate equal to or greater than 80%.

8. Effluent samples shall be taken downstream of any addition to the treatment works and prior to mixing with the receiving waters.

9. For parameters where both 30-day average and maximum limits are specified but where the monitoring frequency is less than four times a month, the following procedure shall apply:

(a) Initially, beginning not later than the first week of the second month after the adoption of this permit, a representative sample shall be obtained of each waste discharge at least once per week for at least four consecutive weeks and until compliance with the 30-day average limit has been demonstrated. Once compliance has been demonstrated, sampling and analyses shall revert to the frequency specified.

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(b) If future analyses of two successive samples yield results greater than 90% of the maximum limit for a parameter, the sampling frequency for that parameter shall be increased (within one week of receiving the laboratory result on the second sample) to a minimum of once weekly until at least four consecutive weekly samples have been obtained and compliance with the 30-day average limit has been demonstrated again and the discharger has set forth for the approval of the Executive Officer a program which ensures future compliance with the 30-day average limit.

E. Reporting Requirements

1. The discharger shall file with the Board technical reports on self-monitoring work performed according to the detailed specifications contained in any Monitoring and Reporting Programs as directed by the Executive Officer.

2. In reporting the monitoring data, the discharger shall arrange the data in tabular form so that the date, the constituents, and the concentrations are readily discernable. The data shall be summarized to demonstrate compliance with waste discharge requirements and, where applicable, shall include results of receiving water observations.

3. For every item where the requirements are not met, the discharger shall submit a statement of the actions undertaken or proposed which will bring the discharge into full compliance with requirements at the earliest time and submit a timetable for correction.

4. The discharger shall submit to the Board, together with the first monitoring report required by this permit, a list of all chemicals and proprietary additives which could affect this waste discharge, including quantities of each. Any subsequent changes in types and/or quantities shall be reported promptly.

5. The discharger shall file a technical report with this Board not later than 30 days after receipt of this Order, relative to the operation and maintenance program for this waste disposal facility. The information to be contained in that report shall include, as a minimum, the following:

(a) The name and address of the person or company responsible for operation and maintenance of the facility.

(b) Type of maintenance (preventive or corrective).

(c) Frequency of maintenance, if preventive.

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If an operation and maintenance report has been supplied to the Board previously and there have been no changes, a second report need not be provided.

6. Monitoring results shall be reported at the intervals specified in the Monitoring and Reporting Program.

   (i) Monitoring results must be reported on a Discharge Monitoring Report (DMR).

   (ii) If the discharger monitors any pollutant more frequently than required by this Order using test procedures approved under 40 CFR Part 136 or as specified in this Order, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR.

   (iii) Calculations for all limitations that require averaging of measurements shall utilize an arithmetic mean unless otherwise specified in this Order.

7. Reports of compliance or noncompliance with, or any progress reports on interim and final requirements contained in any compliance schedule of this Order shall be submitted no later than 14 days following each schedule date.

8. By March 1 of each year, the discharger shall submit an annual report to the Board. The report shall contain both tabular and graphical summaries of the monitoring data obtained during the previous year. In addition, the discharger shall discuss the compliance record and the corrective actions taken or planned which may be needed to bring the discharge into full compliance with the waste discharge requirements.

9. The discharger shall include in the annual report, an annual summary of the quantities of all chemicals, listed by both trade and chemical names, which are used for cooling and/or boiler water treatment and which are discharged.

10. Each monitoring report must affirm in writing that:

    "all analyses were conducted at a laboratory certified for such analyses by the State Water Resources Control Board or approved by the Executive Officer and in accordance with current EPA guideline procedures or as specified in this Monitoring Program".

11. Each report shall contain the following completed declaration:

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"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Executed on the _____ day of _____
at _____.

_____(Signature)

_____(Title)"

12. If no flow occurred during the reporting period, the monitoring report shall so state.

13. For any analyses performed for which no procedure is specified in the EPA guidelines or in the Monitoring and Reporting Program, the constituent or parameter analyzed and the method or procedure used must be specified in the monitoring report.

14. This Board requires the discharger to file with the Board, within 90 days after the effective date of this Order, a technical report on his preventive (failsafe) and contingency (cleanup) plans for controlling accidental discharges, and for minimizing the effect of such events. The technical report should:

    (a) Identify the possible sources of accidental loss, untreated waste bypass, and contaminated drainage. Loading and storage areas, power outage, waste treatment unit outage, and failure of process equipment, tanks and pipes should be considered.

    (b) Evaluate the effectiveness of present facilities and procedures and state when they became operational.

    (c) Describe facilities and procedures needed for effective preventive and contingency plans.

    (d) Predict the effectiveness of the proposed facilities and procedures and provide an implementation schedule containing interim and final dates when they will be constructed, implemented, or operational.

This Board, after review of the technical report, may establish conditions which it deems necessary to control accidental discharges and to minimize the effects of such events. Such conditions may be incorporated as part of this Order, upon notice to the discharger.

15. In the event wastes are transported to a different disposal site during the report period, the following shall be reported in the monitoring report:

    (a) Types of wastes and quantity of each type;

    (b) Name and address for each hauler of wastes (or method of transport if other than by hauling); and

    (c) Location of the final point(s) of disposal for each type of waste.

    If no wastes are transported offsite during the reporting period, a statement to that effect shall be submitted.

16. The discharger shall report any noncompliance that may endanger health or the environment. Any information shall be provided orally within 24 hours from the time the discharger becomes aware of the circumstances. A written submission shall also be provided within five days of the time the discharger becomes aware of the circumstances. The written submission shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times and, if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

    The following shall be included as information that must be reported within 24 hours under this paragraph:

    (a) Any unanticipated bypass that exceeds any effluent limitation in the Order.

    (b) Any upset that exceeds any effluent limitation in the Order.

    (c) Violation of a maximum daily discharge limitation for any of the pollutants listed in this Order to be reported within 24 hours.

    The Regional Board may waive the above-required written report on a case-by-case basis.

17. Should the discharger discover that it failed to submit any relevant facts or that it submitted incorrect information in a report, it shall promptly submit the missing or correct information.

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18. The discharger shall report all instances of noncompliance not otherwise reported at the time monitoring reports are submitted. The reports shall contain all information listed in E-16.

19. Each monitoring report shall state whether or not there was any change in the discharge as described in the Order during the reporting period.

20. The discharger shall mail a copy of each monitoring report to:

(a) EXECUTIVE OFFICER
CALIFORNIA REGIONAL WATER QUALITY
CONTROL BOARD - LOS ANGELES REGION
107 South Broadway - Room 4027
Los Angeles, CA 90012-4596

(b) A copy of such monitoring report for those discharges designated as a major discharge shall also be mailed to:

REGIONAL ADMINISTRATOR
ENVIRONMENTAL PROTECTION AGENCY
Region 9
215 Fremont Street
San Francisco, CA 94105

F. Publicly Owned Wastewater Treatment Plant Requirements (Does not apply to any other type or class of discharger)

1. Publicly owned treatment works (POTWs) must provide adequate notice to the Regional Board of:

(a) Any new introduction of pollutants into the POTW from an indirect discharger that would be subject to sections 301 or 306 of the Clean Water Act if it were directly discharging those pollutants.

(b) Any substantial change in the volume or character of pollutants being introduced into that POTW by a source introducing pollutants into the POTW at the time of issuance of the Order.

Adequate notice shall include information on the quality and quantity of effluent introduced into the POTW as well as any anticipated impact of the change on the quantity or quality of effluent to be discharged from the POTW.

2. The discharger shall file a written report with the Board within 90 days after the average dry-weather waste flow for any month equals or exceeds 75 percent of the design capacity of his waste treatment and/or disposal facilities. The discharger's senior administrative officer shall sign a letter which transmits that report and certifies

that the policy-making body is adequately informed about it. The report shall include:

(a) Average daily flow for the month, the date on which the instantaneous peak flow occurred, the rate of that peak flow, and the total flow for that day.

(b) The discharger's best estimate of when the average daily dry-weather flow rate will equal or exceed the design capacity of his facilities.

(c) The discharger's intended schedule for studies, design, and other steps needed to provide additional capacity for his waste treatment and/or disposal facilities before the waste flow rate equals the capacity of present units.

3. The flow measurement system shall be calibrated at least once per year or more frequently, to ensure continued accuracy.

4. The discharger shall require any industrial user of the treatment works to comply with applicable service charges and toxic pretreatment standards promulgated in accordance with Sections 204(b), 307, and 308 of the Federal Clean Water Act or amendments thereto. The discharger shall require each individual user to submit periodic notice (over intervals not to exceed nine months) of progress toward compliance with applicable toxic and pretreatment standards developed pursuant to the Federal Clean Water Act or amendments thereto. The discharger shall forward a copy of such notice to the Board and the Regional Administrator.

5. Collected screening, sludges, and other solids removed from liquid wastes shall be disposed of at a legal point of disposal, and in accordance with the provisions of Division 7 of the California Water Code. For the purpose of this requirement, a legal point of disposal is defined as one for which waste discharge requirements have been prescribed by a Regional Water Quality Control Board and which is in full compliance therewith.

6. Supervisors and operators of publicly owned wastewater treatment plants shall possess a certificate of appropriate grade in accordance with regulations adopted by the State Water Resource Control Board.

The annual report required by E-8 shall address operator certification and provide a list of current operating personnel and their grade of certification. The report shall include the date of each facility's Operation and Maintenance Manual, the date the manual was last reviewed, and whether the manual is complete and valid for the current facilities. The report shall restate, for the record, the laboratories used by the discharger to monitor compliance with this order and permit and provide a summary of performance.

G. Definitions

1. "Bypass" means the intentional diversion of waste streams from any portion of a treatment facility whose operation is necessary to maintain compliance with the terms and conditions of this Order.

2. "Composite sample" means, for flow rate measurements, the arithmetic mean of no fewer than eight individual measurements taken at equal intervals for 24 hours or for the duration of discharge, whichever is shorter.

   "Composite sample" means, for other than flow rate measurement,

   (a) A combination of at least eight individual portions obtained at equal time intervals for 24 hours, or the duration of the discharge, whichever is shorter. The volume of each individual portion shall be directly proportional to the discharge flow rate at the time of sampling.

   OR

   (b) A combination of at least eight individual portions of equal volume obtained over a 24-hour period. The time interval will vary such that the volume of wastewater discharged between samplings remains constant.

   The compositing period shall equal the specified sampling period, or 24 hours, if no period is specified.

3. "Daily discharge" means:

   (a) For flow rate measurements, the average flow rate measured during a calendar day or during any 24-hour period reasonably representative of the calendar day for purposes of sampling.

   (b) For pollutant measurements, the concentration or mass emission rate measured during a calendar day or during any 24-hour period reasonably representative of the calendar day for purposes of sampling.

4. The "daily discharge rate" shall be obtained from the following calculation for any calendar day:

$$\text{Daily discharge rate} = \frac{8.34}{N} \sum_{1}^{N} Q_i C_i$$

in which N is the number of samples analyzed in any calendar day, Q_i and C_i are the flow rate (MGD) and the constituent concentration (mg/l) respectively, which are associated with each of the N grab samples which may be taken in any calendar day. If a composite

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sample is taken, C_i is the concentration measured in the composite sample and Q_i is the average flow rate occurring during the period over which samples are composited.

5. "Daily maximum" limit means the maximum acceptable "daily discharge." For pollutant measurements, unless otherwise specified, the results to be compared to the "daily maximum" limit are based on "composite samples."

6. "Duly authorized representative" is one whose:

   (a) Authorization is made in writing by a principal executive officer or ranking elected official;

   (b) Authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.); and

   (c) Written authorization is submitted to the Regional Board and EPA Region 9. If an authorization becomes no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements above must be submitted to the Regional Board and EPA Region 9 prior to or together with any reports, information, or applications to be signed by an authorized representative.

7. "Grab sample" is defined as any individual sample collected in a short period of time not exceeding 15 minutes. "Grab samples" shall be collected during normal peak loading conditions for the parameter of interest, which may or may not be during hydraulic peaks. It is used primarily in determining compliance with "daily maximum" limits and the "instantaneous maximum" limits.

8. "Hazardous substance" means any substance designated under 40 CFR 116 pursuant to Section 311 of the Clean Water Act.

9. "Heavy metals" are for purposes of this Order, arsenic, cadmium, chromium, copper, lead, mercury, silver, nickel,, and zinc.

10. "Instantaneous maximum" concentration is defined as the maximum value measured from any single "grab sample."

11. "Median" of an ordered set of values is that value below and above which there is an equal number of values, or which is the arithmetic mean of the two middle values, if there is no one middle value.

12. "Priority pollutants" are those constituents referred to in 40 CFR 401.15 and listed in the EPA NPDES Application Form 2C, pp. V-3 thru V-9.

13. "6-month median" means a moving "median" of daily values for any 180-day period in which daily values represent flow-weighted average concentrations within a 24-hour period. For intermittent discharges, the daily value shall be considered to equal zero for days on which no discharge occurred.

14. "7-day" and "30-day average" shall be the arithmetic average of the values of daily discharge calculated using the results of analyses of all samples collected during any 7 and 30 consecutive calendar day periods, respectively.

15. "Toxic pollutant" means any pollutant listed as toxic under Section 307(a)(1) of the Clean Water Act or under 40 CFR 122, Appendix D.

16. "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with effluent limitations because of factors beyond the reasonable control of the discharger. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper action.

TENTATIVE

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E OF CALIFORNIA GEORGE DEUKMEJIAN, *Governor*

IFORNIA REGIONAL WATER QUALITY CONTROL BOARD—
ANGELES REGION

OUTH BROADWAY, SUITE 4027
ANGELES, CALIFORNIA 90012-4596
620-4460

December 26, 1986

Mr. James E. Crawley
Director of Engineering, Transit Facilities
Metro Rail Project
Southern California Rapid Transit District
425 Main Street
Los Angeles, California 90013

WASTE DISCHARGE REQUIREMENTS (NPDES PERMIT NO. CA0059714)

We have completed our review of your application for a permit to discharge wastes under the National Pollutant Discharge Elimination System (NPDES).

Pursuant to the Federal Clean Water Act, as amended, and in accordance with the California Administrative Code, we have prepared tentative waste discharge requirements.

Enclosed, for your review, are copies of the requirements for discharges during construction of the initial phase of the Metro Rail Project (MOS-1) consisting of:

a) Board Order;
b) Standard Provisions and General Monitoring and Reporting Requirements; and,
c) Monitoring and Reporting Program.

In accordance with administrative procedures, this Board at a public hearing to be held on January 26, 1987 at 9:30 a.m., 107 South Broadway, Room 1138, Los Angeles, California, will consider the tentative requirements and comments submitted in writing regarding any or all portions thereof. The Board will hear any testimony pertinent to this discharge and the tentative requirements. We expect the Board to take action at the hearing; however, as testimony indicates, the Board at its discretion may order further investigation.

To be included in the Board's agenda folder, any written comment any person has regarding this tentative Order must be received by January 8, 1986. However, comments received after that date will also be considered.

MAILING LIST
for
SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
(Metro Rail Project - MOS-1, CA0059714)

Environmental Protection Agency, Region 9, Administrative Service Division (W-5-1)
U.S. Corp of Engineers
NOAA, National Marine Fisheries Service
Mr. Archie Matthews, State Water Resources Control Board, Division of Water Quality
Ms. Bonnie Wolstoncroft, State Water Resources Control Board, Office of Chief Counsel
Department of Fish and Game, Region 5
Department of Health Services, Sanitary Engineering Section
Department of Health Services, Hazardous Waste Section
Department of Water Resources
City of Los Angeles, Department of Public Works, Bureau of Engineering
City of Los Angeles, Department of Public Works, Bureau of Sanitation
City of Los Angeles, Wastewater Systems Engineering Division
Los Angeles County, Department of Health Services
Los Angeles County, Department of Public Works, Hydraulic/Water Conservation Division
Los Angeles County, Department of Public Works, Waste Management Division
Los Angeles County, Department of Health Services
Central and West Basin Water Replenishment District
Ms. Rebecca Gil, Office of Assemblyman Dave Elder
638 South Beacon Street, Suite 307
San Pedro, California 90731

If you have any questions, please call me at (213) 620-5681 or Winnie Deslate at (213) 620-4838.

NELSON WONG
Senior Water Resource Control Engineer

cc: See attached mailing list

Enclosures

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ATE OF CALIFORNIA
GEORGE DEUKMEJIAN, *Governor*

LIFORNIA REGIONAL WATER QUALITY CONTROL BOARD—
S ANGELES REGION
SOUTH BROADWAY, SUITE 4027
S ANGELES, CALIFORNIA 90012—4596
3) 620-4460

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December 29, 1986

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JAN 05 1987
BTC.C.

Mr. James E. Crawley
Director of Engineering, Transit Facilities
Metro Rail Project
Southern California Rapid Transit District
425 Main Street
Los Angeles, California 90013

WASTE DISCHARGE REQUIREMENTS (NPDES PERMIT NO. CA0059714)

On December 26, 1986, we transmitted tentative waste discharge requirements for your proposed discharge of wastes to the City of Los Angeles' storm drain system during construction of the Metro Rail MOS-1 facility..

We have found some typographical errors in the transmitted tentative Board Order on page 5, "Effluent Limitations Ib" on limits for settleable solids, total suspended solids, and total dissolved solids. The effluent limits for these constituents should have read:

Constituent	Units	30-day Average	Daily Maximum	
Total Suspended Solids	mg/l	50	150	← ES
	lb/day	16,847	50,540	
Settleable Solids	ml/l	0.1	0.3	
Total Dissolved Solids	mg/l	---	1500	

The corrected tentative Order is enclosed.

If you have any questions, please call me at (213) 620-5681 or Winnie Deslate at (213) 620-4838.

NELSON WONG
Senior Water Resource Control Engineer

cc: See Mailing List

Enclosures

DEC 31 1986

ITEM #_____
FILE #_____

MAILING LIST
for
SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
(Metro Rail Project - MOS-1, CA0059714)

Environmental Protection Agency, Region 9, Administrative Service Division (W-5-1)
U.S. Corp of Engineers
NOAA, National Marine Fisheries Service
Mr. Archie Matthews, State Water Resources Control Board, Division of Water Quality
Ms. Bonnie Wolstoncroft, State Water Resources Control Board, Office of Chief Counsel
Department of Fish and Game, Region 5
Department of Health Services, Sanitary Engineering Section
Department of Health Services, Hazardous Waste Section
Department of Water Resources
City of Los Angeles, Department of Public Works, Bureau of Engineering
City of Los Angeles, Department of Public Works, Bureau of Sanitation
City of Los Angeles, Wastewater Systems Engineering Division
Los Angeles County, Department of Health Services
Los Angeles County, Department of Public Works, Hydraulic/Water Conservation Division
Los Angeles County, Department of Public Works, Waste Management Division
Los Angeles County, Department of Health Services
Central and West Basin Water Replenishment District
Ms. Rebecca Gil, Office of Assemblyman Dave Elder
638 South Beacon Street, Suite 307
San Pedro, California 90731

RECEIVED
FACILITIES DESIGN MGMT.
JAN 14 1987

"COPY FURNISHED TO: JEM KNM H Chaliff

87-00117

M E M O R A N D U M

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
TRANSIT SYSTEMS DEVELOPMENT DEPARTMENT
TRANSIT FACILITIES

RECEIVED
JAN 13
D.C.C.

****

TO: Project Managers File: U.0

FROM: Michael F. Merrick *M F Merrick*

DATE: January 9, 1987

SUBJECT: NPDES Permits

****

Attached for your action is the Tentative Board Order and Correspondence relating to the NPDES Permit for the Project that was received from the California Regional Water Quality Control Board. It is anticipated that the Board Order will be approved as drafted at the Board's meeting on January 26, 1987.

The effluent limitations in the Board Order which apply to site discharges to the storm sewer system during Project construction must be included in the requirements for each facilities contract. Items (b) and (c), the monitoring and reporting programs referenced in the Board's letter of December 26, 1986, will be performed by the CM. To do the monitoring will require that each contractor establish a sample station in the construction stormwater effluent line downstream of any treatment facilities (e.g. removal of sulfides, oil and grease, grit etc.) and prior to discharge from the site.

Attachment

cc: R. Murray
J. Crawley
J. Strosnider
M. Polacek
H. Chaliff

ATE OF CALIFORNIA
LIFORNIA REGIONAL WATER QUALITY CONTROL BOARD—
S ANGELES REGION
' SOUTH BROADWAY, SUITE 4027
S ANGELES, CALIFORNIA 90012—4596
3) 620-4460

GEORGE DEUKMEJIAN, *Governor*

December 26, 1986

Mr. James E. Crawley
Director of Engineering, Transit Facilities
Metro Rail Project
Southern California Rapid Transit District
425 Main Street
Los Angeles, California 90013

WASTE DISCHARGE REQUIREMENTS (NPDES PERMIT NO. CA0059714)

We have completed our review of your application for a permit to discharge wastes under the National Pollutant Discharge Elimination System (NPDES).

Pursuant to the Federal Clean Water Act, as amended, and in accordance with the California Administrative Code, we have prepared tentative waste discharge requirements.

Enclosed, for your review, are copies of the requirements for discharges during construction of the initial phase of the Metro Rail Project (MOS-1) consisting of:

a) Board Order;
b) Standard Provisions and General Monitoring and Reporting Requirements; and,
c) Monitoring and Reporting Program.

In accordance with administrative procedures, this Board at a public hearing to be held on January 26, 1987 at 9:30 a.m., 107 South Broadway, Room 1138, Los Angeles, California, will consider the tentative requirements and comments submitted in writing regarding any or all portions thereof. The Board will hear any testimony pertinent to this discharge and the tentative requirements. We expect the Board to take action at the hearing; however, as testimony indicates, the Board at its discretion may order further investigation.

To be included in the Board's agenda folder, any written comment any person has regarding this tentative Order must be received by January 8, 1986. However, comments received after that date will also be considered.

If you have any questions, please call me at (213) 620-5681 or Winnie Deslate at (213) 620-4838.

NELSON WONG
Senior Water Resource Control Engineer

cc: See attached mailing list

Enclosures

MAILING LIST
for
SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
(Metro Rail Project - MOS-1, CA0059714)

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Los Angeles County, Department of Public Works, Hydraulic/Water Conservation Division
Los Angeles County, Department of Public Works, Waste Management Division
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Ms. Rebecca Gil, Office of Assemblyman Dave Elder
638 South Beacon Street, Suite 307
San Pedro, California 90731

State of California

Resources Agency

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD, LOS ANGELES REGION

ORDER NO. _____

NPDES NO. CA0059714

WASTE DISCHARGE REQUIREMENTS

FOR

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICTS
CONSTRUCTION: Metro Rail Project - MOS-1

The California Regional Water Quality Control Board, Los Angeles Region, finds:

1. Southern California Rapid Transit District (RTD), a public corporation, has filed a report of waste discharge, and has applied for waste discharge requirements and a National Pollutant Discharge Elimination System (NPDES) permit.

2. RTD is constructing, and will subsequently operate the initial phase of the minimal operable segment (MOS-1) of the Metro Rail facility at downtown Los Angeles. The MOS-1 segment will span from about Alameda and 7th Streets to Wilshire and Alvarado Streets. Wastewater streams up to 40.4 million gallons per day (mgd) will be generated during construction. RTD proposes to discharge these wastes streams to the City of Los Angeles' storm drain systems (nine outfalls) which flow to either the Los Angeles River or Ballona Creek, both are waters of the United States, above the tidal prism.

3. The report of waste discharge describes the discharges during construction of the MOS-1 segment. The wastewaters during construction consists of ground water from dewatering operations, excavation seepages, stormwater inflows, and equipment, tunnel, and station washdowns. Construction discharges reportedly will be for a period of 36 months.

TENTATIVE

The different discharge points are described below:

Outfall No.	Discharges[1] (Thousand Gallons) Ground Water	Storm Water	Washdowns	TOTAL	Receiving Water	Facility Segment
001	15,000.0	72.6	8.0	15,080.6	LAR[2]	East Portal & Crossover Const.
002	15,000.0	20.2	8.0	15,028.2	LAR	Union Station & Crossover Const.
003	10,000.0	16.0	8.0	10,024.0	LAR	Union Station to 5th/Hill Tunnel
004	0.6	24.0	8.0	32.6	LAR	Civic Center Station Const.
005	13.2	28.8	8.0	50.0	LAR	5th/Hill Station Const.
006	32.2	16.0	8.0	56.2	LAR	5th/Hill 7th/Flower Tunnel
007	9.7	20.4	8.0	38.1	LAR	7th/Flower Station
008	2.3	16.0	8.0	26.3	Ballona Creek	7th/Flower to Wilshire/Alvarado Tunnel
009	8.0	25.0	8.0	41.0	Ballona Creek	Wilshire/Alvarado Station Const.
TOTAL	40,066.0	239.0	72.0	40,377.0		

[1] Maximum Estimated Flow

[2] Los Angeles River

4. The major flow during construction will be from groundwater dewatering operations around Union Station, where the cut-and-cover method of construction will be used. The maximum groundwater flow from this area (Discharge Serial Nos. 001, 002, and 003) is estimated at 40 mgd, with an average flow of 15 mgd.

5. The report of waste discharge indicates that the quality of the ground water that would be discharged is poor. Analytical results of ground water samples show high concentrations of the following constituents:

Sulfides	65 mg/l
Total dissolved solids	2,000 mg/l
Oil and grease	10 mg/l
Biological Oxygen Demand	90 mg/l
Phthalates	11 ug/l
Phenol	5 ug/l
Pentachlorophenol	50 ug/l

TENTATIVE

Analyses for other organic priority pollutants showed none detectable or below action levels.

6. Dry weather flow at the Los Angeles River (measured near Firestone Blvd.) averages about 31 mgd for water years 1983-84 and 1984-85. The quality of the dry weather flow is as follows:

Total Dissolved Solids	- 482 to 740 (average about 700) mg/l
Dissolved Oxygen	- 8.2 to 19./0 mg/l
pH	- 8.1 to 8.8

7. The major impacts the proposed discharge (Discharge Serial Nos. 001, 002 and 003) would have on the Los Angeles River are:

   A. Sulfides

      (1) Nuisance Problem - The main concern is the low odor threshold of hydrogen sulfide (H_2S) which is 0.66 micrograms per cubic meter (ug/m^3) in the atmosphere.

      RTD reports that an emission rate of 20 pounds per day at the discharge point would result in 0.65 ug/m^3 for one mile, 100 meters high. This emission rate is equivalent to about 1.5 mg/l of sulfides.

      (2) Water Quality Degradation - At the discharge point, the ground water discharge will decrease the dissolved oxygen in the receiving water because of the biological oxygen demand by the sulfides. Without any treatment of the groundwater, staff anticipates that certain sections of the river could be depleted of oxygen. In addition, sulfides are toxic to fresh water aquatic organisms (0.5 - 1.0 mg/l).

      (3) Damage to storm drains and flood control structures - RTD reports it has master contracts with the City of Los Angeles and the County of Los Angles regarding reimbursements to the City and/or the County for costs of repairs and/or replacements of damaged structures resulting from the discharge. RTD and the City or County would inspect the structures before and after the discharge to determine the damages incurred.

      RTD is also working with the U.S. Corps of Engineers regarding discharges to the Los Angeles River Channel.

   B. Total Dissolved Solids (TDS) - The proposed discharge will contain an average TDS concentration of 2000 mg/l which exceeds the water quality objectives (1500 mg/l) contained in the Los Angeles River

TENTATIVE

Basin Plan. In addition, downstream of the discharge, the Los Angeles County Department of Public Works diverts water to the Dominguez Gap Recharge Basin, which is operated by the Central and West Basins Water Replenishment Districts (CWBWRD). Water is diverted for ground water recharge only if the TDS concentration is less than 700 mg/l. RTD is working with CWBWRD on an agreement for RTD to reimburse CWBWRD the cost of imported water for groundwater recharge whenever the TDS concentration of RTD discharges is over the Los Angeles Basin Plan limits and increases the TDS concentration of the river water to be over 700 mg/l.

8. RTD proposes to treat the ground water to remove sulfides prior to discharge to the Los Angeles River. Treatment will consist of hydrogen peroxide oxidation of sulfides to sulfur, and flotation and sedimentation to remove suspended solids. Sludge will be hauled to a legal disposal site.

9. The Board adopted a revised Water Quality Control Plan for the Los Angeles River Basin on November 27, 1978. The Plan contains water quality objectives for the Los Angeles River and Ballona Creek. The requirements contained in this Order, as they are met, will be in conformance with the goals of the Plan.

10. The beneficial uses of the Los Angeles River are: ground water recharge non-contact-water recreation, and (within the tidal prism) water contact and non-contact water recreation, industrial service supply, ocean commercial and sport fishing, preservation of rare and endangered species, marine habitat, and saline water habitat.

    The beneficial use of Ballona Creek is: non-contact water recreation. The beneficial uses of Ballona Creek tidal prism are: water contact recreation, non-contact water recreation, ocean commercial and sport fishing, preservation of rare and endangered species, marine habitat, shellfish harvesting, and saline water habitat.

11. The issuance of waste discharge requirements for this discharge is exempt from the provisions of Chapter 3 (commencing with Section 21100) of Division 13 of the Public Resources Code in accordance with Water Code Section 13389.

12. Effluent limitation standards established pursuant to Section 301 of the Federal Clean Water Act and amendments thereto are applicable to the discharge.

The Board has notified the discharger, and interested agencies and persons of its intent to prescribe waste discharge requirements for this discharge and has provided them with an opportunity to submit their written views and recommendations.

TENTATIVE

The Board in a public hearing heard and considered all comments pertaining to the discharge and to the tentative requirements.

This Order shall serve as a National Pollutant Discharge Elimination System permit pursuant to Section 402 of the Federal Clean Water Act, or amendments thereto, and shall take effect at the end of ten days from the date of its adoption, provided the Regional Administrator, EPA, has no objections.

IT IS HEREBY ORDERED, that Southern California Rapid Transit District, in order to meet the provisions contained in Division 7 of the California Water Code and regulations adopted thereunder, and the provisions of the Federal Clean Water Act and regulations and guidelines adopted thereunder, shall comply with the following:

I. Effluent Limitations

a. Wastes discharged shall be limited to those described herein, as proposed.

b. The discharge of effluent containing constituents in excess of the following limits is prohibited:

Constituent	Units	Discharge Limitations 30-Day Average	Daily Maximum
Settleable Solids	ml/l	0.1	0.3
	mg/l	50	150
	lbs/day[1]	16,847	50,540
Total dissolved solids	mg/l	20	60
BOD_5(20°C)	lbs/day[1]	6,739	20,216
	mg/l	10	15
Oil and Grease	lbs/day[1]	3,369	5,054
	mg/l	1.0	2.5
Sulfides	mg/l	—	1,500[3]
Total dissolved solids[2]	mg/l	—	1.0
Phenols	lbs/day[1]	337	337
	ug/l	—	30
Pentachlorophenol			

[1] Based on a maximum flow of 40.4 mgd.

[2] This limit does not apply to Discharge Serial Nos. 008 and 009 (Ballona Creek).

[3] This limit may be exceeded for Discharge Serial Nos. 001 through 007 provided no water is diverted from the Los Angeles River for recharge at Dominguez Gap Recharge Basin.

* Modified by Board's letter of 12/29/80

TENTATIVE

c. The toxicity of the effluent shall be such that the average survival in undiluted effluent for any three (3) consecutive 96-hour static or continuous flow bioassay tests shall be at least 90%, with no single test producing less than 70% survival.

d. The wastes discharged shall not contain odor-producing constituents in concentrations that will cause nuisance.

II. Receiving Water Limitations

a. The waste discharged shall not cause the pH of the receiving water to be less than 6.5 nor more than 8.5

b. The waste discharge shall not cause the dissolved oxygen of the receiving waters to be less than 5.0 mg/l.

III. Requirements and Provisions

This Order includes the attached "Standard Provisions and General Monitoring and Reporting Requirements."

IV. Expiration Date

This Order expires on January 10, 1990.

The discharger must file a Report of Waste Discharge in accordance with Title 23, California Administrative Code, not later than 180 days in advance of such date, as application for issuance of new waste discharge requirements.

I, Robert P. Ghirelli, Executive Officer, do hereby certify that the foregoing is a full, true and correct copy of an Order adopted by the California Regional Water Quality Control Board, Los Angeles Region on January 26, 1987.

ROBERT P. GHIRELLI, D.Env.
Executive Officer

WD:sml

TENTATIVE

E OF CALIFORNIA — GEORGE DEUKMEJIAN, Governor

FORNIA REGIONAL WATER QUALITY CONTROL BOARD—
ANGELES REGION
OUTH BROADWAY, SUITE 4027
NGELES, CALIFORNIA 90012-4596
620-4460

Copies to Monsees
Palovich
Merrill
JEC

December 29, 1986

Mr. James E. Crawley
Director of Engineering, Transit Facilities
Metro Rail Project
Southern California Rapid Transit District
425 Main Street
Los Angeles, California 90013

WASTE DISCHARGE REQUIREMENTS (NPDES PERMIT NO. CA0059714)

On December 26, 1986, we transmitted tentative waste discharge requirements for your proposed discharge of wastes to the City of Los Angeles' storm drain system during construction of the Metro Rail MOS-1 facility..

We have found some typographical errors in the transmitted tentative Board Order on page 5, "Effluent Limitations Ib" on limits for settleable solids, total suspended solids, and total dissolved solids. The effluent limits for these constituents should have read:

Constituent	Units	30-day Average	Daily Maximum
Total Suspended Solids	mg/l	50	150
	lb/day	16,847	50,540
Settleable Solids	ml/l	0.1	0.3
Total Dissolved Solids	mg/l	---	1500

The corrected tentative Order is enclosed.

If you have any questions, please call me at (213) 620-5681 or Winnie Deslate at (213) 620-4838.

NELSON WONG
Senior Water Resource Control Engineer

cc: See Mailing List

DEC 31 1986

ITEM #

FILE #

MAILING LIST
for
SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
(Metro Rail Project - MOS-1, CA0059714)

Environmental Protection Agency, Region 9, Administrative Service Division (W-5-1)
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Los Angeles County, Department of Public Works, Hydraulic/Water Conservation Division
Los Angeles County, Department of Public Works, Waste Management Division
Los Angeles County, Department of Health Services
Central and West Basin Water Replenishment District
Ms. Rebecca Gil, Office of Assemblyman Dave Elder
638 South Beacon Street, Suite 307
San Pedro, California 90731

87-C0055

M E M O R A N D U M

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
TRANSIT SYSTEMS DEVELOPMENT DEPARTMENT
TRANSIT FACILITIES

****

DATE: January 6, 1987

TO: File

FROM: N. Tahir

SUBJECT: Summary Minutes of Meeting with the State Department of Health Services, Toxic Substances Control Division CADHS(TSCD)

****

Subject meeting was held on December 23, 1986 at the CADHS offices at 107 S. Broadway, Los Angeles. Attendees and summary minutes are as follows:

Attendees:

CADHS
Jim Smith - Program Manager
Jean Liu

MRTC
Jim Monsees

SCRTD
James Crawley
Nadeem Tahir

Earth Technology
Larry Barker
Tau Phung

Minutes:

1. CADHS staff was briefed on the Districts current assessment of the contaminated soil at the A-130 site.

2. CADHS was informed of the remedial action alternatives under consideration and what permit and approvals may be required.

3. Mr. Smith of CADHS indicated that we should consider all feasible alternatives, that they are not biased against any of the alternatives such as land farming, on-site incapsulation or land farming.

4. It was Mr. Smith's recommendation that the A-130 site should not be included in the EPA's designated list of clean-up sites. He believed that while it may allow funding from the Superfund budget, it will considerably slow the process. We agreed to work with them to meet clean-up requirements, but to keep site off the Superfund list.

5. Mr. Smith felt that clean-up costs and treatment costs at the A-130 site should be recoverable from the Southern California Gas Company who operated the Coal Gassification plant at this site and residues from which are the contaminated material in question.

6. Mr. Smith was very cooperative and helpful, he agreed to allow us to review their files pertaining to other projects in the area. We agreed to a seperate appointment to review these files.

7. He suggested that we not wait till the Earth Technology study is complete before asking for their review. We should submit data and material as it becomes available. In this regard, we agreed to submit the preliminary report including results of laboratory testing the week of January 5, 1986.

cc: J. Monsees
J. Crawley
R. Murray

NT:pc:5.27

J. Moreno

RTD

January 8, 1987
File: U.0

87-00079

RECEIVED
JAN 09 1
D.C.C.

Dr. Robert P. Ghirelli
California Regional Water Quality
Control Board
Los Angeles Region
107 South Broadway, Room 4027
Los Angeles, CA 90012

Attn: Mr. Nelson Wong

Subject: NPDES Permit CA0059714 - Metro Rail Project

Dear Dr. Ghirelli:

The District has reviewed the tentative waste discharge requirements contained in the Board's letters of December 26 and 29, 1986 which will be considered at the Board meeting to be held on January 26, 1987.

The District requests that the following items be considered by the Board prior to adopting the tentative permit requirements.

Waste Discharge Requirements - Paragraph 8.

Paragraph 8 describes a method of sulfide treatment that the District proposed in its letter of September 30, 1986. Since that date, through continued analysis and pilot testing of groundwater samples from wells near Union Station, the District is considering alternatives for sulfide removal.

An alternative treatment process will employ hydrogen peroxide at varying rates to completely oxidize the sulfide in the groundwater to sulfate. With this process, minimal colloidal sulfur will be produced in the effluent. The oxidation reaction requires adjustment of the pH which will be followed by a further adjustment to return carbonate precipitates to solution and meet the Waste Discharge Requirements. A process flow diagram is shown on Figure 1.

The Standard Provisions and General Monitoring and Reporting Requirements. Paragraph 23.

Paragraph 23 prohibits the by-passing of the treatment facility. The discharges at points 001, 002 and 003 will each consist of flows from several dewatering wells situated at various locations on large construction sites. It is expected that the quality of groundwater from these wells will vary from well to well and with time. In the event that groundwater from any dewatering well(s) conforms to the effluent limitations contained in the Waste Discharge Requirements,

the District requests that such flow be allowed to by-pass the treatment facilities and be recombined with the treated effluent upstream of the monitoring station (see Figure 2). The results of by-passing a portion of the flow will be to reduce TDS levels in the discharge to the Los Angeles River, reduce chemical usage and lower treatment costs.

The Monitoring and Reporting Program

Page T-1 of the Program requires daily monitoring of sulfides in the effluent at points 001 through 009. Based on the results of the District's geotechnical exploration, it is expected that Discharges 004 through 009 will contain sulfide levels less than 0.1 mg/l. Should the priority pollutant sampling program indicate that sulfides are not present at these locations, the District requests that quarterly rather than daily monitoring for sulfides be required.

The Monitoring and Reporting Program

Page T-3 of the Monitoring and Reporting Program requires daily monitoring of sulfides in the receiving waters of both the LA River and Ballona Creek. If, as expected, Discharges 004 through 009 are found to contain sulfide levels less than those specified in the Waste Discharge Requirements, it is requested that the Board eliminate the requirement for monitoring sulfides in Ballona Creek.

The Standard Provisions and General Monitoring and Reporting Requirements. Paragraph E.5.

Paragraph E.5 requires a report be submitted on the operation and maintenance program for the treatment facility. Paragraph E.14 of the Standard Provisions requires a report be submitted on the preventive (failsafe) and contingency (cleanup) plans for the work.

There will be 9 individual construction contracts involved in the MOS-1 Segment of the Metro Rail Project. Construction of these contracts will be initiated over a period of approximately 6 to 9 months. As a result, it will not be practical for the District to submit reports on the total MOS-1 Segment within the 30 and 90 day periods following issuance of the Board Order. The District requests that the Board approve the submittal of individual reports for each construction contract as construction of that contract commences and that the submittal schedule for the reporting requirements be modified to commence "30 days after issuance of the Notice to Proceed for each construction contract".

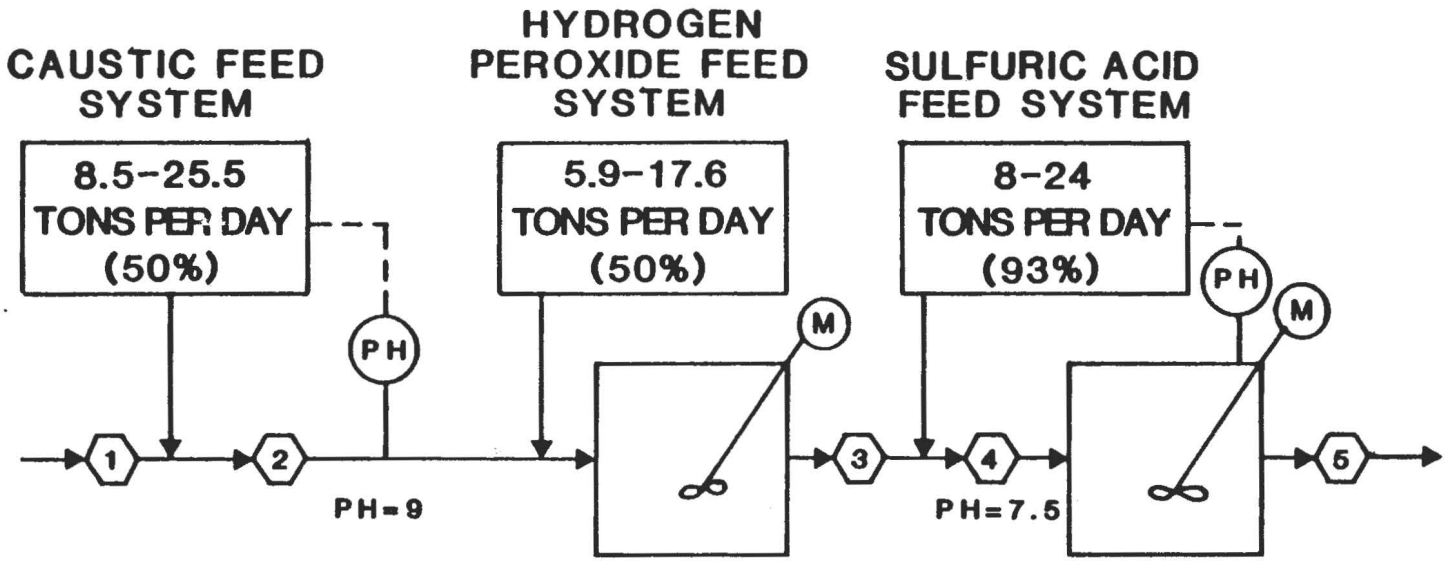
The District wishes to thank you and your staff for the assistance provided during the review of its permit application.

Your favorable consideration of these requests will be greatly appreciated.

Sincerely,

James E. Crawley, P.E.
Director of Engineering
Transit Facilities

PLANT FLOW 5-15 MG



SULFIDE OXIDATION REACTOR 10 MINUTE RETENTION TIME 35,000-105,000 GALLONS

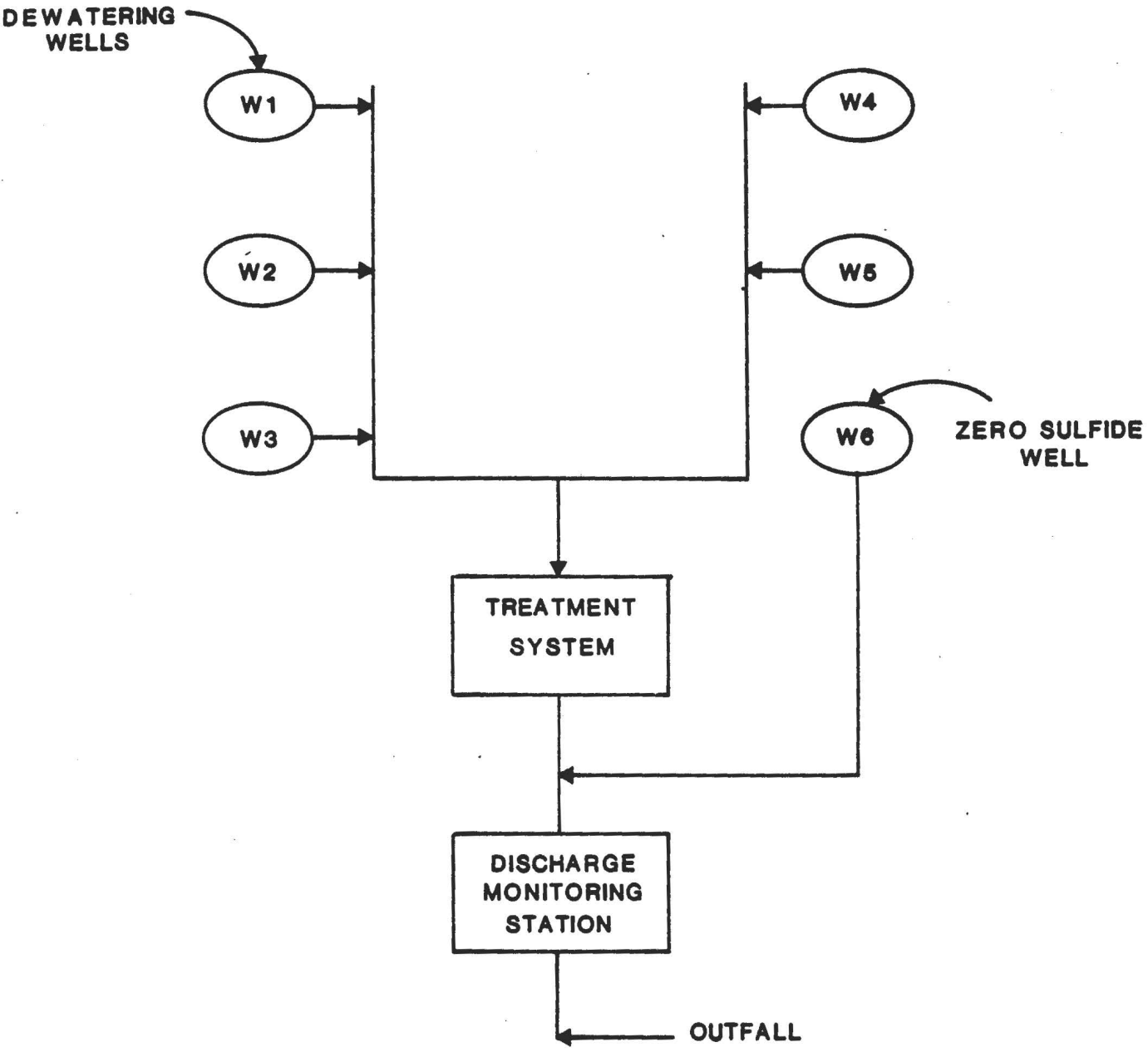
NEUTRALIZATION TANK 5 MINUTE RETENTION TIME 18,000-53,000 GALLONS

COMPOSITIONS

	PH	SULFIDE	SULFATE(PPM)	SUSPENDED SOLIDS
1.	7.5	40	130-580	0
2.	9.0	40	130-580	> 50
3.	9.0	0	700-1100	> 50
4.	7.5	0	700-1100	< 50
5.	7.5	0	700-1100	< 50

FIGURE 2

TYPICAL SYSTEM SCHEMATIC FOR DISCHARGES 01, 02, and 03.



NOTE: Wells 1-5 contain sulfides.

APPENDIX F

DESCRIPTION OF SCREENING TECHNIQUES FOR IDENTIFICATION OF CONTAMINATED SOILS

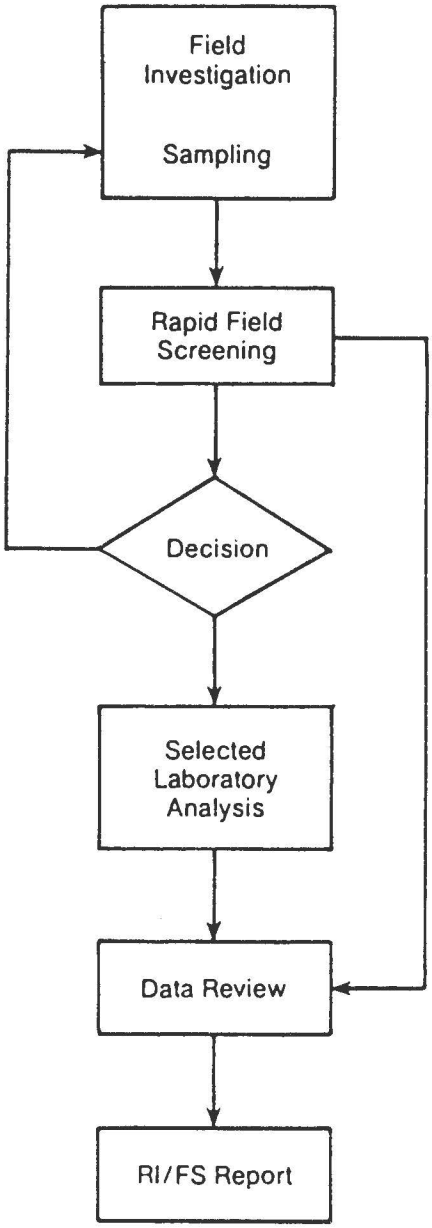


Figure 1
Use of Field Screening Techniques in Remedial Investigations/Feasibility Studies

analyzed using the UV instrument and the PNA concentration is readily calculated using the measured instrument response and the calibration curve. The instrument operating conditions are shown in Table 1.

Volatile Organic Screening Technique

This technique is a quantitative analytical method for determination of 1,1,2,2-tetrachloroethylene, 1,1,2-trichloroethylene and 1,1-dichloroethylene in water using a portable GC. The results of the field screening technique correlate well with analytical data obtained by conventional laboratory analysis.

This screening technique utilizes a portable GC—the Photovac Model 10A10. The Photovac Model 10A10 uses gas chromatography to separate the components in the gaseous mixture, followed by detection using UV light. Molecules having ionization potentials greater than that of the ultraviolet light source (11 electron volts) are less likely to be ionized. Once the molecule is ionized by the UV Energy, the resulting charged particles are captured in an electric field and detected with a sensitive electrometer which amplifies the current for display on a recorder.

Table 1
Method Detection Limits and Operating Conditions

Screening Technique	Parameter	Retention Time (min)	Method Detection Limit (ug/l)
Volatile Organics[1]	1,1-Dichloroethylene	0.62	1.0
	1,1,2-Trichloroethylene	3.32	1.0
	1,1,2,2-Tetrachloroethylene	9.68	2.0
PNA[2]	Total PNAs-Soil/solvent	-	1-10 ppm (ug/g)[3]
	Total PNAs- Water	-	10.0

1. Gas Chromatograph Column Conditions:

   Chromatograph column conditions: 1.5' SE-30 support and % coating unknown. Helium carrier gas at 20 ml/min to establish method detection limits. High grade air at 20 ml/min in actual field use. Ambient temperature.

2. UV Fluorescence Spectrophotometer Conditions:

   Response = 0
   Fixed Scale = 0.1
   Recorder Scale = 1000 mV
   Slit width: excitation 10 nm, emission 10 nm

Wavelength pairs	Excitation	Emission
Pair 1	280	340
Pair 2	250	400

   Recorder Speed 10 nm/cm
   Scan Speed Time

   NOTE: Both recorder speed and scan speed will be set automatically by going into wavelength program.

3. Dependent upon site background concentration.

The technique entails acquisition of a headspace sample from a field sample that has been allowed to reach equilibrium. The gaseous sample then is injected with inert gas into a Photovac model 10A10 portable gas chromatograph. The associated individual component concentrations are determined with a simple calculation, using a previous calibration factor based on standard solutions and the measured instrument response for each sample. The instrument operating conditions are shown in Table 1.

METHOD DEVELOPMENT PROCEDURES

Before implementation in the field, optimum operating conditions and procedures were determined for each screening technique. In addition, each method was validated by determining the recovery fraction from spiked samples and establishing positive correlations between the screening technique and standard laboratory analysis.

PNA Screening Method Development

Initially, three target PNA compounds were chosen for both the soil and water method validation. The compounds chosen were the most predominant PNAs at the two sites used to test this technique. These compounds (naphthalene, acenapthene and phanthrene) also should parallel the behavior of the other PNAs known to be present on two test sites. Using standard solutions of the three target compounds, UV fluorescence spectra were generated over a wide concentration range. The fluorescence data were used to determine instrument sensitiyity and excitation and emission maxima for the target compounds. This information then was used to determine optimum sample size, method detection limits and instrument conditions for both the soil and water methods. Based on the UV fluorescence characteristics of the target compounds and knowledge of other PNA compounds known

Field Screening Techniques Developed Under the Superfund Program

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ABSTRACT

Field screening techniques were developed by WESTON for the Superfund Program to accommodate the increasing data requirements associated with Remedial Investigations/Feasibility Studies. Techniques have been developed for application at National Priority List (NPL) sites for field analysis of two classes of contaminants: (1) polynuclear aromatic hydrocarbons (PNAs) and (2) volatile organics.

The methods for screening PNAs and volatile organics were developed in the laboratory and validated by comparison with standard laboratory analysis. The method for screening PNAs, consisting of a one-step field extraction followed by a UV fluorescence spectropthotometric analysis, was developed for determination of total PNAs in soil and water samples.

The volatile organic screening method was developed for detection of 1,1-dichloroethylene, 1,1,2-trichloroethylene and 1,1,2,2-tetrachloroethylene in a water matrix. This method utilizes a head space analysis with a Photovac portable gas chromatograph at ambient conditions.

Each of the three screening techniques is a reliable method of analysis of its respective contaminants and was successfully implemented in the field at different NPL sites. In addition, the field application of these techniques demonstrated rapid turnaround times for sample analysis and the cost-effectiveness of field screening.

INTRODUCTION

The Remedial Investigations/Feasibility studies (RI/FS) process for NPL sites under the Superfund Program often have been prolonged because of data requirements. Many factors, including issues relating to liability, quality assurance, enforcement and cost recovery have contributed to significant increases in the amount of data necessary for completion of a RI/FS. As a result, the associated schedules and costs to conduct the studies have increased accordingly.

In an effort to expedite the RI/FS process, the U.S. EPA has encouraged the development of field screening techniques. These techniques allow a more focused, more complete, expedient and cost-effective field effort during the RI. The major advantages of the field screening techniques include:

- Rapid turnaround times enabling cost-saving field decisions
- Analysis of a larger number of samples in the field
- Ability to redirect and focus sampling efforts thereby increasing the accuracy of estimates of zones of contamination and shortening field schedules
- Optimum selection of samples for off-site laboratory analysis by standard methods

Fig. 1 demonstrates how screening techniques can be incorporated into an RI/FS.

This paper summarizes two field screening techniques that were developed for and implemented at NPL sites during fiscal years 1985 and 1986. These include screening techniques for field analysis of the following classes of contaminants:

- PNAs soil, water and sediment
- Volatile organics in water

This paper presents an overview of the method development procedures for the field screening techniques. The analytical methods, equipment requirements, typical costs for implementation, anticipated sample throughput, examples of typical site applications and technique limitations are discussed in this paper.

DESCRIPTION OF FIELD SCREENING TECHNIQUES

PNA Screening Technique

This field technique is a rapid semi-quantitative analytical method for determining total PNAs in soil, sediment and water samples (i.e., for contamination assessment at wood treating sites). The method yields a total concentration of PNAs which is comparable to the sum of individual PNA compound concentrations obtained from conventional analytical methods (e.g., U.S. EPA-CLP Protocol).

This screening technique utilizes a UV fluorescence spectrophotometer as the detection instrument. The fluorescence spectrophotometer uses ultraviolet light to excite electrons which will emit light at certain wavelengths when returning to their initial state. Different chemical compounds and concentrations of these compounds in a mixture are determined by the varying degrees that they absorb a particular wavelength of light (i.e., different instrument response values). The instrument response is displayed digitally and on a chart recorder.

The UV spectrophotometer is calibrated using standard solutions with known concentrations of PNAs in acetonitrile or hexane. Measured quantities of each field sample are extracted with acetonitrile (from soil or sediment) or hexane (from water) solvents in an on-site laboratory. A sample of the extract is then

be prevalent on the sites, 280/340 and 250/400 were chosen as e optimum wavelength pairs (excitation/emission) for detection total PNAs.

A quantitative fluorescence response was observed for each rget compound from 0.01 to 1.0 µg/l concentration in the andard solution. The calibration curve was observed to be lmost linear within one order of magnitude of concentration. he most accurate quantification was obtained by working within concentration range of 0.1 to 1.0 ug/l.

In the final step of the method development for each site, ppropriate extraction solvents were chosen for each method ased on performance (i.e., rapid dispersion in soil), sensitivity nd lack of instrument interference. Acetonitrile was chosen for ie soil/sediment extraction and hexane for the water extrac- on. The method for screening soil samples consists of adding nhydrous sodium sulfate (to absorb water from wet soil) and V grade acetonitrile to a weighed amount of soil. The mixture is aken vigorously for about 15 sec; after 1 min, it can be filtered. he extract then is analyzed by the UV fluorescence spectro- hotometer, diluting the extract into a readable range as neces- ry. For water samples, a measured volume of sample is mixed ith UV grade hexane for about 1 min. After 5 min, the hexane yer can be removed and analyzed by UV fluorescence.

Background soil and water samples taken from each of the two tes were spiked with the three target PNAs to establish the ccuracy and precision for both the soil and the water methods. he methods showed high recoveries of the PNAs as listed in able 2. Recoveries above 100% occur because calibration curves ere extrapolated to non-linear response regions, thus giving con- ntrations that were biased on the high end of the scale.

After establishing method performance, soil and water samples om the site were analyzed by the UV screening method. The re- ilts were compared to those obtained by U.S. EPA CLP GC/ S techniques. Standard solutions of the seven most prevalent NAs previously discussed were used to generate the calibration rve. The PNA screening technique correlated within an order of agnitude of the GC/MS results (Table 3).

olatile Organics Method Development

Initially, five volatile aromatic compounds were selected for udy: 1,1-dichloroethane, 1,1-dichloroethylene (DCE), 1,1,1-tri- loroethane, 1,1,2-trichloroethylene (TCE) and 1,1,2,2-tetra- loroethylene (PCE). To demonstrate correlation of the data, boratory grade water was fortified with a methanolic solution of e above compounds spanning the concentration range of 20 µg/l. These solutions were analyzed in triplicate using both e Photovac and standard laboratory methods (purge and trap— .S. EPA method 601). Blanks containing methanol equivalent the volume of spike added also were analyzed in triplicate. dditionally, method detection limits (MDL) for specified com- unds were determined from data obtained from the Photovac odel 10A10. The instrument parameters used during calibra- on procedures for the purge and trap system and the Photo- ic 10A10 are shown in Table 4.

The results showed good response for samples greater than 1 to ug/l of the chloroethylenes (i.e., 1,1,2-trichloroethylene). How- er, samples of the chloroalkanes (i.e., 1,1,1-trichloroethane) d not exhibit a measureable response at 1000 µg/l, and the rresponding alkanes could not be identified. This result can be pected because of the high ionization potential, which means ese compounds are less likely to be ionized by the Photovac traviolet light. These results are presented in Table 5.

In the second step of the method development, standard cal- ration procedures were identified to demonstrate that the easurement of the standard is not affected by method or matrix terferences. Calibration standards were prepared at a minimum of three concentration levels for each parameter by the addition of secondary dilution standards to reagent water.

Table 2
Method Accuracy and Precision for PNA Screening Technique for Two Sites

Total Concentration µg/g or µg/l[1]	Average Recovery (%) Naphthalene/ Acenaphthene	RSD (%)[2]	Average Recovery (%) Phenanthrene	RSD (%)[2]
Soil/Sediment Matrix				
6	85	2.5	87	2.0
15	83	1.8	77	1.3
30	79	3.3	78	3.0
150	90	0.6	85	0.7
300	97	0.0	89	0.6
3	65.5	12.7	86.1	9.6
15	79.0	6.5	92.6	13.0
30	60.6	3.3	66.4	7.7
150	100.0	5.5	130.0	9.6
300	93.2	2.3	94.2	0.9
Water Matrix				
9	94	10	100	11
90	98	4.1	97	2.4
1800	101	4.5	101	3.5
9	81.0	1.7	93.6	8.8
90	96.7	1.2	111.0	6.6
1800	94.0	3.9	96.6	3.6

1. µg/l = Soil matrix concentration; µg/l = water matrix concentration.
2. RSD = Relative Standard Deviation.

Table 3
Comparison of UV Fluorescence Screening and GC/MS Data for Total PNA Concentration in Soil, Sediment, and Water Samples from Two Sites

Sample I.D.	Sample Type	Total PNA Concentration, µg/g or µg/l[1] UV Fluorescence				
		#1	#2	#3	Ave.	GC/MS
Soil/Sediment Matrix						
SS1	On-site	14.4	6.5	1.4	8.1	7.0
SS2	On-site	21.6	45.5	48.8	42.4	120
SS3	On-site	104,000	76,300	85,700	88,900	19,000
SS4	Background	4.1	4.2	3.6	4.0	4.1
SG-1	On-site	490,000	430,000	370,000	390,000	64,000
SG-2	On-site	230,000	230,000	82,000	19,000	19,000
SB-1	Background	30	48	51	44	35
SB-2	Background	4.2	9.5	5.4	6.4	19
Water Matrix						
SW-1	On-site	3.1	4.4	6.3	4.6	9.7
SW-1	On-site (2nd site)	4,000	2,600	440	2,600	1,300
SW-2	On-site	490,000	310,000	390,000	400,000	150,000
SW-1	Background	15	17	24	19	ND[2]
SW-2	Background	33	37	143	44	ND[2]

1. µg/l = Soil matrix concentration; µg/l = water matrix concentration.
2. ND = Not Detected.

Table 4
Instrument Parameters for the Volatile Organics Method Development

PURGE AND TRAP

Tekmar liquid Sample Concentrator LSC-2
Tekmar Model ALS Automatic Laboratory Sampler
Hewlett Packard Model 5880A Gas Chromatograph
Tracor Model 700A Hall Elec. Cond. Detector

Carrier: He @ 40 ml./min.

Analytical Column: 8' x 1/8" SS 1% SP 1000 on Cabopack B 60/80 mesh.

Volumne Purged: 5 ml.

Temperature: 45° for 3 minutes

Program: 8° per minute to 220°
Hold at 220° for 35 minutes

Intergrator: Hewlett Packard Model 3390A

PHOTOVAC 10A10

Carrier: He at 20 ml./min.
Temperature: Ambient approximately (15-24°c)
Injection Volume: 100 ul Teflon
Analytical Column: 1.5' SE-30 Support and % Coating unknown
Integrator: Hewlett Packard Model 3390A

Table 5
Method Accuracy and Precision for Volatile Organics Screening Technique

Parameter	Standard Concentration (ug/l)	Concentration[1] (ug/l)	Concentration (ug/l)	RSD (%)[2]	Recovery (%)
1,1-Dichloroethylene	2	2.6	1.65-2.30	16.6	-
	8	-	6.8	-	75
	15	20.3	6.34-8.21	13.8	-
1,1,2-Trichloroethylene	2	2.2	1.83-2.44	14.5	-
	8	-	3.1	-	39
	15	17.3	11.71-15.7	14.8	-
1,1,2,2-Tetrachloroethylene	2	2.4	1.63-1.96	9.6	-
	8	-	3.2	-	40
	15	24.1	11.16-15.70	17.8	-

1. 2 hour equilibrium.
2. RSD = Relative Standard Deviation.

Table 6
Performance Audit Samples for Volatile Organics Screening Technique

Sample I.D.	Compound	Reported Value (ug/l)	True Value (ug/l)	Performance Evaluation
PCP-1	1,1-DCE	<2	NP[1]	Acceptable
	PCE	1.7	NP[1]	--
	PCE	2.7	NP[1]	--
	Unknown	9.3 as PCE	--	Acceptable
PCP-2	Unknown	25 as 1,1-DCE	--	Acceptable[2]
	1,1-DCE	2.1	60	--
	PCE	5.5	7.2	Acceptable
	PCE	13.4	16	Acceptable

1. Not Present.
2. Unknown VOC is possibly trans-1,2-DCE.

Table 7
Estimated Cost Breakdown for Field Implementation[1]

PNA Screening	Cost
Analytical facilities (UV fluorescence spectrophotometer, recorder, analytical balance, refrigerator, lab trailer etc.)	$800 - $900/week
Disposable equipment	$7-8/sample
Manpower (2 operators)	$600-$700/day
Throughput	20-30 samples/day
Estimated average cost per sample	$40-50.
Volatile Organics Screening	
Analytical facilities (photovac, recorder, lab trailer, etc).	$600-$700/day
Disposable equipment	$2-3/sample
Manpower	$400-$500/day
Throughput	20 samples/day
Estimated average cost per sample	$25-35.

1. Based on 1985 dollars and actual field experience.

The field laboratory met the minimum requirements of the U.S. EPA Quality Control Office which included an initial demonstration of laboratory capability and an on-going analysis of spiked samples to evaluate and document data quality. The field laboratory demonstrated through the analyses of quality control check standards that the operation of the measurement system was under control.

To establish the ability to generate acceptable accuracy and precision, two performance evaluation samples were provided by the U.S. EPA. These samples were tested in accordance with the field screening procedure developed for volatile organics during the first week of field screening. A review of the data by the Region V Quality Assurance Office concurred that quantification of trichloroethylene and tetrachloroethylene was acceptable using the volatile organics screening technique. These data are shown in Table 6.

EQUIPMENT REQUIREMENTS AND TYPICAL COSTS FOR IMPLEMENTATION

The cost to implement the PNA screening technique in the field involves equipment, temporary laboratory facilities and operator salaries. The equipment requirements include a UV fluorescence spectrophotometer/chart recorder, analytical balance, disposable laboratory supplies for the extraction process and a small refrigerator to preserve standards.

The average expected cost per sample is $40-$50 per sample with a sample throughput of about 20-30 samples per day. The estimated costs are shown in Table 7.

Volatile organics screening in the field involves equipment, temporary laboratory and operator salaries. The equipment requirements include a Photovac instrument with a chart recorder and appropriated disposable laboratory supplies. The estimated cost is $20-$30 per sample with a sample throughput of about 20 samples/day. The estimated costs are shown in Table 7.

The PNA and volatile organics screening techniques can contribute valuable information to field programs. However, there are limitations associated with the screening techniques. Because both techniques are actually laboratory procedures modified for use in the field, the limitations for the procedures are similar and can be associated with almost any laboratory procedure.

Both the UV fluorescence spectrophotometer and the gas chromatograph operate at ambient temperature and should be set up in an area in the field where temperatures are expected to remain fairly constant. Therefore, the laboratory trailer should be equipped with an air conditioning and/or a heating unit.

The PNA screening technique is relatively simple; a trained technician can perform the analyses. The operator must have some experience in laboratory extraction procedures, instrument operation and basic instrument properties and screening theory so that any problems encountered during field implementation can be evaluated and corrected.

In addition, an analytical trailer equipped with a fume hood is required for the PNA screening technique because solvents are used in the extraction process. Since the PNA screening technique requires a selection of target compounds and understanding of matrix interferences, it must be validated for each site specific situation.

The volatile organics screening technique requires a qualified chemist with previous GC experience. An additional limitation encountered using the Photovac screening is the requirement of gaseous samples; therefore, headspace samples of a water matrix need to be prepared for analysis. The volatile organics screening has not been developed to screen soil samples.

CONCLUSION

The PNA screening method provides an order-of-magnitude estimate of total PNA concentration in soils, water and sediments. This determination allows the sampling effort to concentrate on and fully characterize contaminated areas and then focus off-site laboratory analyses on the most critical areas. The screening method is site-specific and should not be applied to other site investigations without laboratory investigation to provide recalibration and method validation.

The volatile organic screening technique can be used to determine concentrations of DCE, TCE and PCE compounds in water using head space analysis. In the past, both methods have been successfully implemented for on-site analysis. The volatile organics screening technique was used to analyze groundwater

samples to evaluate the vertical stratification of contaminants in municipal wells at an NPL site. The PNA screening technique was used to identify zones of contamination at an inactive wood treating site and will be implemented at an active wood treating site in the near future. Soil, sediment and water samples were analyzed during an on-site investigation; the data were used to make field decisions such as monitor well and test pit placement, and sample selection for off-site laboratory analysis.

Overall, these field screening techniques have been reliable, fast and cost-effective when used within their limitations and in concert with proper laboratory techniques and quality assurance/ quality control procedures.