SOIL REMEDIATION WORKPLAN

E. C. Buehrer & Associates, Inc.
1061 Eastshore Highway
Albany, California

Aegis Project No. 90-007

August 21, 1991

Prepared By:
AEGIS ENVIRONMENTAL, INC.
1050 Melody Lane, Suite 160
Roseville, California 95678
(916) 782-2110

TABLE OF CONTENTS

FIGURES

APPENDICES

1.0 INTRODUCTION

Aegis Environmental, Inc. (Aegis), presents this workplan to accomplish soil remediation at 1061 Eastshore Highway, Albany (Alameda County), California (Figure 1). The site is occupied by E. C. Buehrer & Associates, Inc.

1.1 Purpose

The purpose of this soil remediation workplan is to:

- Propose remediation of shallow soils containing petroleum hydrocarbons by excavation.

1.2 Scope

The proposed scope of work to accomplish soil remediation is summarized below:

- Abandon groundwater monitoring wells (wells) MW-1 through MW-4 prior to beginning excavation work.
- Remove approximately 80 cubic yards of wire-reinforced concrete from the area indicated on Figure 2.
- Excavate contaminated soil down to as near groundwater as possible (which is at an approximate depth of 3-½ feet).
- Collect representative soil samples from the sidewalls of the excavation. Submit the soil samples to a state-certified laboratory for analysis of petroleum hydrocarbons to document removal of contaminated soil.
- Stockpile excavated soil on site.
- Collect and submit representative soil samples from stockpiled soil for laboratory analysis. Characterize the soil for proper treatment and/or disposal, based on laboratory analytical data.
- Complete the backfilling of the excavation with approval from Alameda County Department of Environmental Health, Hazardous Materials Division.
- The excavation will be backfilled with a suitable fill material to achieve a 90 percent compaction rating and allow replacement of 6 inches of wire-reinforced concrete.
- Prepare and submit a factual report presenting the results of soil remediation.

2.0 BACKGROUND INFORMATION

2.1 Site Description

The occupant of the site, E. C. Buehrer, Inc., has leased the site from Bay Port Investors since 1964. The site facilities consist of two buildings. The large building along the western boundary of the site is utilized for offices (about 25 percent) and work bays for equipment repair (about 75 percent). The small building along the southern boundary of the site is utilized as a welding and machine shop, and includes a spray-painting booth. The site is constructed on fill material consisting of bay muds.

2.2 Site History

A 300-gallon underground storage tank (UST) containing waste-oil and a 1,000-gallon steel, single-wall, UST containing gasoline were excavated in February, 1988. Liquid sample analysis collected from the waste-oil tank excavation revealed nonpolar oil & grease was present at 17.0 parts-per-million (ppm).

Total petroleum hydrocarbons (TPH) as gasoline, were detected in the gasoline tank excavation sample at 2.0 ppm. A detailed site history is presented in the "Problem Assessment Report" (Aegis, July 9, 1991).

In April 1990, four wells were installed as part of Aegis' site assessment. The results of the investigation revealed TPH as gasoline in soil at concentrations up to 130 ppm and TPH as diesel at concentrations up to 900 ppm, both in well MW-4. Three chlorinated hydrocarbon compounds were detected at up to 5.6 ppm, also in soil in well MW-4. Details of the results are presented in the "(Hydrogeological Investigation Results Report" (Aegis, June 12, 1990).

In April 1991, nine soil borings were drilled on the site. Four of the soil borings were converted to monitoring wells (MW-5 through MW-8). The results of this work revealed a limited extent of TPH as gasoline and diesel in soil but oil & grease, and TPH as motor oil were found in all nine borings. Details of the results of this investigation are presented in, "Problem Assessment Report" (Aegis, July 9, 1991).

2.3 Adjacent Land Uses

The site is located in an industrial area of Albany, California, near the Berkeley city limits. Adjacent to the site's eastern boundary is an open area that was formerly occupied by an Alcan Aluminum Metals Plant. To the north exists an irrigation and plumbing supply business and to the south is a diesel-engine service and repair shop. Eastshore Highway is located to the west of the site, parallel to Interstate Highway 80.

2.4 Utilities

Underground utilities at the site were located prior to previous work performed. Three underground utility structures are located on the site. A storm sewer system runs north-south the length of the site in the driveway area east of the main building (Figure 2). A natural gas line runs north-south along the east edge of the site within 2 feet of a chain-link fence. A city sanitary sewer main runs north-south the length of the site immediately east of the storm drainage system.

3.0 SOIL REMEDIATION WORKPLAN

Aegis proposes to remediate contaminated soils at the site by excavating approximately to the depth at which groundwater occurs, about 3-½ feet below surface grade (Figure 2). This excavation will remove approximately 750 cubic yards of soil. Laboratory analysis of soil samples collected from excavation sidewalls will document removal of contaminated soils. Treatment and/or disposal of excavated soils will be accomplished by one of the remediation techniques presented in Section 3.1. All fieldwork will be done in accordance with the standard operating procedures presented in Appendix A. The following sections present details of Aegis' proposed workplan.

3.1 Soil Remediation Alternatives

The factors involved in selecting a remediation option include subsurface characteristics such as soil properties and depth to groundwater, site-specific constraints such as property size and location, time restrictions, and economic and technological limitations. The options include in-situ remediation or excavation with treatment and disposal (ex-situ), or excavation and direct disposal to an appropriate waste management unit. The following subsections discuss remediation alternatives for soil.

3.1.1 In-Situ Remediation

Several types of in-situ remediation technologies have been researched. Among them, in-situ bioremediation and vapor extraction or soil venting are the most common. These technologies require soils with relatively high permeability to air flow. In-situ bioremediation requires a time commitment of a minimum of several months as well. Vapor extraction is not effective for removal of heavy hydrocarbons such as diesel and motor oil, except over a very long term. The soil types beneath 1061 Eastshore Highway in Albany consist mainly of silts and clays, which have low permeabilities. Due to shallow groundwater, soil types and time constraints, in-situ vapor extraction and bioremediation are not considered viable remediation options for this site.

3.1.2 Ex-Situ Remediation

Treatment alternatives for excavated soils containing petroleum hydrocarbons include incineration, landfarming, and composting. Landfarming entails thin spreading and the use of microorganisms to achieve microbial degradation of organic pollutants. Composting entails applying a vacuum to a large pile of material to provide oxygen for biodegradation. Because of space and time constraints, landfarming and composting are not considered viable remediation options for this site.

The treatment and disposal methods proposed include thermal destruction by incineration, and direct disposal at a landfill. Laboratory analytical results of soil stockpile samples will determine which method of disposal will be employed. Soil will be segregated during excavation based on field screening. Incineration, if warranted, will be done by Port Costa Materials of Port Costa, California. Landfill disposal, if warranted, will be at BFI's Vasco Road Landfill in Livermore, California.

3.2 Excavation

Removal of Existing UST

Excavation is the most practical remediation alternative for this site. Excavation will follow the removal of the surface covering the area indicated on Figure 2. The surface consists of approximately 4 to 6 inches of wire-reinforced concrete. The concrete will be disposed of as inert construction material at an unclassified waste management unit (county landfill).

The excavation will not dislodge monitoring wells MW-5 or MW-8 because of their proximity to the site boundary. Groundwater monitoring can continue to be performed in these two wells and in wells MW-6 and MW-7. The excavation will also be directed away from the existing UST to avoid any disturbance of the tank or its product lines.

Soil will be excavated to a depth of approximately 3-½ feet over the proposed area shown on Figure 2. The extent of excavation was determined based on the results of two preliminary site assessments performed by Aegis, "Hydrogeological Investigation Results Report (Aegis, June 12, 1990) and "Problem Assessment Report" (Aegis, July 9, 1991).3.3 Segregation of Hydrocarbon-Impacted Soil

3.3 Segregation and Stockpiling of Excavated Soils

As soil is excavated, it will be screened with a photoionization detector and inspected visually. The soil will be segregated and stockpiled based on field screening so that soils with higher levels of petroleum hydrocarbon concentrations can be treated or disposed of separately from the soils with lower concentrations of hydrocarbon content.

Stockpiled soil will be placed within plastic sheeting, on site, until all analytical results are received and disposal facility acceptance is obtained. Representative soil samples will be collected from each stockpile and submitted to a state-certified analytical laboratory for composite analysis. Soil samples will be analyzed for TPH as gasoline, mineral spirits, diesel and motor oil, and for benzene, toluene, ethylbenzene, and xylenes (BTEX), oil & grease,and total lead. Selected samples will be analyzed for halogenated volatile organics. Additional analysis will be performed to fulfill the acceptance requirements of the waste management unit selected, as discussed in Section 3.4.

3.4 Required Laboratory Analysis For Soil Treatment and Disposal

In addition to analysis for TPH as gasoline and diesel, and BTEX, direct disposal to a landfill will require analysis of one representative soil sample for compliance with the Resource Conservation and Recovery Act (RCRA). The analyses include the determination of the solubility threshold limit concentration (STLC) of lead by the Waste Extraction Test (WET), and reactivity, ignitability, and corrosivity.

Disposal for off site incineration will require TPH definition by analysis for TPH as gasoline, diesel and motor oil, and BTEX. The limit for TPH as gasoline is 1,000 and 30,000 ppm for diesel and oil & grease. Analysis for CAM 17 metals as persistent and bioaccumulative toxic substances (Title 22) will be required for the determination of the total threshold limit concentration (TTLC). If the TTLC of any of the CAM 17 metals is greater than 10 times the STLC limit for that metal, the STLC must be determined and laboratory certification that no Hazardous Materials are present above Title 22 limits will be required.

3.5 Grading Permit Requirements

The general engineering contractor retained by Aegis to excavate soils and backfill the excavation will be responsible for obtaining any grading permits required by local agencies.

3.6 Monitoring Well Abandonment

Monitoring wells MW-1 through MW-4 will be abandoned to the surface prior to excavation of the site. The wells will be abandoned by removing the PVC casing and drilling out the filter pack material. Then a Portland cement/bentonite grout mixture will be pumped to the well bottoms (a depth of approximately 10 feet), through a tremie??? pipe, until the well boring is filled.

4.0 SCHEDULE

Aegis will proceed with the work outlined in this plan when approval is obtained from the Alameda County Health Care Services Department of Environmental Health. Excavation and stockpiling of contaminated soil can proceed within two weeks of regulatory approval. A results report will be submitted to the involved parties and regulatory agencies approximately one month after laboratory analytical results are obtained.

5.0 REMARKS/SIGNATURES

The interpretations and opinions contained in this workplan represent our professional opinions. These opinions are based on currently available information, and were developed in accordance with currently accepted hydrogeologic and engineering practices at this time and for this location. Other than this, no warranty is implied or intended.

AEGIS ENVIRONMENTAL, INC.

Larry Braybrooks
Project Geologist

William E. Stein
Registered Engineer
#C26043

Date

LB/WES/law

6.0 REFERENCES

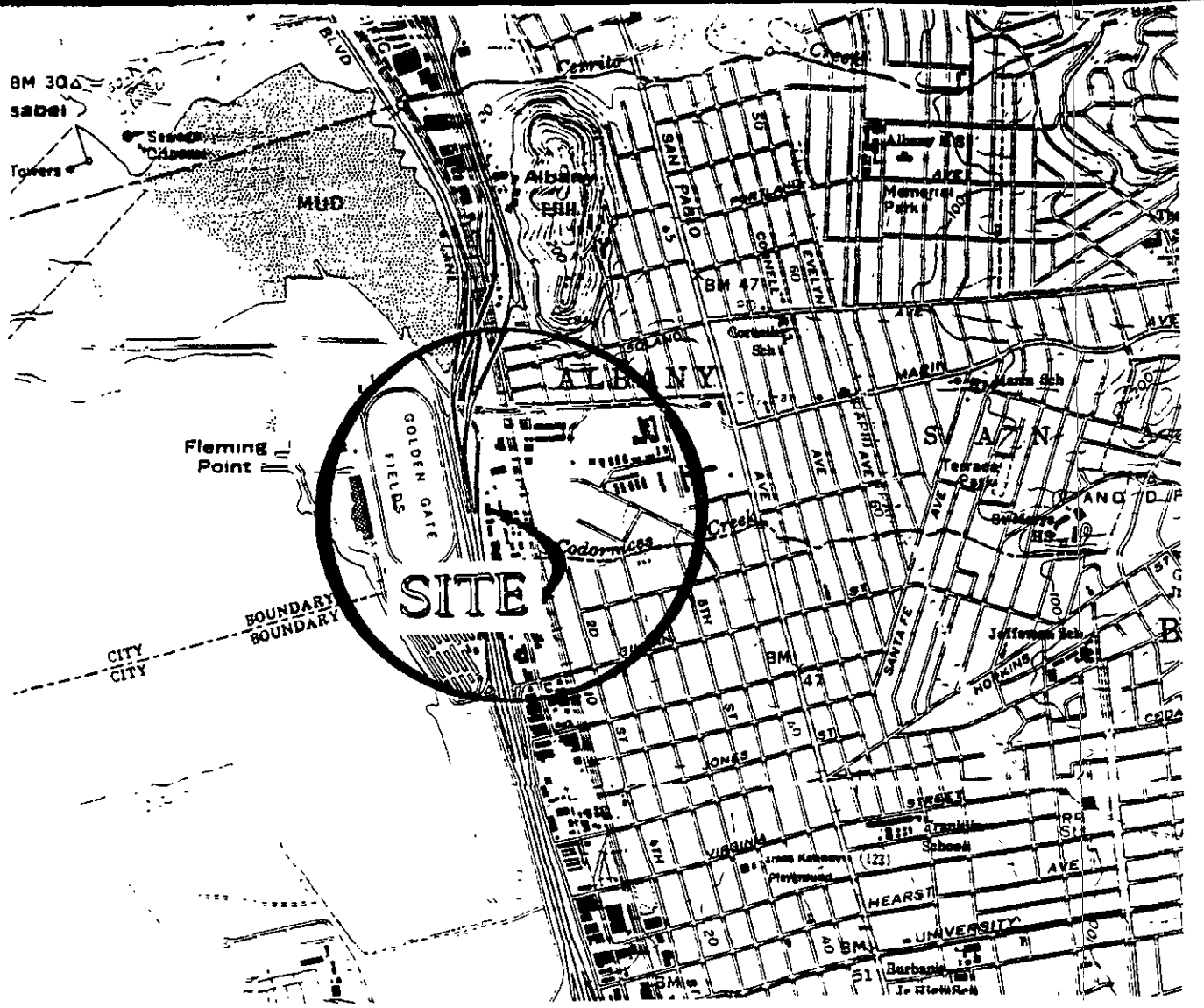
Hydroleogical Investigation Results Report, Aegis Environmental, Inc., June 12, 1990.

Problem Assessment Report, Aegis Environmental, Inc., July 9, 1991.

"Innovative Techniques for the Bioremediation of Contaminated Soil", Mr. Joseph Mathewson, Protek Environmental, Inc.

Wallace & Kuhl, 1989, untitled document.

FIGURES



SCALE: 1"= 2,000'

0 2,000

GENERAL NOTES:

BASE MAP FROM USGS 7.5 MINUTE TOPOGRAPHIC RICHMOND & OAKLAND WEST, CA.

CALIF

FIGURE 1
SITE LOCATION MAP
E. C. Buehrer Associates, Inc.
1061 Eastshore Highway
Albany, Ca.

AEGIS Job Number 90-007

DRAWN BY: Ed Bernard DATE: April 8,1991
REVIEWED BY: L Braybrooks DATE: April 14,1991

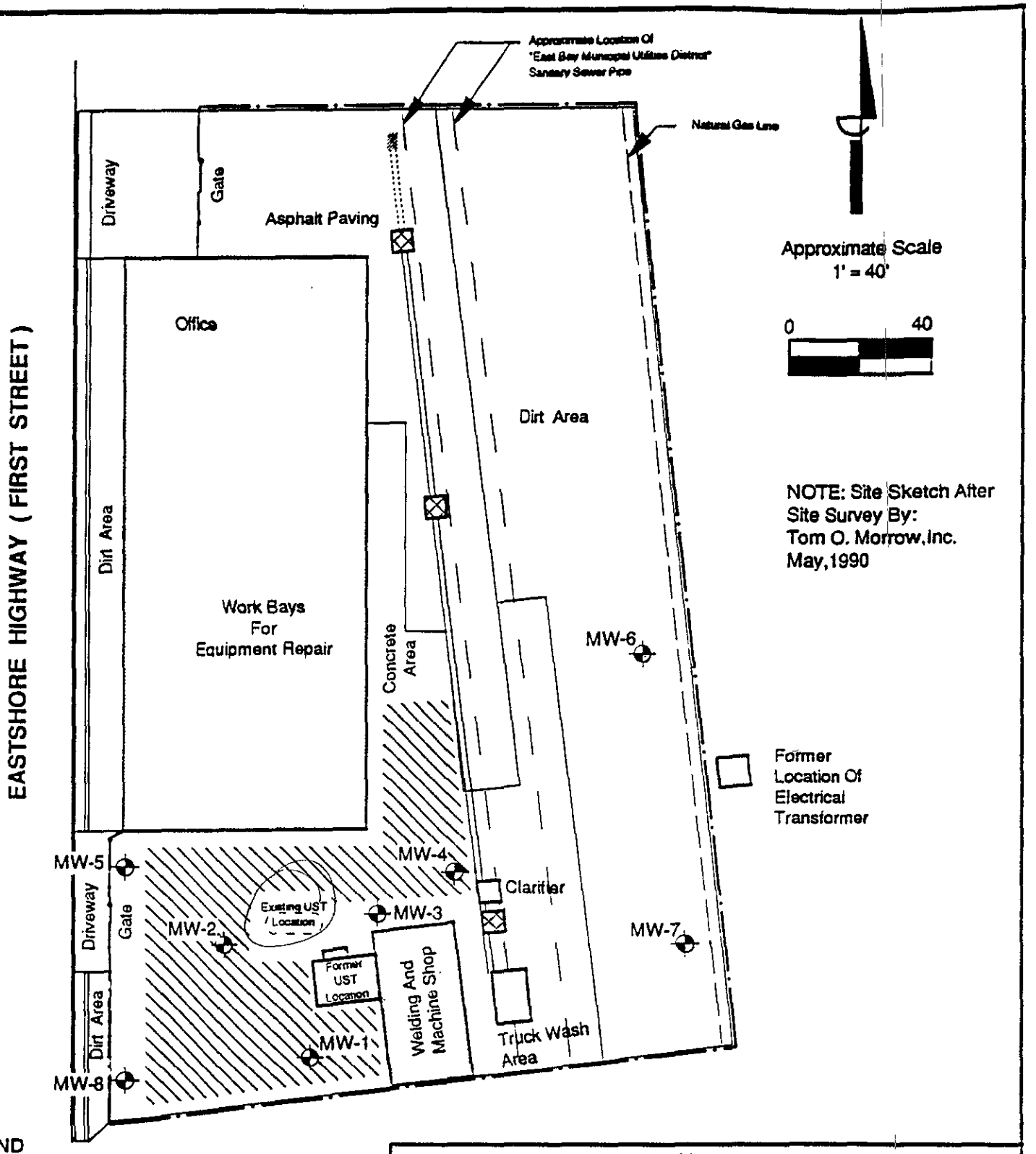


FIGURE 2
SITE MAP
E. C. Buehrer Associates, Inc.
1061 Eastshore Highway
Albany, Ca.

AEGIS Job Number 90-007

DRAWN BY: Dennis Hada **DATE:** July 26, 1991

REVIEWED BY: [signature] **DATE:** 7/26/91

APPENDIX A

STANDARD OPERATING PROCEDURES

AEGIS ENVIRONMENTAL, INC.
STANDARD OPERATING PROCEDURES
RE: SOIL EXCAVATION AND SAMPLING
SOP-2

Excavation and subsequent soil sampling is performed under the direction of a registered geologist or civil engineer. To reduce the potential for cross-contamination, all excavation equipment are either steamed cleaned or washed prior to use and between excavations. Soil samples for chemical analysis are collected in cleaned, thin-walled brass tubes, 6-inches long by 2 inches outside-diameter. If used, one tube may be set in a 2-inch inside diameter hand-driven sampler. To reduce the potential for cross-contamination between samples, the sampler is washed in a solution of trisodium phosphate and doubly rinsed between each sampling event.

Upon recovery, a portion of the soil sample is sealed for later screening with either a portable photoionization detector (PID), flame ionization detector or an explosimeter. Another portion of the sample is used for description of the excavated materials. A third portion of the sample is hermetically sealed, labeled and refrigerated for delivery, under strict chain-of-custody, to the analytical laboratory. These procedures minimize the potential for cross-contamination and volatilization of volatile organic compounds prior to chemical analysis.

AEGIS ENVIRONMENTAL, INC.
STANDARD OPERATING PROCEDURES
RE: SOIL CLASSIFICATION
SOP-3

Soil samples are classified according to the Unified Soil Classification System (USCS). Representative portions of the samples may be shipped under strict chain-of-custody to an analytical laboratory for further examination and verification of the in-field classification, and analysis of soil mechanical and/or petrophysical properties. The soil types are indicated on logs of either excavations or borings together with depths corresponding to the sampling points, and other pertinent information.

AEGIS ENVIRONMENTAL, INC.
STANDARD OPERATING PROCEDURES
RE: SAMPLE IDENTIFICATION AND CHAIN-OF-CUSTODY PROCEDURES
SOP-4

Sample identification and chain-of-custody procedures ensure sample integrity, and document sample possession from the time of collection to its ultimate disposal. Each sample container submitted for analysis is labeled to identify the job number, date, time of sample collection, a sample number unique to the sample, any in-field measurements made, sampling methodology, name(s) of on site personnel and any other pertinent field observations also recorded on the field excavation or boring log.

Chain-of-custody forms are used to record possession of the sample from time of collection to its arrival at the laboratory. During shipment, the person with custody of the samples will relinquish them to the next person by signing the chain-of-custody form(s) and noting the date and time. The sample-control officer at the laboratory will verify sample integrity, correct preservation, confirm collection in the proper container(s) and ensure adequate volume for analysis.

If these conditions are met, the samples will be assigned unique laboratory log numbers for identification throughout analysis and reporting. The log numbers will be recorded on the chain-of-custody forms and in the legally-required log book maintained in the laboratory. The sample description, date received, client's name and any other relevant information will also be recorded.

AEGIS ENVIRONMENTAL, INC.
STANDARD OPERATING PROCEDURES
RE: LABORATORY ANALYTICAL QUALITY ASSURANCE AND CONTROL
SOP-5

In addition to routine calibration of the analytical instruments with standards and blanks, the laboratory analyst is required to run duplicates and spikes on 10 percent of the analyses to insure an added measure of precision and accuracy. Accuracy is also verified through the following:

1. U.S. Environmental Protection Agency (EPA) and State certification programs;

2. Participation in an inter-laboratory or "round-robin" quality assurance program;

3. Verification of results with an alternative method. For example, calcium may be determined by atomic absorption, ion chromatography, or titrimetric methods. Volatile organic compounds may be determined through either purge and trap or liquid-liquid extraction methods; and,

4. Miscellaneous checks of equipment accuracy. Where trace analysis is involved, purity of the solvents, reagents and gases employed is of great concern. The laboratory maintains a service contract on all major instrumentation, including gas chromatograph, atomic absorption, ion chromatography and total organic carbon analyzers. Each of these instruments are serviced and maintained regularly.

APPENDIX B

SITE HEALTH AND SAFETY PLAN

FIELD INVESTIGATION TEAM
SITE HEALTH AND SAFETY PLAN

A. GENERAL INFORMATION

Client: E. C. Buehrer, Inc. Aegis Project Number: 90-007

Site Name: E. C. Buehrer, Inc. Client Project Number: N/A

Street Address: 1061 Eastshore Highway, Albany, CA

Plan Prepared by: Gail Small Date: 07/15/91

Approved by: Larry Braybrooks Date:

Revised by: Date:

Revision Approved by: Date:

Objectives:

Phase I -

Phase II -

Phase III - Remediation of soil contamination by excavation.

Proposed Date of Investigation: August 19, 1991

Hazard Summary/Level of Protection

A:_____ B:_____ C:_____ D:_____(with modifications)

B. SITE/WASTE CHARACTERISTICS

Waste/Contaminant Type(s): ___Liquid __X_Soil___Solid___Sludge Gas

Characteristic(s): ___ Corrosive____Ignitable____Radioactive
__X_ Volatile ____Toxic ____Reactive
____ Unknown ____Other (Name):

Contaminant Source (type and location):

Various - USTs containing waste-oil and unleaded gasoline, off site sources of diesel and oil are suspect.

Surrounding Features (residences, power lines, terrain, surface water bodies, etc.):

Industrial area; a storm sewer system runs north-south along the length of the site east of the main building; a natural gas line runs north-south along the easte edge of the property boundary; a city sanitary sewer main runs north-south the length of the site immediately east of the storm sewer system.

Status (active,inactive,unknown): active

History (worker or non-worker injury; complaints from public; previous agency action):

On February 18m, 1988, a 300-gallon steel, single-wall, underground waste-oil tank and a 1,000-gallon steel, single-wall, underground gasoline storage tank were excavated and removed from the site. The tanks were removed by Willis Brothers Excavating, Pacheco, California. Reportedly, in December 1987, the 300-gallon waste-oil tank failed a prevision tank test. The failed test, in part, prompted the decision to remove the waste-oil tank. According to file documents, the 1,000-gallon gasoline storage tank had not been in use for the previous 2 to 3 years so the site operators decided to remove it along with the waste-oil tank. A 1,000-gallon single-wall underground gasoline tank is still in use at the site (Figure 2).

C. HAZARD EVALUATION

Have all contaminants been identified that may be present on site?
Yes__X__ No_____

List all chemicals below that have been identified or are suspected on site and their maximum concentrations in soil/water. Information on hazardous properties are listed in the appendix. For chemicals not shown in the appendix, enter the hazardous property information in the spaces provided.

Chemical Name	Maximum Concentration: In Soil	In Water
Benzene	0.012	0.0075
Toluene	0.120	0.0018
Ethylbenzene	0.0052	0.0006
Xylenes	0.018	0.001
Chromium	69.0	NA
Lead	38.0	NA
Zinc	520	NA
TPH (diesel)	900.0	0.480
TPH (gasoline)	130.0	150.0
TPH (motor oil)	280.0	700.0
TPH (mineral spirits)	<10.0	0.150
TOTAL OIL & GREASE	2,400	<5.0
NON-POLAR OIL & GREASE	730	<5.0
1,1-dichloroethane	0.0056	0.00049
Tetrachloroethene	0.0046	ND
Trichloroethene	0.004	ND
Chloroethane	ND	0.0009
Aroclor 1254 (PCB)	300	NA
Aroclor 1260 (PCB)	0.066	NA

(ppm) = parts per million
NA = Not analyzed

Free product present? _____ Yes __X__ No

Type of product present: _____ Leaded __X__ Unleaded __X__ Diesel

D. SITE SAFETY WORK PLAN

PERSONNEL

Team Member	Title	Responsibility
Larry Braybrooks	Project Geologist	Site Coordinator
Larry Braybrooks	Project Geologist	Site Safety Officer

PERIMETER ESTABLISHED

Map/Sketch Attached?	Yes X	No___
Site Secured?	Yes X	No___
Perimeter Identified?	Yes X	No___
Contamination zones identified? line defined?	Yes___	No X
Free Product?	Yes___	No X
Dissolved Product?	Yes X	No___

INVESTIGATION-DERIVED MATERIAL DISPOSAL:

Soil and water from investigative activities will be stockpiled and stored on site until analyses are available to document the concentrations and contaminants. Soil stockpiled on site will be contained within plastic sheeting. Material removed from the site will be disposed of in accordance with existing regulation and guidelines.

D1. PERSONAL SAFETY

SITE ENTRY PROCEDURES:

PERSONNEL PROTECTION:

Level of protection: A_____ B_____ C_____ D__X__

Modifications:

1. All personnel must wear hard hat, safety shoes, safety glasses and/or face shield.
2. Neoprene gloves and tyvek/saranax suit should be worn if contact with contaminated water or soil is likely.
3. Hearing protection must be worn if noise levels prevent normal conversation at a distance of three feet. No smoking, eating, or drinking is allowed on site.
4. Respiratory protection is dependent on conditions listed in next section.
5. No personnel are to enter or approach any excavation area where there is a danger of wall collapse or confined space entry.

Surveillance Equipment and Materials:

Instrumentation	Action Level	Action
photoionization detector (hNu)	5 units or 5 times background (breathing zone)	use halfmask respirator with organic cartridges
	1000 ppm	eliminate all ignition sources, leave site until levels are reduced
oxygen meter	<19. 5% oxygen	do not enter area or confined space until levels are reduced.
explosimeter	>10% LEL	eliminate all ignition sources
	>20% LEL	reduce levels immediatly or leave site.

First Aid Equipment: Standard first aid kit, portable eye wash.

First Aid Procedures:

Ingestion: DO NOT induce vomiting, summon medical help.
Inhalation: Move victim to fresh air, seek medical attention if needed.
Dermal Exposure: Remove contaminated clothing, flush with water.

DECONTAMINATION PROCEDURE:

Personnel: Flush exposed skin with soap and water.

WORK LIMITATIONS:(time of day, weather, heat/cold stress):

In high ambient temperatures, follow heat-stress precautions: Provide plenty of cool water and electrolytes (e.g., Gatorade), remove protective clothing during breaks; check resting pulse and increase number of breaks if pulse does not return to normal during work break.

In cold ambient temperatures (<0°F.), follow hypothermia precautions. Work may only progress during daylight hours or under conditions of adequate lighting.

ELECTRICAL HAZARDS:

Will be located by U.S.A. before drilling.

Maintain at least 10 feet clearance from overhead power lines. If unavoidably close to overhead or buried power lines, turn power off and lockout circuit breaker. Avoid standing in water when operating electrical equipment.

CONFINED SPACES:

Monitor organic vapors and oxygen before entering. If the following values are exceeded, do not enter.

1. Oxygen < 20.0%.

2. Total hydrocarbons > 5 ppm above background, if all air contaminants have not been identified.

3. Concentrations of specific air contaminants exceeding action levels in Section D, if all air contaminants have been identified.

If entering a confined space, monitor oxygen and organic vapors continuously.

AGENCIES CONTACTED IN UNDERGROUND UTILITY SEARCH:

Underground Service Alert

E. EMERGENCY INFORMATION

LOCAL TELEPHONE NUMBERS (provide area codes):

Ambulance	911
Hospital Emergency Room	415-540-1303 Alta Bates Hospita
Poison Control Center	1-800-523-2222
Fire Department	911 or 644-6161
Airport	415-577-4000 Oakland International
Explosives Unit	911

SITE RESOURCES:

Water supply available on site:	Yes X	No ____
Telephone available on site:	Yes X	No ____
Bathrooms available on site:	Yes X	No ____
Other resources available on site:	Yes ____	No X

If yes, identify:

If you answered "no" to any of the above questions, identify the closest available facility, and provide directions.

EMERGENCY CONTACTS	PHONE NO.
1. Project Manager: Larry Braybrooks	(916) 782-2110
2. Health and Safety Officer: Douglas Sheeks	(916) 782-2110
4. Site Contact: Clayton Johnson or Neil Hamre	(415) 527-1161
5. Regulatory Contact: Alameda County	(415) 271-4320

F. EMERGENCY ROUTES

(Give name address, telephone number, directions, distance and time estimate, and map.)

HOSPITAL: Alta Bates

From Eastshore Highway, go left (east) on Gilman, take Gilman to San Pablo (8 blocks). Turn right on San Pablo (south), follow to Ashby. Turn left on Ashby (east) and follow to Colby Street. Colby Street is between Telegraph Avenue and College Avenue. Hospital is at 3001 Colby Street. Distance is approximately 5.5 miles. Travel time is approximately 10 minutes.

OTHER:

G. HAZARD EVALUATION

PARAMETER	TLV (ppm)	OT (ppm)	IDLH (ppm)	VOLATILITY	SKIN HAZARD	EXPLOSIVITY
Benzene	0.1	4	2,000	H	L	H
Ethylbenzene	100	NS	2,000	M	L	H
Toluene	100	2	2,000	M	L	H
Xylene	100	<1	10,000	H	M	H
Gasoline	300	NS	NS	H	L	H

KEY: TLV = Threshold Limit Value (Worker - 8 Hours)
OT = Odor Threshold
DLH = Immediately Dangerous to Life and Health
NS = None Specified
NR = Not Reported
H = High
M = Medium
L = Low
U = Unknown

APPENDIX A: HAZARDOUS PROPERTY INFORMATION
Explanations and Footnotes

Water solubility is expressed in different terms in different references. Many references use the term "insoluble" for materials that will not readily mix with water, such as gasoline. However, most of these materials are water soluble at the part per millon or part per billion level. Gasoline for example, is insoluble in the gross sense, and will be found as a discreet layer on top of the ground water. But certain gasoline constituents, such as benzene, toluene, and xylene will also be found in solution in the ground water at the part per millon or part per billion level.

A. Water solubility expressed as 0.2g means 0.2 grams per 100 grams water at 20°C.

B. Solubility of metals depends on the compound in which they are present.

C. Several chlorinated hydrocarbons exhibit no flash point in conventional sense, but will burn in presence of high energy ignition source or will form explosive mixtures at temperatures above 200°F.

D. Practically non-flammable under standard conditions.

E. Expressed as mm Hg under standard conditions

F. Explosive concentrations of airborne dust can occur in confined areas.

G. Values for Threshold Limit Value - Time Weighted Average (TLV-TWA) are OSHA Permissible Exposure Limits (PEL) except where noted in H. and I.

H. TLV - TWA adopted by the American Conference of Government Industrial Hygienists (ACGIH) which is lower than the OSHA PEL.

I. TLV - TWA recommended by the National Institute for Occupational Safety and Health (NIOSH). A TLV or PEL has not been adopted by the ACGIH or OSHA.

J. A. - Corrosive
B. - Flammable
C. - Toxic
D. - Volatile
E. - Reactive
F. - Radioactive
G. - Carcinogen
H. - Infectious
K. Dermal Toxicity data is summarized in the following three categories:

Skin penetration

A - negligible penetration (solid-polar)
B - slight penetration (solid-nonpolar)
C - moderate penetration(liquid-nonpolar)
D - high penetration (gas/liquid-nonpolar)

Systemic Potency

E - slight hazard - LD_{50} = 500-15,000 mg/kg
lethal dose for 70 kg man = 1 pint-1 quart
F - moderate hazard - LD_{50} = 50-500 mg/kg
lethal dose for 70 kg man = 1 ounce-1 pint
G - extreme hazard - LD_{50} = 10-50 mg/kg
lethal dose for 70 kg man = drops to 20 ml

Local Potency

H - slight - reddening of skin
I - moderate - irritation/inflammation of skin
J - extreme - tissue destruction/necrosis

1. Acute Exposure Symptoms

A - abdominal pain
B - central nervous system depression
C - comatose
D - convulsions
E - confusion
F - dizziness
G - diarrhea
H - drowsiness
I - eye irritation
J - fever
K - headache
L - nausea
M - respiratory system irritation
N - skin irritation
O - tremors
P - unconsciousness
Q - vomiting
R - weakness

HAZARDOUS PROPERTY INFORMATION - FUELS

Material	Water[a] Solubility	Specific Gravity	Vapor Density	Flash Point °F	Vapor[b] Pressure	LEL UEL	LD_{50} mg/kg	TLV-TWA[c]	IDLH Level	Odor Threshold or Warning Concentration	Hazard[d] Property	Dermal[e] Toxicity	Accute[f] Exposure Symptoms
Diesel Fuel	insoluble	0.81-0.90	---	130	---	0.6-1.3 6.0-7.5		none established	NE	0.008 ppm	BCD	CI	BCEFHIKL MNP
Gasoline	insoluble	0.72-0.76	3-4	-45	variable	1.4% 7.6%		300 ppm	NE	< 1 ppm	BCDG	CI	BCEFHIKL MNP
Kerosene	insoluble	0.83-1.0	---	100-165	5	0.7% 5.0%		none established	NE	0.008 ppm	BCD	CI	BCEFHIKL MNP

HAZARDOUS PROPERTY INFORMATION - VOLATILE ORGANIC PRIORITY POLLUTANTS

Material	Water[a] Solubility	Specific Gravity	Vapor Density	Flash Point °F	Vapor[b] Pressure	LEL UEL	LD_{50} mg/kg	TLV-TWA[c]	IDLH Level	Odor Threshold or Warning Concentration	Hazard[d] Property	Dermal[e] Toxicity	Accute[f] Exposure Symptoms
Acrolein	22%	0.8410	1.9	-15	214 mm	2.8% 31.0%	46	0.1 ppm	5 ppm	0.1-16.6 (0.21-0.5)	BCED	BJ	ABDFGHIK LMNOPQR
Acrylonitrile	7.1%	0.8060	1.8	30	83 mm	3.0% 17.0%	82	2.0 ppm	4,000 ppm	19-100	BCEGD	DIG	FGIKLMNQ R
Benzene	820 ppm	0.8765	2.8	12	75 mm	0.339% 7.1%	3800	10.0 ppm	2,000 ppm	4.68	BCGD	CIG	BCDFHIKL MNOQR
Bromomethane	0.1 g	1.732	3.3	none	1.88 atm	13.5% 14.5%		5.0 ppm	2,000 ppm	no odor	CD		BCDEIJKL MNOQR
Bromodichloromethane	insoluble	1.980	--	none	n/a	non-flam.	916	none established	none specified		CGD		BIMN
Bromoform	0.01 g	2.887	--	none	5 mm	non-flam.	1147	0.5 ppm	n/a	530	CED		BCDKMN
Carbon Tetrachloride	0.08%	1.5967	5.3	none	91 mm	non-flam.	2800	5.0 ppm	300 ppm	21.4-200	CD	JGH	ABCFGHKN Q
Chlorobenzene	0.01 g	1.1058	3.9	84	8.8 mm	1.3% 9.6%	2910	75.0 ppm	2,400 ppm	0.21-60	BCD	CIF	BCFIKLMN OPQR
Chloroethane	0.6 g	0.8978	2.2	-58	1.36 atm	3.8% 15.4%		1000.0 ppm	20,000 ppm		BCD		BFHIKMNP
2-Chloroethylvinyl Ether	insoluble	1.0475	3.7	80	30 mm	--	250	none established	none specified		BCD		HIM
Chloroform	0.8 g	1.4832	4.12	none	160 mm	non-flam.	800	10.0 ppm	1,000 ppm	50-307 fatigue (>4096)	CD		BCEGIKLM N
Chloromethane	0.74%	0.9159	1.8	32	50 atm	7.6% 19.0%		50.0 ppm	10,000 ppm	10-100 no odor (500-1000)	BCD	DHF	ABCDEFGI JKLOQR
Dibromochloromethane	insoluble	2.451	--	--	--	--	848	none established	none specified		BCD		BFHIMNPQ

HAZARDOUS PROPERTY INFORMATION - VOLATILE ORGANIC PRIORITY POLLUTANTS (CONTINUED)

Material	Water[A] Solubility	Specific Gravity	Vapor Density	Flash Point °F	Vapor[I] Pressure	LEL UEL	LD_{50} mg/kg	TLV-TWA[C]	IDLH Level	Odor Threshold or Warning Concentration	Hazard[J] Property	Dermal[K] Toxicity	Accute[L] Exposure Symptoms
1,1-Dichloroethane (DCA)	0.1 g	1.1757	8.4	22	182 mm	6.0% 16.0%	725	100.0 ppm	4,000 ppm	5 ppm	BCD		ABHIMNO
1,2-Dichloroethane	0.8%	1.2554	3.4	55	87 mm	6.2% 16.0%	670	10.0 ppm[H]	1,000 ppm	6 ppm	BCDG		BCFGLMNQ
1,1-Dichloroethylene (DCE)	2250 mg/l @ 77°F	--	3.4	3	591 mm	7.3% 16.0%	200	5.0 ppm[H]	none specified		BCD		BIMN
Trans-1,2-Dichloroethylene	slightly soluble	1.2565	--	36	400 mm	9.7% 12.8%		none established	none specified	.0043 mg/l	BCD		ABFILOQ
1,2 Dichloropropane	0.26%	1.1583	3.9	60	40 mm	3.4% 14.5%	1900	75.0 ppm	2,000 ppm	50	BCD		ABGHIKMN Q
Cis-1,3-Dichloropropane	insoluble	1.2	3.8	83	28 mm	5.0% 14.5%	250	1.0 ppm[H]	none specified		BCD		ABGHIKLM NP
Trans-1,3-Dichloropropane	insoluble	1.2	3.8	83	28 mm	5.0% 14.5%		1.0 ppm[H]	none specified		BCD		ABGHIKLM NP
Ethylbenzene	0.015 g	0.867	3.7	59	7.1 mm	1.0% 6.7%	3500	100.0 ppm	2,000 ppm	0.25-200 (200)	BCD	CIF	ABFHIKLM NPQR
Methylene Chloride	slightly soluble	1.335	2.9	none	350 mm	12.0%[C] unavailable	167	100.0 ppm[H]	5,000 ppm	25-320 (5000)	CED	CIF	BCIKLMNP R
1,1,2,2-Tetrachloroethane	0.19%	1.5953	5.8	none	5 mm	non-flam.		1.0 ppm[H]	150 ppm	3-5	CD		ABCFHIKL MNOQ
Tetrachloroethylene	0.15 g/ml	1.6227	5.8	none	15.8 mm	non-flam.	8850	50.0 ppm[H]	500 ppm	4.68-50 (160-690)	CD		ACFHIKLM NP
1,1,1-Trichloroethane (TCA)	0.07 g	1.3390	4.6	none	100 mm	8.0%[C] 10.5%	10300	350.0 ppm	1,000 ppm	20-400 (500-1000)	BCED		ABEFHIKL NOP
1,1,2-Trichloroethane	0.45	1.4397	4.6	none	19 mm	6.0%[C] 15.5%	1140	10.0 ppm	500 ppm	0	C		BEFGHIKL MNOPQ

HAZARDOUS PROPERTY INFORMATION - VOLATILE ORGANIC PRIORITY POLLUTANTS (CONTINUED)

Material	Water[a] Solubility	Specific Gravity	Vapor Density	Flash Point °f	Vapor[a] Pressure	LEL UEL	LD_{50} mg/kg	TLV-TWA[c]	IDLH Level	Odor Threshold or Warning Concentration	Hazard[b] Property	Dermal[a] Toxicity	Accute[a] Exposure Symptoms
Trichloroethylene (TCE)	0.1%	1.4642	4.5	90	58 mm	12.5% 90.0%	4920	50.0 ppm[n]	1,000 ppm	21.4-400	BC		BFKLNOPQ
Trichlorofluoromethane	0.11 g	1.494	--	none	0.91 atm	non-flam.		1000.0 ppm	10,000 ppm	135-209	CD		BFHKLQ
Toluene	0.05 g	0.866	3.2	40	22 mm	1.3% 7.1%	5000	100.0 ppm	2,000 ppm	0.17-40 fatigue (300-400)	BC	BHE	BEFHIKLM NOPQ
Vinyl Chloride	negligible	0.9100	2.24	-108	3.31 atm	3.6% 33.0%	500	1.0 ppm	none specified	260	BCEG	DJG	ABFHIKLN-R

HAZARDOUS PROPERTY INFORMATION - HEAVY METALS

Material	Water* Solubility	Specific Gravity	Vapor Density	Flash Point °f	Vapor* Pressure	LEL UEL	LD_{50} mg/kg	TLV-TWA*	IDLH Level	Odor Threshold or Warning Concentration	Hazard* Property	Dermal* Toxicity	Acute* Exposure Symptoms
Arsenic	B	5.727	n/a	none	n/a	F		10.0 ug/m³	none specified		CEG	CJG	ACDGJLMO QR
Beryllium	B	1.85	n/a	none	n/a	F		2.0 ug/m³	none specified		C		IJMNR
Cadmium	B	8.642	n/a	none	n/a	F	225	0.5 mg/m³	40/mg³		C		ABGIKLMN QR
Chromium	B	7.20	n/a	none	n/a	F F		0.5 mg/m³	500/mg³				FMNQ
Copper	B	8.92	n/a	none	n/a	F		0.1 mg/m³	none specified		C		FGIJLMOQ R
Lead	B	11.3437	n/a	none	n/a	F		50.0 ug/m³	none specified		C		ACDFGOQR
Mercury	B	13.5939	7.0	none	0.0012 mm	F		50.0 ug/m³	28 mg/m³		C		AGLMNQ
Nickel	B	8.9	n/a	none	n/a	F		1.0 mg/m³	none specified		C		DGJLMNQ
Silver	B	10.5	n/a	none	n/a	F		0.01 mg/m³	none specified		C		IN
Thallium	B	11.85	n/a	none	n/a	F		0.1 mg/m³	20 mg/m³		C	BG	ADGLNOQ
Zinc	B	7.14	n/a	none	n/a	F		none established	none specified		C		DF

HAZARDOUS PROPERTY INFORMATION - MISCELLANEOUS

Material	Water[a] Solubility	Specific Gravity	Vapor Density	Flash Point °F	Vapor[f] Pressure	LEL UEL	LD_{50} mg/kg	TLV-TWA[c]	IDLH Level	Odor Threshold or Warning Concentration	Hazard[d] Property	Dermal[e] Toxicity	Accute[f] Exposure Symptoms
Acetone	soluble	0.8	2.0	-4	400 mm	2.5% 12.8%	9750	750 ppm	10,000 ppm	100	BCD	DI	N
Asbestos	insoluble	2.5	n/a	none	n/a	non-flam.		0.2-2 fibers/cc	none specified		CG		MN
Chromic Acid	soluble	1.67-2.82	n/a	none	n/a	non-flam.		none established	none specified		ACEG		GIN
Cyanides	58-72%		n/a	none	n/a	non-flam.		5 mg/m^3	50 mg/m^3		CE		FKLNPQ
PCB (Generic)	slightly soluble	--	n/a	none	n/a	non-flam.		1.0 ug/m^3[f]	none specified		CG		CHLPQ
Phenol	8.4%	1.0576	3.2	175	0.36 mm	1.8% 8.6%	414	5 ppm	100 ppm	0.047-5 (48)	C		ABCDGIKM NOQ
Xylene	0.00003%	0.8642	3.7	84	9.0 mm	1.1% 7.0%	5000	100 ppm	10,000 ppm	0.5-200 (200)	BCD		ABFHIKLM NPQ