

**SITE CHARACTERIZATION/
ASSESSMENT PROPOSAL
FOR
PARKING GARAGE
AT
1432 HARRISON STREET
OAKLAND, CALIFORNIA**

Submitted to:

Alameda County Health Care Services Agency
Hazardous Materials Program
Department of Environmental Health (ACDEH)
80 Swan Way, Room 200
Oakland, California 94621

Submitted by:

SCS Engineers
6761 Sierra Court, Suite D
Dublin, California 94568

February 15, 1991

File No. 0390044.00

SCS ENGINEERS

February 15, 1991
File No. 0390044.00

Alameda County Health Care Services
Division of Hazardous Materials
Department of Environmental Health (ACDEH)
80 Swan Way, Room 200
Oakland, California 94621

Attention: Mr. Paul Smith

Subject: Site Characterization/Assessment Proposal
for Oakland Parking Garage
at 1432 Harrison Street
Oakland, California 94612

Dear Mr. Smith:

SCS Engineers (SCS) is pleased to offer this work plan for a site characterization/assessment at the above mentioned parking garage for your review. The attached work plan is consistent with the Regional Water Quality Control Board (RWQCB) "Staff recommendations for initial evaluation and investigation of underground tanks" and contains the following elements:

- Introduction
- Site Description
- Plan for Determining Soil Contamination
- Plan for Determining Groundwater Contamination
- Site Safety Plan


As you know, previous reports have disclosed various areas of contamination and abandoned underground storage tanks at the above site. This work plan is to further define the nature and extent of soil and groundwater contamination, and to determine actual number of underground storage tanks or other sources of contamination.

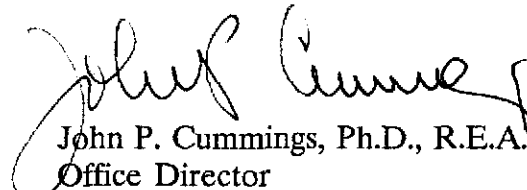
This work plan has been prepared in accordance with the care and skill generally exercised with reputable professionals, under similar circumstances, in this or similar localities.

Mr. Paul Smith
February 15, 1991
Page Two

SCS Engineer appreciates the opportunity to provide you with these environmental services. If you have any questions, please contact either of the undersigned at (415) 829-0661.

Sincerely,


Nels R. Johnson, P.E.
Senior Project Engineer
SCS Engineers


John P. Cummings, Ph.D., R.E.A., R.E.P.
Office Director
SCS Engineers

NRJ/JPC/egh

Attachment

CONTENTS

1.0 INTRODUCTION

2.0 SITE DESCRIPTION

3.0 PLAN FOR DETERMINING SOIL CONTAMINATION

4.0 PLAN FOR DETERMINING GROUNDWATER CONTAMINATION

PLATE 1: VICINITY MAP

PLATE 2: SITE MAP

PLATE 3: PROPOSED MONITORING WELLS

PLATE 4: "SUBSURFACE CONSULTANTS" Preliminary Investigation Results

PLATE 5: TYPICAL MONITORING WELL

PLATE 6: CHAIN-OF-CUSTODY FORM

PLATE 7: HAZARDOUS WASTE MANIFEST

APPENDIX 1: SITE SAFETY PLAN

APPENDIX 2: RESUMES

APPENDIX 3: STATEMENT OF QUALIFICATIONS (Separate Cover)

1.0 INTRODUCTION

On January 25, 1991, Mr. Paul Smith with the Hazardous Materials Program of the Alameda County Health Care Services Agency's, Department of Environmental Health (the Department), requested SCS Engineers to submit a site characterization/assessment proposal for the property located at 1432 Harrison Street (including a connecting Alice Street property) in Oakland, California. Plate 1 is a vicinity map pinpointing the subject site's location. This request was made pursuant to a Cleanup Order under Health and Safety Code Section 25299.37(c) issued on September 24, 1990 to Alvin Bacharach and Barbara Borsuk, the owners of the property described. The following proposal has been prepared pursuant to and consistent with the California Regional Water Quality Board's "Staff recommendation for initial evaluation and investigation of underground tanks."

The site is currently a garage utilized for parking automobiles and light trucks. It essentially consists of two buildings. The first is the entrance of the parking garage on 1432 Harrison Street. This building is a single-story with partial mezzanine, and constructed of timber and masonry. The second is a multi-story garage that is on the Alice Street portion of the subject site and is composed of reinforced concrete construction. Historical aerial photographs date the buildings back some forty to fifty years.

Previous investigations conducted by other parties have determined that the soil and groundwater have been contaminated from gasoline, diesel and PCBs. Sources for this contamination may be from on-site underground storage tanks and/or adjacent off-site underground storage tanks. It is not known if off-site sources have migrated and contributed to the subject site's contamination. The Department determined that this preliminary data was not sufficient to determine the nature and extent of the contamination, and therefore requested the performance of a more comprehensive site characterization/assessment pursuant to its September 24, 1990 Cleanup Order.

SCS ENGINEERS

February 15, 1991
File No. 0390044.00

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Alameda County Health Care Services
Division of Hazardous Materials
Department of Environmental Health (ACDEH)
80 Swan Way, Room 200
Oakland, California 94621

Attention: Mr. Paul Smith

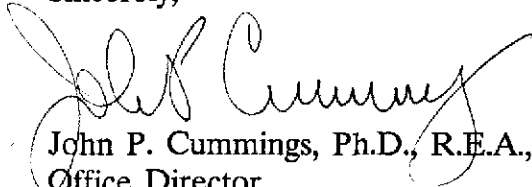
Subject: SCS Report dated February 15, 1991

Dear Mr. Smith:

Attached is page 2 of the subject report on the Site Characterization for the Oakland Parking Garage at 1432 Harrison Street, Oakland, California. This page was inadvertently omitted. Please insert this page into your copy.

Thank you.

Sincerely,



John P. Cummings, Ph.D., R.E.A., R.E.P.
Office Director
SCS Engineers

TLS/sdd

Attachment

The previous investigation, disclosed that there are several underground storage tanks within the boundaries of the subject site. A description of these tanks and investigative and remedial actions which have been performed to date with respect to them is as follows:

Waste Oil Tanks

There are two waste oil tanks located in the basement of the multi-story parking structure along Alice Street. The date of installation of these tanks is unknown. There are no records currently available documenting the volume and composition of these tanks. However it is believed that each tank has a 1000-gallon capacity and is of steel construction. On October 27, 1990 Falcon Energy removed a total of 1300-gallons of waste oil product from both tanks.

Gasoline Tanks

There are two gasoline tanks located under the sidewalk on Harrison Street in front of subject site. Permits issued to a former long-term tenant of the garage, Douglas Motor Services, show that these tanks currently have 1000-gallon capacities, are of steel construction and were installed in 1975 and 1982 respectively. On October 27, 1990, Falcon Energy removed as much product as possible from the tanks. The condition of these tanks is unknown. The recovered gasoline product along with the waste oil which was recovered, has been accepted and utilized by a recycling contractor. A copy of the hazardous waste manifest is in Plate 7.

It should be noted that there is evidence of two other abandoned in-place underground storage tanks just a few feet from the above mentioned gasoline tanks, on the adjacent site owned by another party or parties.

Hydraulic Lift Reservoir

Recent geophysical investigations show evidence of an underground reservoir near the hydraulic lift area inside the parking garage at 1432 Harrison Street.

There is no record of any integrity testing for any of the above tanks. It is believed that these tanks may have been a source of the site's contamination. However, the total quantity of product loss cannot be estimated.

There was a previous subsurface investigation done by Subsurface Consultants in October 1990. The results of their report will be outlined in the Site Description section.

2.0 SITE DESCRIPTION

The site is bordered on the east by Alice Street and on the west by Harrison Street. Lake Merritt is approximately one-quarter mile east from subject site. Plate 2 is a site map that delineates the building perimeter, adjacent streets and suspected on-site as well as off-site underground storage tank locations.

A Preliminary Subsurface Investigation for 1432 Harrison Street was performed by Subsurface Consultants in October 1990. An outline of that report is as follows:

Six test borings were drilled using four-inch diameter, solid-flight auger drilling equipment. Detailed logs were prepared and undisturbed samples of the soil collected by a geologist from Subsurface Consultants. Soil cuttings were stored in steel barrels and left on-site.

Groundwater was encountered during drilling at depths varying from about 23 to 25 feet below the Harrison Street level. Information regarding flow direction below site is not available. However it is suspected to flow east toward Lake Merritt.

Test borings indicate the site is underlain by dense, fine-grained sands containing varying amount of silt and clay. According to geologic maps, these sediments are part of the Merritt sand formation.

Soil samples were selected to be analyzed based on visual inspection and organic vapor screening. The selected soil samples were analyzed by Curtis and Tompkins, Ltd., a laboratory certified by the California Department of Health Services. The results of the testing are summarized on Plate 4 and in the following Table 1. (Table 1 represents the analytical results obtained by Subsurface Consultants).

TABLE 1. CONTAMINANT CONCENTRATIONS IN SOIL
(Results of Subsurface Consultants October 1990 Investigation)

Boring & Depth	TVH ¹ (ppm)	B ² (ppb)	T ³ (ppb)	X ⁴ (ppb)	X ⁵ (ppb)	TOG ⁶ (ppm)	TKH ⁷ (ppm) Keros./Diesel	OTHER S010/Sol Ph/P ---/(ppm)/(p
B1 @ 20'	6,300	99,000	490,000	610,000	110,000	---	---/---	---/---/---
B2 @ 18.5'	9,300	98,000	900,000	1,100,000	190,000	---	---/---	---/0.21/---
B3	--- ⁸	---	---	---	---	---	---/---	---/---/---
B4 @ 10'	---	---	---	---	---	6,300	ND ⁹ /1,700	---/---/---
B5 @ 22.5'	110	24	210	1,300	69	---	---/---	---/---/---
B6 @ 9'	---	ND	ND	ND	ND	ND	98/ND	ND/0.06/9 (Arochlor 1
B6 @ 9.5'	---	---	---	---	---	ND	140/ND	---/---/---
B7 @ 13'	ND	ND	ND	ND	ND			
B7 @ 20'	2,500	3,500	34,000	130,000	33,000	---	---/---	---/0.07/---
B8 @ 22.5'	1,200	2,300	38,000	89,000	18,000	---	---/---	---/---/---

- 1 Total Volatile Hydrocarbons, mg/kg = ppm
- 2 Benzene, ug/kg = ppb
- 3 Toluene
- 4 Xylene
- 5 Ethylbenzene
- 6 Total Oil & Grease
- 7 Total Extractable Hydrocarbons (as kerosene and diesel)
- 8 Not tested for
- 9 Not detected

3.0 PLAN FOR DETERMINING EXTENT OF SOIL CONTAMINATION

As presently proposed, the soil sampling will be carried out concurrently with the drilling for the installation of the groundwater monitoring wells. As discussed in the following section, the placement of the wells is designed to investigate suspected sources of contamination. It is intended that the existing tanks will be removed after the completion of the site characterization and risk assessment.

The methodology for the collection and handling of the soil samples obtained during the drilling is presented in the following section. Spoils from the drilling will be placed in 55-gallon drums and stored on-site until the results of the analyses are available. All excavated soil will be removed from the site. There are presently no plans for any on-site surface remediation of any excavated soil. *to where? is this site plan*

In addition to the soil samples collected during the drilling, it is proposed that a section of the concrete floor overlying the two waste oil tanks adjacent to Alice Street be cut and removed. This would be done during the site characterization investigation to allow for hand auger sampling of the soil below these tanks. It will also provide additional data on the size and shape of the tanks and the location of associated piping.

There are presently no plans to conduct a soil gas survey at the site. If the results of the soil and groundwater analyses indicate that a soil gas survey would be useful in better defining the extent of the contamination, a soil gas survey would be considered for the future.

It is presently unclear what contaminants are present at the site and until that is established, it is not possible to define a process for screening for "clean" and "contaminated" soil. A screening process will be established at the time the tanks are removed.

4.0 PLAN FOR DETERMINING GROUNDWATER CONTAMINATION

A total of 13 monitoring wells are presently proposed to characterize the extent of suspected groundwater contamination at the site. The approximate locations of the proposed wells are shown on Plate 3. The exact locations may be slightly modified based on logistical constraints encountered in the field. After the approval of the proposal by the Department, the County will be approached as required to obtain proper encroachment permits.

4.1 Placement Rationale

The proposed wells are designed to investigate the level of contamination both at known or suspected sources and in the assumed downgradient direction. Based on the assumed southeasterly direction of groundwater flow, any contaminants which may migrate from their source are expected to move in a southeasterly direction toward Lake Merritt.

4.2 Drilling and Installation of Wells

The proposed groundwater monitoring wells will be installed using a hollow stem auger drilling rig. Because of the height constraints imposed by the ceiling within the existing structure, a small, skid-mounted rig will be utilized inside the building. The wells in the sidewalk area of Harrison Street will be installed using a truck-mounted drilling rig.

The well installation will be coordinated by a field geologist, under the supervision of a Certified Engineering Geologist (CEG). The borings will be logged by the field geologist and soils encountered will be classified using the Unified Soil Classification System. Well logs for each boring showing lithologies encountered and well construction details will be included in the final report.

The borings inside the building will be approximately 6 inches in diameter and the other borings will be 10 inches in diameter. They will be drilled to a depth of about 10 feet below the groundwater surface. The augers will be steam cleaned on-site at the completion of each boring. Waste water and sludge from the steam cleaning will be collected and transferred to 55-gallon drums for on-site storage. The waste water will be analyzed and the results will determine the final disposition.

specify type of analytical sampling for each boring/mw

Soil samples will be collected at a minimum of every 5 feet, with a modified California sampler, retained in brass sleeves, examined, sealed with aluminum foil, capped with plastic end caps, tightly wrapped with tape, labeled, and kept in cold storage (4 degrees C) for transport to a chemical laboratory certified by the California Department of Health Services. Samples will be screened in the field by use of a photo-ionization detector (PID).

The groundwater monitoring well will be constructed in the borehole using flush-mounted threaded PVC well casing. As presently proposed, the wells inside the building will be two inches in diameter and the wells in the sidewalk area will be four inches in diameter. Factory slotted screen with 0.020 inch (or possibly 0.010 inch depending on the units) slots will be placed in the aquifer, with solid PVC pipe above. The perforated zone of the casing will be installed from about 5 feet above groundwater to the total depth of the well (approximately 10 feet below groundwater). This should accommodate the anticipated seasonal water level fluctuations at the site. A flush-mounted threaded end cap will be placed on the bottom of the perforated section. Couplings between the casing sections will be flush-set, threaded pipe with no glued connections. All casing will be steam-cleaned prior to installation.

The well casing will be set inside the hollow augers in order to prevent caving of the hole prior to installation of the casing. The annular space surrounding the well screen will be filled with a filter pack (Monterey Sand No. 3) to at least 2 feet above the top of the screened interval and capped off with a bentonite seal approximately 3 feet thick. The sand will be poured slowly into the annular space between the PVC pipe and the augers. This procedure will be interrupted periodically to measure the depth to the top of the sand by a weighted tape. The remaining annular space will be filled with a cement/grout mixture to about 1 foot below grade. The top of the well will be cemented and set with a locking monument well cover. The concrete surface seal will be sloped away from the well casing at the ground surface. Plate 5 presents a cross-sectional diagram of a typical monitoring well.

A reference point of each monitoring well casing will be marked and surveyed by SCS Engineers to establish elevations that will be used for depth to water measurements and gradient calculations. The leveling survey will measure elevations to the nearest 0.01 foot.

4.3 Well Development

The well will be developed to increase its specific capacity, to prevent sanding, to obtain maximum well life, and to collect representative samples of the groundwater. Well development generally repairs damage done to the formation by drilling operations, restores natural hydraulic properties to the adjacent soils, and improves hydraulic properties near the borehole so that water flows more freely into the well.

The wells will be developed by removing the finer material from the formation and filter pack surrounding the wells. This procedure will consist of several steps: bailing the well and then pumping the well until it produces clean water (water with less than 10 ppm suspended solids). All of the groundwater

produced during the well development operations will be stored in approved 55-gallon drums.

All equipment used in well development will be decontaminated prior to and after its use in a well. The decontamination procedures will consist of steam-cleaning and/or washing of equipment using Trisodium phosphate soap, tap water rinse, and distilled water rinse.

4.4 Water level Measurement and Groundwater Sampling

Prior to groundwater sampling, static water level measurements will be taken using a water level indicator. Readings will be taken to the nearest 0.01 foot from a marked reference point on the well casing.

A clear disposal bailer will be lowered into each well to sample the upper surface of the groundwater prior to purging. Any floating product will be noted and measured in the bailer.

Following the water level measurement, the wells will be purged of three to four well volumes of water. This procedure will permit a representative sample of groundwater to be obtained from the aquifer rather than water which had been standing in the well. Notations will be made as to odor, color, and turbidity of the water being removed from the well.

Samples will be collected using an acrylic bailer and contained in pre-cleaned 40 ml vials with Teflon-coated septa or 1 liter amber jars. All efforts will be made to minimize the volatilization of the samples. Samples will be labeled with a sample tag and placed in an ice chest along with Chain-of-Custody documentation. A copy of the Chain-of-Custody form to be used for documentation is attached as Plate 6.

4.5 Laboratory Analysis of Groundwater Samples

A state-certified laboratory will be utilized to analyze all soil and water samples. These samples will be analyzed using standard EPA methodologies and protocol.

Duplicate samples will be collected from each well in the manner described above. The duplicate will be analyzed in the event that the original sample has been tampered with, broken, or otherwise rendered unusable.

Trip and field blanks will also accompany samples submitted to the laboratory. The trip blank will be filled in the laboratory using ultrapure laboratory water. The field or rinsate blank will be collected at the sampling site using ultrapure water which has been poured into the acrylic bailer and sampled under the same conditions as the groundwater samples.

Groundwater purged from the well will be contained in drums on-site at each well location. Drums will be clearly marked to identify the contents and source.

Samples taken to the laboratory will be refrigerated at 4 degrees Celsius until they are analyzed. All samples will be analyzed within the proper time of sample retention per EPA guidelines. Laboratory reports will include information regarding sample identification, date sampled, date received, and date analyzed. Laboratory QA/QC details will be available for inspection and inclusion in reports.

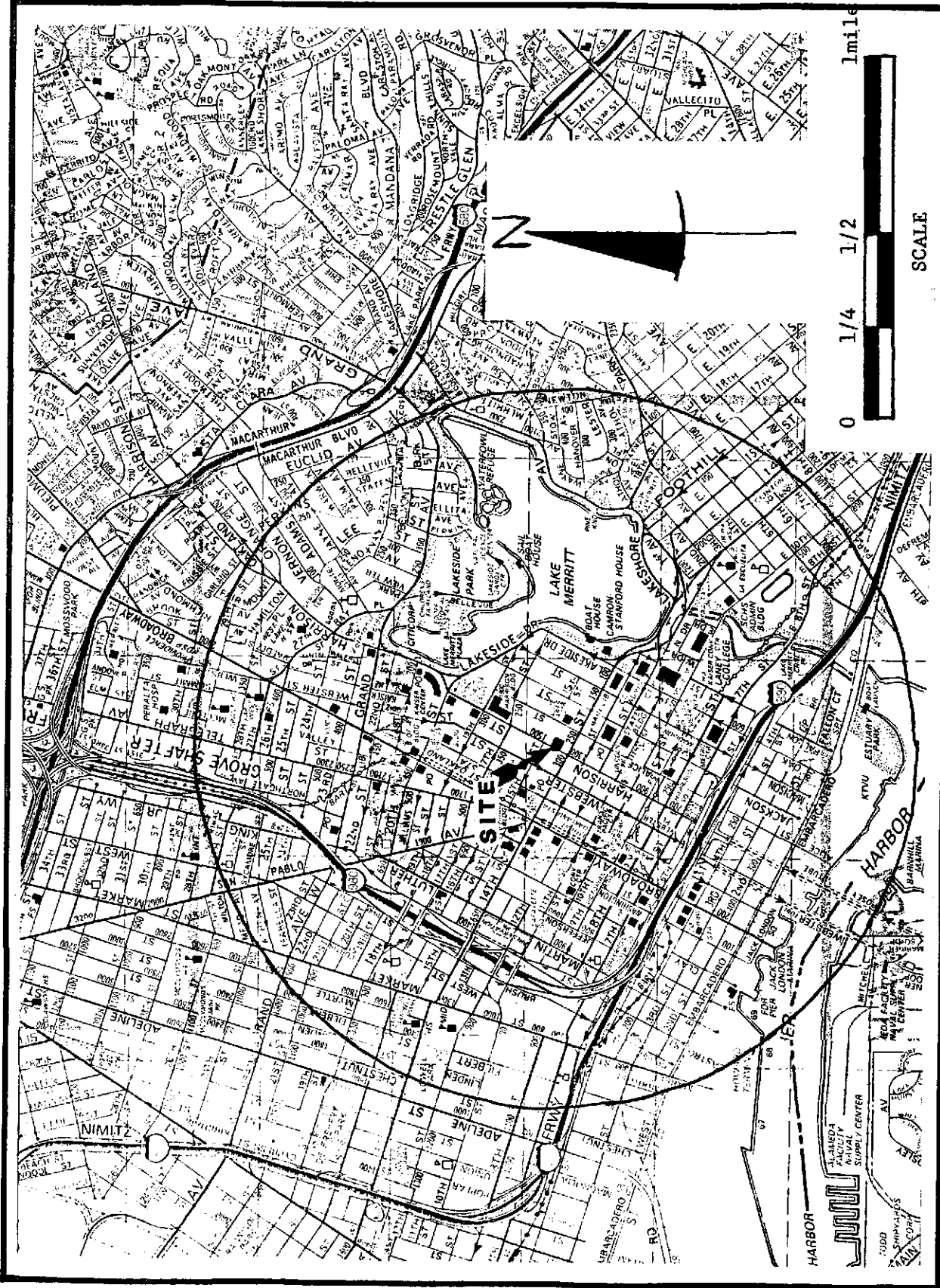


PLATE 1: 1432 HARRISON STREET SITE, VICINITY MAP

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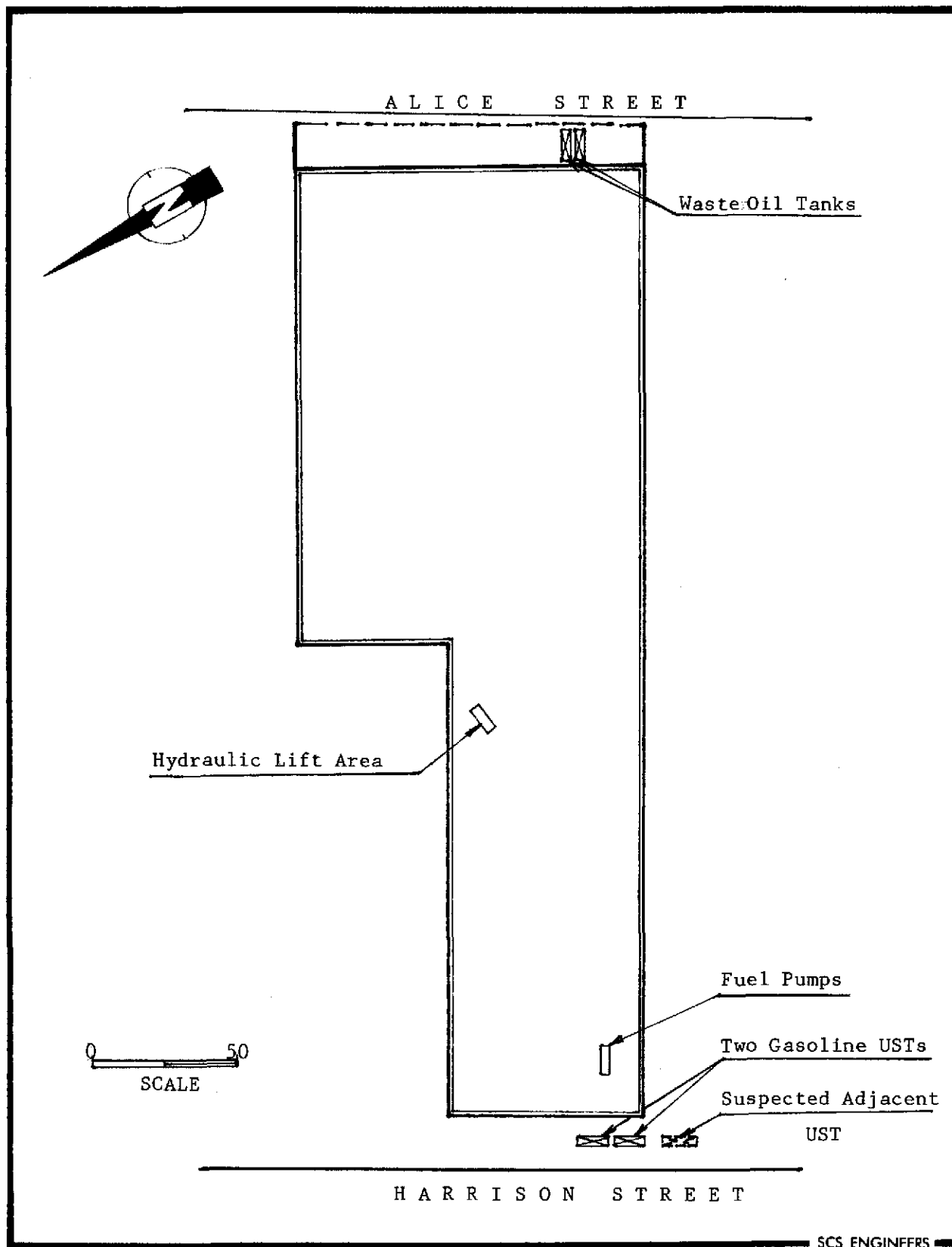


PLATE 2: 1432 HARRISON Street , OAKLAND , Site Map

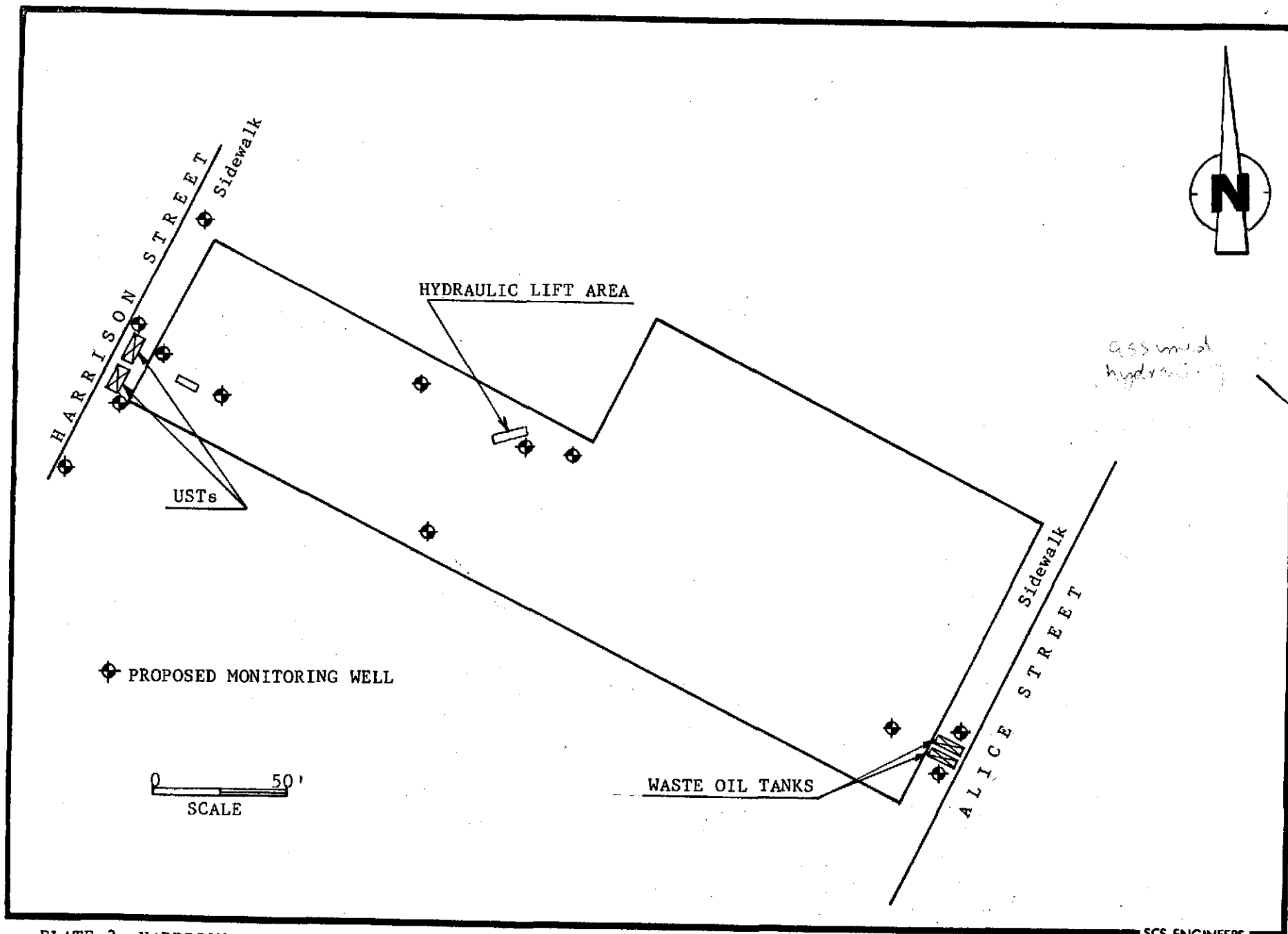


PLATE 3: HARRISON STREET GARAGE-OAKLAND Site , Proposed Monitoring Wells

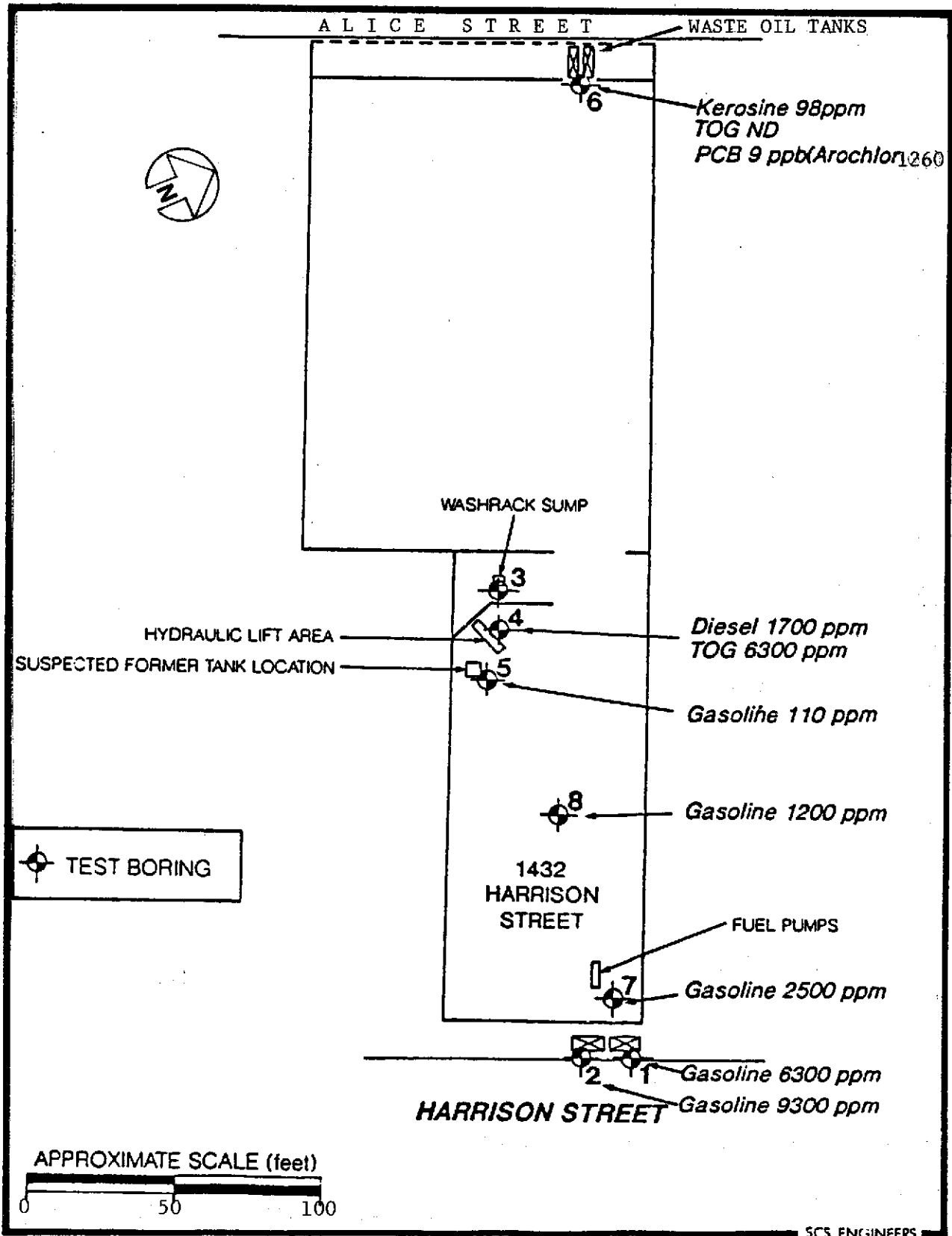
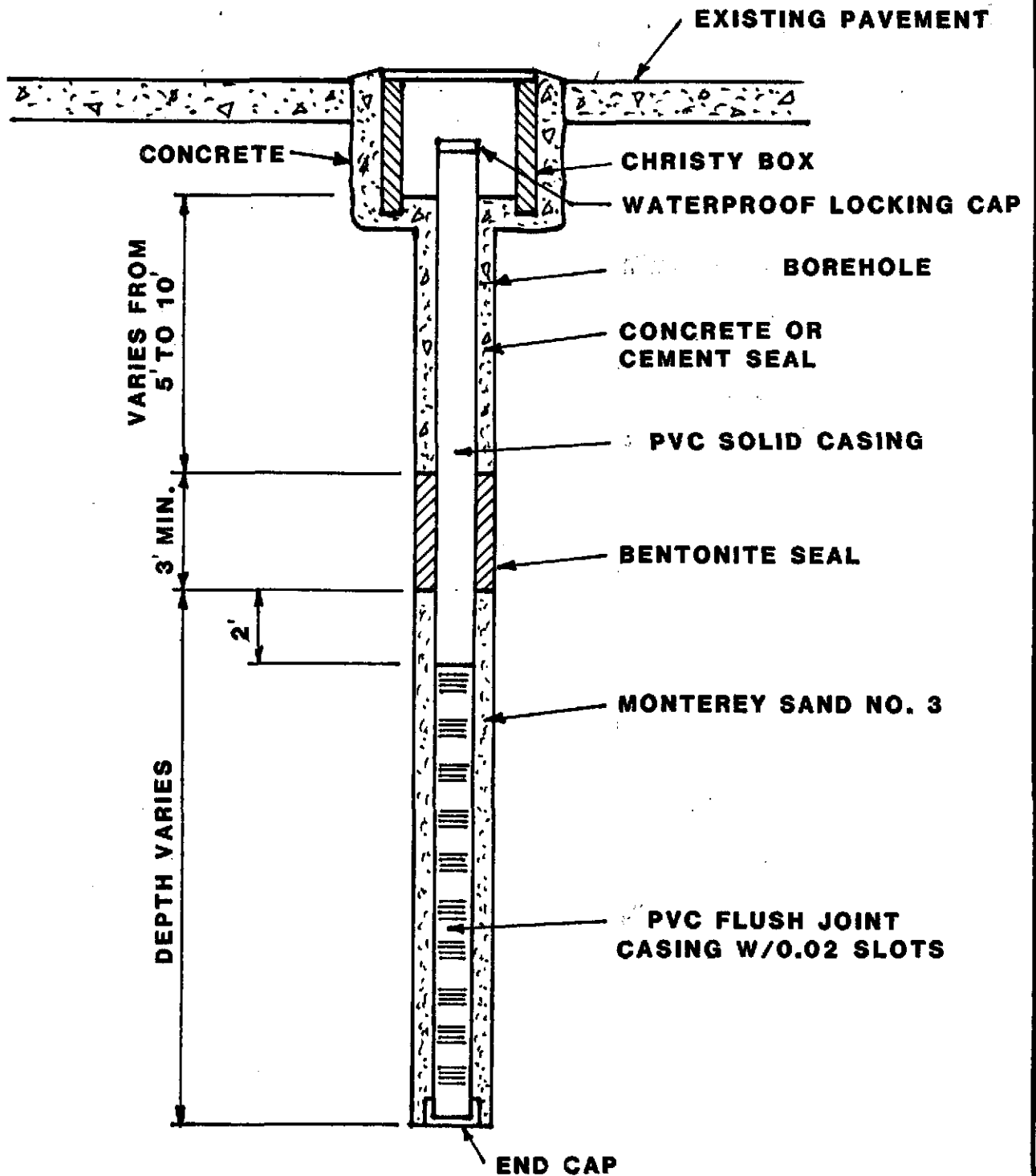


PLATE 4: RESULTS FROM SUBSURFACE CONSULTANTS

GROUNDWATER MONITORING WELL



NOT TO SCALE



SCS ENGINEERS

STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS, INC.

6781-D SIERRA COURT
DUBLIN, CA 94568

1432 HARRISON STREET, MONITORING WELL

Project No.

Date:

Plate

5

CHAIN OF CUSTODY RECORD

SGS
ANALYTICAL
LABORATORY



2960 WALNUT AVENUE
LONG BEACH, CALIFORNIA 90806
(213) 595-9324
Fax (213) 595-6709

PERSONNEL

SITE INFORMATION

Name (signature) _____
 Name (print) _____
 Company _____
 Address _____
 City, State, Zip _____
 Telephone _____

Job Name _____
 Job Number _____
 Sample Location _____

 P.O. Number _____

Relinquished by (Signature)	Received by (Signature)	Date	Time
Relinquished by (Signature)	Received by (Signature)	Date	Time

Analysis laboratory should complete "sample cond. upon receipt" section below, sign, and return copy to Shipper

Sample Number	Sample Type	No. of Cont.	Site Identification	Date Sampled	Analysis Requested	Sample Cond. Upon Receipt
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Remarks: _____

89618164
 IN CASE OF AN EMERGENCY OR SPILL, CALL THE NATIONAL RESPONSE CENTER 1-800-424-8802; WITHIN CALIFORNIA CALL 1-800-952-7650
 TRANSPORTER
 FACILITY

UNIFORM HAZARDOUS WASTE MANIFEST		1. Generator's US EPA ID No. CA0000054054200001		Manifest Document No. 200001	2. Page 1 of 1	Information in the shaded areas is not required by Federal law.	
3. Generator's Name and Mailing Address A. BACHARACH & B. BORSUK 87 Rico Way San Francisco, CA 94123				A. State Manifest Document Number 89618164			
4. Generator's Phone (415) 922-4740				B. State Generator's ID			
5. Transporter 1 Company Name FALCON ENERGY ASSOCIATES		B. US EPA ID Number CA0982526857		C. State Transporter's ID CA 2463		D. Transporter's Phone (209) 463-7108	
7. Transporter 2 Company Name C.O.R.I. dba Evergreen Environmental Svc		B. US EPA ID Number CA0980695761		E. State Transporter's ID		F. Transporter's Phone (800) 972-5284	
9. Designated Facility Name and Site Address EVERGREEN ENVIRONMENTAL SERVICES 6880 Smith Avenue Newark, CA 94560				G. State Facility's ID CA0980695761		H. Facility's Phone (800) 972-5284	
11. US DOT Description (Including Proper Shipping Name, Hazard Class, and ID Number)		12. Containers No. Type	13. Total Quantity	14. Unit Wt/Vol	15. Waste No.		
a. Waste Petroleum Oil, N.O.S., Combustible Liquid, NA 1270		001 TT	1500	G	State: CA 221 EPA/Other: None-RCRA		
b.					State: EPA/Other:		
c.					State: EPA/Other:		
d.					State: EPA/Other:		
J. Additional Descriptions for Materials Listed Above Waste oil tested at LT 1000 ppm chlorides.				K. Handling Codes for Wastes Listed Above 14			
16. Special Handling Instructions and Additional Information Wear protective clothing.							
19. GENERATOR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable International and national government regulations. If I am a large quantity generator, I certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and that I have selected the practicable method of treatment, storage, or disposal currently available to me which minimizes the present and future threat to human health and the environment; OR, if I am a small quantity generator, I have made a good faith effort to minimize my waste generation and select the best waste management method that is available to me and that I can afford.							
Printed/Typed Name BARBARA BORSUK				Signature <i>Barbara Borsuk</i>		Month Day Year 10/27/90	
17. Transporter 1 Acknowledgement of Receipt of Materials				Printed/Typed Name Brian M... Signature <i>Brian M...</i>		Month Day Year 11/02/90	
18. Transporter 2 Acknowledgement of Receipt of Materials				Printed/Typed Name Joseph Luis Lim... Signature <i>Joseph Luis Lim...</i>		Month Day Year 11/02/90	
19. Discrepancy Indication Space							
20. Facility Owner or Operator Certification of receipt of hazardous materials covered by this manifest except as noted in Item 10.							
Printed/Typed Name Joseph Luis Lim... Signature <i>Joseph Luis Lim...</i>				Month Day Year 11/02/90			

D-15 8222 A (1-88)
 EPA 8700-22
 (Rev. 9-85) Previous editions are obsolete.

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GREEN; HAULER RETAINS

SCS ENGINEERS

PLATE 7: 1432 HARRISON STREET, OAKLAND, HAZARDOUS WASTE MANIFEST

SITE HEALTH AND SAFETY PLAN FOR UNDERGROUND STORAGE TANK INSPECTIONS

The following is a generic site health and safety plan for underground storage tank inspections. As indicated throughout the plan, selected sections should only be filled out by people with technical expertise in health and safety issues. In addition, State organizations using this plan should set up a system to ensure that: (1) the plan is used properly and (2) staff follow proper safety procedures.

PART I

Part I (Sections I-IV) should be completed by the UST inspector prior to the site visit.

SECTION I. GENERAL SITE INFORMATION

SITE NAME AND ADDRESS: Oakland Parking Garage
1432 Harrison Street
Oakland, CA 94612

CONTACT PERSON AND PHONE NUMBER:
John P. Cummings
SCS Engineers (415) 829-0661

SITE IDENTIFICATION NUMBER: NA

PROPOSED DATE(S) OF SITE WORK: February - April 1991

SECTION II. DESCRIPTION OF INSPECTION ACTIVITY

PURPOSE OF ACTIVITY:

New Tank Installation	()
Tank Closure	()
Tank/Pipe Removal	()
Tank/Pipe Disposal	()
Petroleum Release Investigation	(X)
Tank/Pipe Repair	()
Leak Detection Testing	()
Installation of Monitor Wells/Sampling	(X)

PROVIDE A BRIEF NARRATIVE DESCRIPTION OF THE PROPOSED INSPECTION ACTIVITIES:

Drilling and installation of at least 13 monitoring wells. At least 9 wells will be inside an existing structure and 3 of the wells will be in an enclosed area with possible poor ventilation. Collection of soil and groundwater samples with probable hydrocarbon contamination.

SECTION III. SPECIFIC SITE INFORMATION

SPECIFIC TANK SYSTEM INFORMATION: Four known underground storage tanks, one reservoir for hydraulic fluid.

Age/Size/Capacity of Tanks and Piping:

Contents of Tank: 2 gasoline storage tanks
2 waste oil tanks

Other (Specify):

TYPE OF SITE

CHECK ALL APPROPRIATE:

Active
 Inactive
 Industrial facility
 Gas station

TSDF
 R & D Facility
 Military base
 Other (Specify) existing parking garage

RELEASE HISTORY

No evidence of leaks or soil contamination ()
Suspected or known leaks and soil contamination (X)
Known groundwater contamination ()

BACKGROUND AND DESCRIPTION OF ANY PREVIOUS INVESTIGATIONS OR INCIDENCE:

Previous investigations consisted of soil borings and soil sampling at selected locations.

BACKGROUND INFORMATION STATUS: () COMPLETE (X) INCOMPLETE

SECTION IV. POTENTIAL HEALTH AND SAFETY HAZARDS

ANTICIPATED PHYSICAL HAZARDS OF CONCERN: (CHECK ALL THAT APPLY AND DESCRIBE)

- | | |
|--|--|
| <input type="checkbox"/> Heat (high ambient temp.) | <input checked="" type="checkbox"/> Heavy equipment |
| <input type="checkbox"/> Cold | <input checked="" type="checkbox"/> Physical injury and trauma resulting from moving machinery |
| <input checked="" type="checkbox"/> Noise | |
| <input checked="" type="checkbox"/> Oxygen depletion | |
| <input type="checkbox"/> Asphyxiation | |
| <input type="checkbox"/> Excavation | <input type="checkbox"/> General construction |
| <input type="checkbox"/> Cave-ins | <input type="checkbox"/> Physical injury and trauma |
| <input type="checkbox"/> Falls, trips, slipping | <input type="checkbox"/> Electrical Hazards |
| <input type="checkbox"/> Handling and transfer of petroleum products | <input checked="" type="checkbox"/> Confined space entry |
| <input type="checkbox"/> Fire | <input type="checkbox"/> Explosions |
| <input type="checkbox"/> Explosions | <input type="checkbox"/> Other (Specify) |

ANTICIPATED BIOLOGICAL HAZARDS: (LIST BELOW) NA

Snakes
 Insects
 Rodents

Poisonous plants
 Other

NARRATIVE: (Provide all information which could impact Health and Safety - e.g., power lines, integrity of dikes, terrain, etc.)

Outside wells - in vicinity of underground utilities; USA to be notified prior to drilling.

Interior wells - care must be taken to avoid possible live overhead electrical cables; may need to arrange for ventilation in enclosed areas.

ANTICIPATED CHEMICAL HAZARDS: (LIST BELOW ALL CHEMICALS PRESENT ON SITE; ATTACH MATERIAL SAFETY DATA SHEETS-MSDS)

1. Gasoline
 2. Benzene
 3. Toluene
 4. Xylene
 5. Ethylbenzene
 6. Kerosene
 7. Diesel Fuel
 8. Polychlorinated Biphenyl (Arochlor 1260)
 - 9.
 - 10.
-

PART II

Section V should only be completed by persons with technical expertise in health and safety.

SECTION V. EVALUATION OF POTENTIAL HAZARDS

" To Be Completed If Appropriate "

CHEMICALS OF CONCERN

<u>Chemical</u>	Highest Observable Concentration (media)	PEL/ TLV	IDLH	Symptoms/ Effects of Acute Exposure
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PART III

Sections VI and VII should be completed by the UST Inspector prior to the site visit.

SECTION VI. METHODS TO CONTROL POTENTIAL HEALTH AND SAFETY HAZARDS

MONITORING INSTRUMENTATION: (NOTE: MONITORING INSTRUMENTS MUST BE USED FOR ALL OPERATIONS UNLESS APPROPRIATE RATIONALE OR RESTRICTIONS ARE PROVIDED).

- Organic Vapor Analyzer
 - Photoionization Detector
 - Combustible Gas Indicator (CGI)
 - Oxygen Meter
 - Hydrogen Sulfide Meter
 - Detector Tubes (specify)
 - Other, specify (toxic gas, air sampling pumps, etc.)
-

IF MONITORING INSTRUMENTS ARE NOT USED, SPECIFY RATIONALE OR JUSTIFICATION OR ACTIVITY/AREA RESTRICTIONS.

NA

ACTION LEVELS (breathing zone):

Combustible Gas Indicator

- 0 - 10% LEL No Explosion Hazard
- 10 - 25% LEL Potential Explosion Hazard; Notify Site Health and Safety Officer
- >25% LEL Explosion Hazard; Interrupt Task/Evacuate

ACTION LEVELS (breathing zone): continued

Oxygen Meter

<21.0% O₂ Oxygen Normal
<21.0% O₂ Oxygen Deficient; Notify Site Health and Safety Officer
<19.5% O₂ Oxygen Deficient; Interrupt Task/Evacuate

Photoionization Detector Specify: NA

() 11.7 ev
() 10.2 ev
() 9.8 ev

Type:

Flame Ionization Detector Specify: NA

Type:

Detector Tubes Specify: NA

Type

Type

Type

PERSONAL PROTECTIVE EQUIPMENT: List all applicable items

Minimum personal protective equipment:

1. Hardhat
2. Safety glasses/goggles
3. Steel toed/shank shoes or boots
4. Flame retardant coveralls
5. Hearing protection (muffs or ear plugs)

Is additional PPE required?

YES / NO

PERSONAL PROTECTIVE EQUIPMENT continued

Check all additional necessary items:

- Uncoated tyvek coveralls
- Saranex tyvek coveralls
- Rubber boots
- Overboots
- Surgical (inner) gloves
- Butyl/neoprene/viton/nitrile outer gloves
- Full face respirators standby type of cartridge:
- SCBA / SAR
- ELSAs
- Other (specify):

VII. EMERGENCY INFORMATION

Emergency Contact:

Fire/Rescue: 911

Ambulance: 911

Police: 911

Hazardous Waste Material Response Units 911

Health and Safety Director: Mr. THOMAS D. WETHERILL

Poison Control Center:

On-site medical facility (clinic): YES / NO

Facility health and safety officer: YES / NO

Name:

Phone number:

Hospital Name and Address: Peralta Hospital

450 - 30th Street, Oakland

Directions to hospital (include a map): 14th St. to Telegraph, north (right) to 30th St., left on 30th, hospital on left.

PART IV

SECTION VIII. PLAN APPROVAL

Plan prepared by:

SCS ENGINEERS

2/15/91

(Date)

Plan approved by:

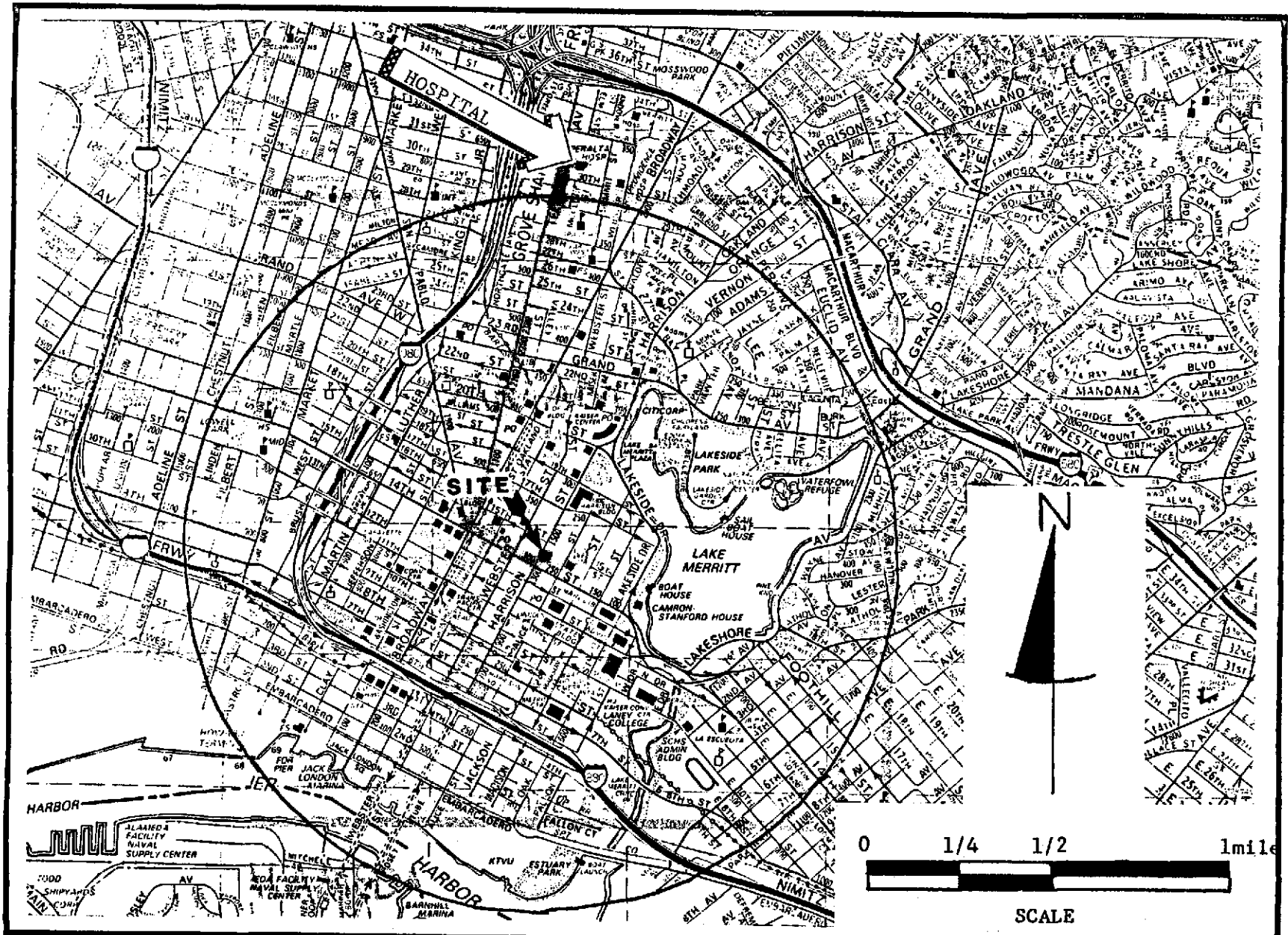
[Signature]

2/15/91
(Date)

Plan approved by:

[Signature]

2/15/91
(Date)



SITE SAFETY PLAN : HOSPITAL ROUTE

SCS ENGINEERS

GASOLINES: AUTOMOTIVE (<4.23g lead/gal)

GAT

<p>Common Synonyms Motor spill Petrol</p>	<p>Watery liquid Colorless to pale brown or pink Gasoline odor</p> <p>Floats on water. Flammable, irritating vapor is produced.</p>
<p>Stop discharge if possible. Keep people away. Shut off ignition sources and call fire department. Stay upwind and use water spray to "knock down" vapor. Isolate and remove discharged material. Notify local health and pollution control agencies.</p>	
<p style="text-align: center;">Fire</p>	<p>FLAMMABLE. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Extinguish with dry chemical, foam, or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.</p>
<p style="text-align: center;">Exposure</p>	<p>CALL FOR MEDICAL AID.</p> <p>VAPOR Irritating to eyes, nose and throat. If inhaled, will cause dizziness, headache, difficult breathing or loss of consciousness. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen.</p> <p>LIQUID Irritating to skin and eyes. If swallowed, will cause nausea or vomiting. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. DO NOT INDUCE VOMITING.</p>
<p style="text-align: center;">Water Pollution</p>	<p>HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. Floating to shorelines. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.</p>
<p>1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Issue warning-high flammability Evacuate area Disperse and flush</p>	<p>2. LABEL 2.1 Category: Flammable liquid 2.2 Class: 3</p>
<p>3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Miscellaneous Hydrocarbon Mixtures 3.2 Formula: (Mixture of hydrocarbons) 3.3 IMO/UN Designation: 3.1/1203 3.4 DOT ID No.: 1203 3.5 CAS Registry No.: Data not available</p>	<p>4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless to brown 4.3 Odor: Gasoline</p>
<p style="text-align: center;">5. HEALTH HAZARDS</p> <p>6.1 Personal Protective Equipment: Protective goggles, gloves. 6.2 Symptoms Following Exposure: Irritation of mucous membranes and stimulation followed by depression of central nervous system. Breathing of vapor may also cause dizziness, headache, and incoordination or, in more severe cases, anesthesia, coma, and respiratory arrest. If liquid enters lungs, it will cause severe irritation, coughing, gagging, pulmonary edema, and, later, signs of bronchopneumonia and pneumonitis. Swallowing may cause irregular heartbeat. 6.3 Treatment of Exposure: INHALATION: maintain respiration and administer oxygen; enforce bed rest if liquid is in lungs. INGESTION: do NOT induce vomiting; stomach should be lavaged (by doctor) if appreciable quantity is swallowed. EYES: wash with copious quantity of water. SKIN: wipe off and wash with soap and water. 6.4 Threshold Limit Value: 300 ppm 6.5 Short Term Inhalation Limits: 500 ppm for 30 min. 6.6 Toxicity by Ingestion: Grade 2; LD₅₀ = 0.5 to 5 g/kg. 6.7 Late Toxicity: None 6.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary. 6.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin. 6.10 Odor Threshold: 0.25 ppm 6.11 IDLH Value: Data not available</p>	

<p style="text-align: center;">6. FIRE HAZARDS</p> <p>6.1 Flash Point: -36°F C.C. 6.2 Flammable Limits In Air: 1.4%-7.4% 6.3 Fire Extinguishing Agents: Foam, carbon dioxide, dry chemical 6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective 6.5 Special Hazards of Combustion Products: None 6.6 Behavior in Fire: Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back. 6.7 Ignition Temperature: 853°F 6.8 Electrical Hazard: Class I, Group D 6.9 Burning Rate: 4 mm/min. 6.10 Adiabatic Flame Temperature: Data not available 6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available</p> <p style="text-align: center;">7. CHEMICAL REACTIVITY</p> <p>7.1 Reactivity With Water: No reaction 7.2 Reactivity with Common Materials: No reaction 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Molar Ratio (Reactant to Product): Data not available 7.8 Reactivity Group: 33</p>	<p style="text-align: center;">10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-T-U-V-W</p> <p style="text-align: center;">11. HAZARD CLASSIFICATIONS</p> <p>11.1 Code of Federal Regulations: Flammable liquid</p> <p>11.2 NAS Hazard Rating for Bulk Water Transportation:</p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Category</th> <th style="text-align: right;">Rating</th> </tr> </thead> <tbody> <tr> <td>Fire</td> <td style="text-align: right;">3</td> </tr> <tr> <td>Health</td> <td></td> </tr> <tr> <td>Vapor Irritant</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Liquid or Solid Irritant</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Poisons</td> <td style="text-align: right;">2</td> </tr> <tr> <td>Water Pollution</td> <td></td> </tr> <tr> <td>Human Toxicity</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Aquatic Toxicity</td> <td style="text-align: right;">2</td> </tr> <tr> <td>Aesthetic Effect</td> <td style="text-align: right;">2</td> </tr> <tr> <td>Reactivity</td> <td></td> </tr> <tr> <td>Other Chemicals</td> <td style="text-align: right;">0</td> </tr> <tr> <td>Water</td> <td style="text-align: right;">0</td> </tr> <tr> <td>Self Reaction</td> <td style="text-align: right;">0</td> </tr> </tbody> </table> <p>11.3 NFPA Hazard Classification:</p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Category</th> <th style="text-align: right;">Classification</th> </tr> </thead> <tbody> <tr> <td>Health Hazard (Blue)</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Flammability (Red)</td> <td style="text-align: right;">3</td> </tr> <tr> <td>Reactivity (Yellow)</td> <td style="text-align: right;">0</td> </tr> </tbody> </table>	Category	Rating	Fire	3	Health		Vapor Irritant	1	Liquid or Solid Irritant	1	Poisons	2	Water Pollution		Human Toxicity	1	Aquatic Toxicity	2	Aesthetic Effect	2	Reactivity		Other Chemicals	0	Water	0	Self Reaction	0	Category	Classification	Health Hazard (Blue)	1	Flammability (Red)	3	Reactivity (Yellow)	0
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<p style="text-align: center;">8. WATER POLLUTION</p> <p>8.1 Aquatic Toxicity: 90 ppm/24 hr/juvenile American shad/TL₅₀/fresh water 91 mg/1/24 hr/juvenile American shad/TL₅₀/salt water 8.2 Waterfowl Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): 8%, 5 days 8.4 Food Chain Concentration Potential: None</p>	<p style="text-align: center;">12. PHYSICAL AND CHEMICAL PROPERTIES</p> <p>12.1 Physical State at 15°C and 1 atm: Liquid 12.2 Molecular Weight: Not pertinent 12.3 Boiling Point at 1 atm: 140-390°F = 60-199°C = 333-472°K 12.4 Freezing Point: Not pertinent 12.5 Critical Temperature: Not pertinent 12.6 Critical Pressure: Not pertinent 12.7 Specific Gravity: 0.7321 at 20°C (liquid) 12.8 Liquid Surface Tension: 18-23 dynes/cm = 0.019-0.023 N/m at 20°C 12.9 Liquid Water Interfacial Tension: 49-51 dynes/cm = 0.049-0.051 N/m at 20°C 12.10 Vapor (Gas) Specific Gravity: 3.4 12.11 Ratio of Specific Heats of Vapor (Gas): (est.) 1.054 12.12 Latent Heat of Vaporization: 130-150 Btu/lb = 71-81 cal/g = 3.0 - 3.4 X 10⁵ J/kg 12.13 Heat of Combustion: -18,720 Btu/lb = -10,400 cal/g = 435.1 X 10³ J/kg 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.25 Heat of Fusion: Data not available 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: 7.4 psia</p>																																				
<p style="text-align: center;">9. SHIPPING INFORMATION</p> <p>9.1 Grades of Purity: Various octane ratings; military specifications 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Open (flame arrester) or pressure-vacuum</p>	<p style="text-align: center;">NOTES</p>																																				

BENZENE

BNZ

Common Synonyms Benzol Benzole		Wetery liquid Colorless Gasoline-like odor
Floats on water. Flammable, irritating vapor is produced. Freezing point is 42°F.		
Avoid contact with liquid and vapor. Keep people away. Wear goggles and self-contained breathing apparatus. Shut off ignition sources and call fire department. Stop discharge if possible. Stay upwind and use water spray to "knock down" vapor. Isolate and remove discharged material. Notify local health and pollution control agencies.		
Fire	FLAMMABLE. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Wear goggles and self-contained breathing apparatus. Extinguish with dry chemical, foam, or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.	
	Exposure CALL FOR MEDICAL AID. VAPOR Irritating to eyes, nose and throat. If inhaled, will cause headache, difficult breathing, or loss of consciousness. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. LIQUID Irritating to skin and eyes. Harmful if swallowed. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.	
Water Pollution	HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.	
1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Issue warning-high flammability Restrict access		2. LABEL 2.1 Category: Flammable liquid 2.2 Class: 3
3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Aromatic Hydrocarbon 3.2 Formula: C ₆ H ₆ 3.3 IMO/UN Designation: 3.2/1114 3.4 DOT ID No.: 1114 3.5 CAS Registry No.: 71-43-2		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless 4.3 Odor: Aromatic; rather pleasant aromatic odor, characteristic odor
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Hydrocarbon vapor canister, supplied air or a hose mask; hydrocarbon-insoluble rubber or plastic gloves; chemical goggles or face splash shield; hydrocarbon-insoluble apron such as neoprene. 5.2 Symptoms Following Exposure: Dizziness, excitation, pallor, followed by flushing, weakness, headache, breathlessness, chest constriction. Come and possible death. 5.3 Treatment of Exposure: SKIN: flush with water followed by soap and water; remove contaminated clothing and wash skin. EYES: flush with plenty of water until irritation subsides. INHALATION: remove from exposure immediately. Call a physician. If breathing is irregular or stopped, start resuscitation, administer oxygen. 5.4 Threshold Limit Value: 10 ppm 5.5 Short Term Inhalation Limit: 75 ppm for 30 min. 5.6 Toxicity by Ingestion: Grade 3; LD ₅₀ = 50 to 500 mg/kg 5.7 Late Toxicity: Leukemia 5.8 Vapor (Gas) Irritant Characteristics: If present in high concentrations, vapors may cause irritation of eyes or respiratory system. The effect is temporary. 5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin. 5.10 Odor Threshold: 4.68 ppm 5.11 IDLM Value: 2,000 ppm		

6. FIRE HAZARDS 6.1 Flash Point: 12°F C.C. 6.2 Flammable Limits In Air: 1.3%-7.9% 6.3 Fire Extinguishing Agents: Dry chemical, foam, or carbon dioxide 6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective 6.5 Special Hazards of Combustion Products: Not pertinent 6.6 Behavior in Fire: Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back 6.7 Ignition Temperature: 1067°F 6.8 Electrical Hazard: Class I, Group D 6.9 Burning Rate: 5.0 mm/min. 6.10 Adiabatic Flame Temperature: Data not available 6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available	10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-T-U-V-W																																				
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8. WATER POLLUTION 8.1 Aquatic Toxicity: 5 ppm/6 hr/minnow/lethal/distilled water 20 ppm/24 hr/sunfish/TL ₅₀ /tap water 8.2 Waterfowl Toxicity: Data not available 1.2 lb./lb. 10 days 8.3 Biological Oxygen Demand (BOD): 1.2 lb./lb. 10 days 8.4 Food Chain Concentration Potential: None	12. PHYSICAL AND CHEMICAL PROPERTIES 12.1 Physical State at 15°C and 1 atm: Liquid 12.2 Molecular Weight: 78.11 12.3 Boiling Point at 1 atm: 176°F = 80.1°C = 353.3°K 12.4 Freezing Point: 42.0°F = 5.5°C = 278.7°K 12.5 Critical Temperature: 552.0°F = 288.9°C = 562.1°K 12.6 Critical Pressure: 710 psia = 48.3 atm = 4.89 MN/m ² 12.7 Specific Gravity: 0.879 at 20°C (liquid) 12.8 Liquid Surface Tension: 28.9 dynes/cm = 0.0289 N/m at 20°C 12.9 Liquid Water Interfacial Tension: 35.0 dynes/cm = 0.035 N/m at 20°C 12.10 Vapor (Gas) Specific Gravity: 2.7 12.11 Ratio of Specific Heats of Vapor (Gas): 1.061 12.12 Latent Heat of Vaporization: 169 Btu/lb = 94.1 cal/g = 3.94 X 10 ⁴ J/kg 12.13 Heat of Combustion: -17,460 Btu/lb = -9696 cal/g = -406.0 X 10 ³ J/kg 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.25 Heat of Fusion: 30.45 cal/g 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: 3.22 psia																																				
9. SHIPPING INFORMATION 9.1 Grades of Purity: Industrial pure 99 + % Thiophene-free 99 + % Nitration 99 + % Industrial 90% 85 + % Reagent 99 + % 9.2 Storage Temperature: Open 9.3 Inert Atmosphere: No requirement 9.4 Venting: Pressure-vacuum	NOTES																																				

TOLUENE

TOL

<p>Common Synonyms</p> <p>Toluol Methylbenzene Methylbenzol</p>	<p>Watery liquid</p> <p>Colorless</p> <p>Pleasant odor</p>	<p>Floats on water. Flammable, irritating vapor is produced.</p>
<p>Stop discharge if possible. Keep people away. Shut off ignition sources and call fire department. Stay upwind and use water spray to "knock down" vapor. Avoid contact with liquid and vapor. Isolate and remove discharged material. Notify local health and pollution control agencies.</p>		
Fire	<p>FLAMMABLE. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Wear goggles and self-contained breathing apparatus. Extinguish with dry chemical, foam, or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.</p>	
Exposure	<p>CALL FOR MEDICAL AID.</p> <p>VAPOR Irritating to eyes, nose and throat. If inhaled, will cause nausea, vomiting, headache, dizziness, difficult breathing, or loss of consciousness. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing difficult, give oxygen.</p> <p>LIQUID Irritating to skin and eyes. If swallowed, will cause nausea, vomiting or loss of consciousness. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. If IN EYES, hold eyelids open and flush with plenty of water. If SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. DO NOT INDUCE VOMITING.</p>	
Water Pollution	<p>Dangerous to aquatic life in high concentrations. Floating to shoreline. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.</p>	
<p>1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Issue warning-high flammability Evacuate area</p>		<p>2. LABEL</p> <p>2.1 Category: Flammable liquid 2.2 Class: 3</p>
<p>3. CHEMICAL DESIGNATIONS</p> <p>3.1 CG Compatibility Class: Aromatic Hydrocarbon 3.2 Formula: C₇H₈ 3.3 IMO/IUN Designation: 3.2/1294 3.4 DOT ID No.: 1204 3.5 CAS Registry No.: 106-96-3</p>		<p>4. OBSERVABLE CHARACTERISTICS</p> <p>4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless 4.3 Odor: Pungent; aromatic, benzene-like; distinct, pleasant</p>
<p style="text-align: center;">5. HEALTH HAZARDS</p> <p>5.1 Personal Protective Equipment: Air-supplied mask; goggles or face shield; plastic gloves. 5.2 Symptoms Following Exposure: Vapors irritate eyes and upper respiratory tract; cause dizziness, headache, anesthesia, respiratory arrest. Liquid irritates eyes and causes drying of skin. If aspirated, causes coughing, gagging, diarrhea, and rapidly developing pulmonary edema. If ingested causes vomiting, griping, diarrhea, depressed respiration. 5.3 Treatment of Exposure: INHALATION: remove to fresh air, give artificial respiration and oxygen if needed; call a doctor. INGESTION: do NOT induce vomiting; call a doctor. EYES: flush with water for at least 15 min. SKIN: wipe off, wash with soap and water. 5.4 Threshold Limit Value: 100 ppm 5.5 Short Term Inhalation Limits: 600 ppm for 30 min. 5.6 Toxicity by Ingestion: Grade 2; LD₅₀ = 0.5 to 5 g/kg 5.7 Late Toxicity: Kidney and liver damage may follow ingestion. 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary. 5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin. 5.10 Odor Threshold: 0.17 ppm 5.11 IDLH Value: 2,000 ppm</p>		

<p style="text-align: center;">6. FIRE HAZARDS</p> <p>6.1 Flash Point: 40°F C.C.; 55°F O.C. 6.2 Flammable Limits in Air: 1.27%-7% 6.3 Fire Extinguishing Agents: Carbon dioxide or dry chemical for small fires, ordinary foam for large fires. 6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective 6.5 Special Hazards of Combustion Products: Not pertinent 6.6 Behavior in Fire: Vapor is heavier than air and may travel a considerable distance to a source of ignition and flash back. 6.7 Ignition Temperature: 997°F 6.8 Electrical Hazard: Class I, Group D 6.9 Burning Rate: 5.7 mm/min. 6.10 Adiabatic Flame Temperature: Data not available</p> <p style="text-align: right;"><i>(Continued)</i></p>	<p style="text-align: center;">10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-T-U</p>																																				
<p style="text-align: center;">7. CHEMICAL REACTIVITY</p> <p>7.1 Reactivity With Water: No reaction 7.2 Reactivity with Common Materials: No reaction 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Molar Ratio (Reactant to Product): Data not available 7.8 Reactivity Group: 32</p>	<p style="text-align: center;">11. HAZARD CLASSIFICATIONS</p> <p>11.1 Code of Federal Regulations: Flammable liquid 11.2 NAS Hazard Rating for Bulk Water Transportation:</p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Category</th> <th style="text-align: left;">Rating</th> </tr> </thead> <tbody> <tr> <td>Fire</td> <td>3</td> </tr> <tr> <td>Health</td> <td></td> </tr> <tr> <td>Vapor Irritant</td> <td>1</td> </tr> <tr> <td>Liquid or Solid Irritant</td> <td>1</td> </tr> <tr> <td>Poisons</td> <td>2</td> </tr> <tr> <td>Water Pollution</td> <td></td> </tr> <tr> <td>Human Toxicity</td> <td>1</td> </tr> <tr> <td>Aquatic Toxicity</td> <td>3</td> </tr> <tr> <td>Aesthetic Effect</td> <td>2</td> </tr> <tr> <td>Toxicity</td> <td></td> </tr> <tr> <td>Other Chemicals</td> <td>1</td> </tr> <tr> <td>Water</td> <td>0</td> </tr> <tr> <td>Self Reaction</td> <td>0</td> </tr> </tbody> </table> <p>11.3 NFPA Hazard Classification:</p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Category</th> <th style="text-align: left;">Classification</th> </tr> </thead> <tbody> <tr> <td>Health Hazard (Blue)</td> <td>2</td> </tr> <tr> <td>Flammability (Red)</td> <td>3</td> </tr> <tr> <td>Reactivity (Yellow)</td> <td>0</td> </tr> </tbody> </table>	Category	Rating	Fire	3	Health		Vapor Irritant	1	Liquid or Solid Irritant	1	Poisons	2	Water Pollution		Human Toxicity	1	Aquatic Toxicity	3	Aesthetic Effect	2	Toxicity		Other Chemicals	1	Water	0	Self Reaction	0	Category	Classification	Health Hazard (Blue)	2	Flammability (Red)	3	Reactivity (Yellow)	0
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<p style="text-align: center;">8. WATER POLLUTION</p> <p>8.1 Aquatic Toxicity: 1180 mg/l/96 hr/sunfish/TL₅₀/fresh water 8.2 Waterfowl Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): 0%, 5 days; 38% (theor), 8 days 8.4 Food Chain Concentration Potential: None</p>	<p style="text-align: center;">12. PHYSICAL AND CHEMICAL PROPERTIES</p> <p>12.1 Physical State at 15°C and 1 atm: Liquid 12.2 Molecular Weight: 92.14 12.3 Boiling Point at 1 atm: 231.1°F = 110.6°C = 383.8°K 12.4 Freezing Point: -139°F = -95.0°C = 178.2°K 12.5 Critical Temperature: 805.4°F = 318.5°C = 591.8°K 12.6 Critical Pressure: 596.1 psia = 40.55 atm = 4.108 MN/m² 12.7 Specific Gravity: 0.867 at 20°C (liquid) 12.8 Liquid Surface Tension: 28.0 dynes/cm = 0.0280 N/m at 20°C 12.9 Liquid Water Interfacial Tension: 36.1 dynes/cm = 0.0361 N/m at 25°C 12.10 Vapor (Gas) Specific Gravity: Not pertinent 12.11 Ratio of Specific Heats of Vapor (Gas): 1.089 12.12 Latent Heat of Vaporization: 155 Btu/lb = 86.1 cal/g = 3.61 x 10⁵ J/kg 12.13 Heat of Combustion: -17,430 Btu/lb = -9686 cal/g = -405.5 x 10³ J/kg 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.25 Heat of Fusion: 17.17 cal/g 12.28 Limiting Value: Data not available 12.27 Reid Vapor Pressure: 1.1 psia</p>																																				
<p style="text-align: center;">9. SHIPPING INFORMATION</p> <p>9.1 Grades of Purity: Research, reagent, nitration at 99.8 + %; industrial: contains 94 + %, with 5% xylene and small amounts of benzene and nonaromatic hydrocarbons; 90/120: less pure than industrial. 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Open (flame arrester) or pressure-vacuum</p>	<p style="text-align: center;">6. FIRE HAZARDS (Continued)</p> <p>6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available</p>																																				

m-XYLENE

XLM

<p>Common Synonyms 1,3-Dimethylbenzene Xylol</p>	<p>Watery liquid Colorless Sweet odor</p>	<p>Floats on water. Flammable, irritating vapor is produced.</p>
<p>Stop discharge if possible. Keep people away. Call fire department. Avoid contact with liquid and vapor. Isolate and remove discharged material. Notify local health and pollution control agencies.</p>		
Fire	<p>FLAMMABLE Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Wear self-contained breathing apparatus. Extinguish with foam, dry chemical, or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.</p>	
Exposure	<p>CALL FOR MEDICAL AID.</p> <p>VAPOR Irritating to eyes, nose, and throat. If inhaled, will cause headache, difficult breathing, or loss of consciousness. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen.</p> <p>LIQUID Irritating to skin and eyes. If swallowed, will cause nausea, vomiting, or loss of consciousness. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES: hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. DO NOT INDUCE VOMITING.</p>	
Water Pollution	<p>HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. Fouling to shoreline. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.</p>	
<p>1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Issue warning-high flammability Evacuate area Should be removed Chemical and physical treatment</p>	<p>2. LABEL 2.1 Category: Flammable liquid 2.2 Class: 3</p>	
<p>3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Aromatic Hydrocarbon 3.2 Formula: m-C₆H₄(CH₃)₂ 3.3 IMO/UN Designation: 3.2/1307 3.4 DOT ID No.: 1307 3.5 CAS Registry No.: 108-38-3</p>	<p>4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless 4.3 Odor: Like benzene; characteristic aromatic</p>	
5. HEALTH HAZARDS		
<p>5.1 Personal Protective Equipment: Approved canister or air-supplied mask; goggles or face shield; plastic gloves and boots. 5.2 Symptoms Following Exposure: Vapors cause headache and dizziness. Liquid irritates eyes and skin. If taken into lungs, causes severe coughing, distress, and rapidly developing pulmonary edema. If ingested, causes nausea, vomiting, cramps, headache, and coma; can be fatal. Kidney and liver damage can occur. 5.3 Treatment of Exposure: INHALATION: remove to fresh air; administer artificial respiration and oxygen if required; call a doctor. INGESTION: do NOT induce vomiting; call a doctor. EYES: flush with water for at least 15 min. SKIN: wipe off, wash with soap and water. 5.4 Threshold Limit Value: 100 ppm 5.5 Short Term Inhalation Limits: 300 ppm for 30 min. 5.6 Toxicity by Ingestion: Grade 3; LD₅₀ = 50 to 500 g/kg 5.7 Late Toxicity: Kidney and liver damage. 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight stinging of the eyes or respiratory system if present in high concentrations. The effect is temporary. 5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause stinging and reddening of the skin. 5.10 Odor Threshold: 0.05 ppm 5.11 IDLH Value: 10,000 ppm</p>		

<p>6. FIRE HAZARDS 6.1 Flash Point: 84°F C.C. 6.2 Flammable Limits in Air: 1.1%-6.4% 6.3 Fire Extinguishing Agents: Foam, dry chemical, or carbon dioxide 6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective. 6.5 Special Hazards of Combustion Products: Not pertinent 6.6 Behavior in Fire: Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back. 6.7 Ignition Temperature: 986°F 6.8 Electrical Hazard: Class I, Group D 6.9 Burning Rate: 5.8 mm/min. 6.10 Adiabatic Flame Temperature: Data not available 6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available</p>	
<p>7. CHEMICAL REACTIVITY 7.1 Reactivity With Water: No reaction 7.2 Reactivity with Common Materials: No reaction 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Molar Ratio (Reactant to Product): Data not available 7.8 Reactivity Group: 32</p>	
<p>8. WATER POLLUTION 8.1 Aquatic Toxicity: 22 ppm/96 hr/bluegill/TL₅₀/fresh water 8.2 Waterfowl Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): 0 lb/lb, 5 days; 0% (theor.), 8 days 8.4 Food Chain Concentration Potential: Data not available</p>	
<p>9. SHIPPING INFORMATION 9.1 Grades of Purity: Research: 99.99%; Pure: 99.9%; Technical: 99.2% 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Open (flame arrester) or pressure-vacuum</p>	
NOTES	

<p>10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-T-U</p>																																					
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12. PHYSICAL AND CHEMICAL PROPERTIES																																					
<p>12.1 Physical State at 15°C and 1 atm: Liquid 12.2 Molecular Weight: 106.16 12.3 Boiling Point at 1 atm: 269.4°F = 131.9°C = 405.1°K 12.4 Freezing Point: -54.2°F = -47.9°C = 225.3°K 12.5 Critical Temperature: 550.8°F = 343.8°C = 617.0°K 12.6 Critical Pressure: 513.8 atm = 34.95 psia = 3.540 MN/m² 12.7 Specific Gravity: 0.864 at 20°C (liquid) 12.8 Liquid Surface Tension: 28.6 dynes/cm = 0.0286 N/m at 20°C 12.9 Liquid Water Interfacial Tension: 36.4 dynes/cm = 0.0364 N/m at 30°C 12.10 Vapor (Gas) Specific Gravity: Not pertinent 12.11 Ratio of Specific Heats of Vapor (Gas): 1.071 12.12 Latent Heat of Vaporization: 147 Btu/lb = 81.9 cal/g = 3.43 X 10⁵ J/kg 12.13 Heat of Combustion: -17,554 Btu/lb = -9752.4 cal/g = -408.31 X 10³ J/kg 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.25 Heat of Fusion: 26.01 cal/g 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: 0.34 psia</p>																																					

O-XYLENE

XLO

<p>Common Synonyms 1, 2-Dimethylbenzene Xylol</p>	<p>Watery liquid Colorless Sweet odor</p> <p>Floats on water. Flammable, irritating vapor is produced.</p>
<p>Stop discharge if possible. Keep people away. Call fire department. Avoid contact with liquid and vapor. Isolate and remove discharged material. Notify local health and pollution control agencies.</p>	
<p style="text-align: center;">Fire</p>	<p>FLAMMABLE Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Wear self-contained breathing apparatus. Extinguish with foam, dry chemical, or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.</p>
<p style="text-align: center;">Exposure</p>	<p>CALL FOR MEDICAL AID.</p> <p>VAPOR Irritating to eyes, nose and throat. If inhaled, will cause headache, difficult breathing, or loss of consciousness. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen.</p> <p>LIQUID Irritating to skin and eyes. If swallowed, will cause nausea, vomiting, or loss of consciousness. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. DO NOT INDUCE VOMITING.</p>
<p style="text-align: center;">Water Pollution</p>	<p>Dangerous to aquatic life in high concentrations. Fouling to shoreline. May be dangerous if it enters water intakes.</p> <p>Notify local health and wildlife officials. Notify operators of nearby water intakes.</p>
<p style="text-align: center;">1. RESPONSE TO DISCHARGE (See Response Methods Handbook)</p> <p>Issue warning-high flammability Evacuate area Should be removed Chemical and physical treatment</p>	<p style="text-align: center;">2. LABEL</p> <p>2.1 Category: Flammable liquid 2.2 Class: 3</p>
<p style="text-align: center;">3. CHEMICAL DESIGNATIONS</p> <p>3.1 CG Compatibility Class: Aromatic Hydrocarbon 3.2 Formula: $C_{10}H_{12}$ (CH₃)₂ 3.3 IMO/UN Designation: 3.2/1307 3.4 DOT ID No.: 1307 3.5 CAS Registry No.: 95-47-6</p>	<p style="text-align: center;">4. OBSERVABLE CHARACTERISTICS</p> <p>4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless 4.3 Odor: Benzene-like, characteristic aromatic</p>
<p>5. HEALTH HAZARDS</p>	
<p>5.1 Personal Protective Equipment: Approved canister or air-supplied mask; goggles or face shield; plastic gloves and boots.</p> <p>5.2 Symptoms Following Exposure: Vapors cause headache and dizziness. Liquid irritates eyes and skin. If taken into lungs, causes severe coughing, distress, and rapidly developing pulmonary edema. If ingested, causes nausea, vomiting, cramps, headache, and coma. Can be fatal. Kidney and liver damage can occur.</p> <p>5.3 Treatment of Exposure: INHALATION: remove to fresh air; administer artificial respiration and oxygen if required; call a doctor. INGESTION: do NOT induce vomiting; call a doctor. EYES: flush with water for at least 15 min. SKIN: wipe off, wash with soap and water.</p> <p>5.4 Threshold Limit Value: 100 ppm 5.5 Short Term Inhalation Limits: 300 ppm for 30 min. 5.6 Toxicity by Ingestion: Grade 3; LD₅₀ = 50 to 500 mg/kg 5.7 Late Toxicity: Kidney and liver damage. 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary. 5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin. 5.10 Odor Threshold: 0.05 ppm 5.11 IDLH Value: 10,000 ppm</p>	

<p>6. FIRE HAZARDS</p>
<p>6.1 Flash Point: 63°F C.C.; 75°F D.C. 6.2 Flammable Limits in Air: 1.1%-7.0% 6.3 Fire Extinguishing Agents: Foam, dry chemical, or carbon dioxide 6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective. 6.5 Special Hazards of Combustion Products: Not pertinent 6.6 Behavior in Fire: Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back. 6.7 Ignition Temperature: 569°F 6.8 Electrical Hazard: Class I, Group D 6.9 Burning Rate: 5.5 mm/min. 6.10 Adiabatic Flame Temperature: Data not available 6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available</p>
<p>7. CHEMICAL REACTIVITY</p>
<p>7.1 Reactivity With Water: No reaction 7.2 Reactivity With Common Materials: No reaction 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Molar Ratio (Reactant to Product): Data not available 7.8 Reactivity Group: 32</p>

<p>8. WATER POLLUTION</p>
<p>8.1 Aquatic Toxicity: >100 mg/l/96 hr/D. magna/TL₅₀/fresh water 8.2 Waterfowl Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): 0 lb/lb. 5 days: 2.5% (theor.), 6 days 8.4 Food Chain Concentration Potential: Data not available</p>

<p>9. SHIPPING INFORMATION</p>
<p>9.1 Grades of Purity: Research: 99.99%; Pure: 99.7%; Commercial: 95+ % 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No reaction 9.4 Venting: Open (flame arrester) or pressure-vacuum</p>

<p>10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-T-U</p>																																				
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<p>12. PHYSICAL AND CHEMICAL PROPERTIES</p>
<p>12.1 Physical State at 15°C and 1 atm: Liquid 12.2 Molecular Weight: 106.16 12.3 Boiling Point at 1 atm: 291.8°F = 144.4°C = 417.6°K 12.4 Freezing Point: -13.3°F = -25.2°C = 248.0°K 12.5 Critical Temperature: 674.8°F = 357.1°C = 630.3°K 12.6 Critical Pressure: 541.5 atm = 36.84 psia = 3.732 MN/m² 12.7 Specific Gravity: 0.880 at 20°C (liquid) 12.8 Liquid Surface Tension: 30.53 dynes/cm = 0.03053 N/m at 15.5°C 12.9 Liquid Water Interfacial Tension: 35.06 dynes/cm = 0.03506 N/m at 20°C 12.10 Vapor (Gas) Specific Gravity: Not pertinent 12.11 Ratio of Specific Heats of Vapor (Gas): 1.068 12.12 Latent Heat of Vaporization: 149 Btu/lb = 82.9 cal/g = 3.47 X 10⁴ J/kg 12.13 Heat of Combustion: -17,556 Btu/lb = -9754.7 cal/g = -408.41 X 10³ J/kg 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.25 Heat of Fusion: 30.84 cal/g 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: 0.28 psia</p>

NOTES

p-XYLENE

XLP

Common Synonyms 1, 4-Dimethylbenzene Xylol		Watery liquid	Colorless	Sweet odor
Floats on water. Flammable, irritating vapor is produced. Freezing point is 56°F.				
Stop discharge if possible. Keep people away. Call fire department. Avoid contact with liquid and vapor. Isolate and remove discharged material. Notify local health and pollution control agencies.				
Fire	FLAMMABLE Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Wear self-contained breathing apparatus. Extinguish with foam, dry chemical, or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.			
	VAPOR Irritating to eyes, nose and throat. If inhaled, will cause dizziness, difficult breathing, or loss of consciousness. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen.			
Exposure	LIQUID Irritating to skin and eyes. If swallowed, will cause nausea, vomiting, loss of consciousness. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. DO NOT INDUCE VOMITING.			
	CALL FOR MEDICAL AID.			
Water Pollution	HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. Fouling to shoreline. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.			
	1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Issue warning-high flammability Evacuate area Should be removed Chemical and physical treatment		2. LABEL 2.1 Category: Flammable liquid 2.2 Class: 3	
3. CHEMICAL DESIGNATIONS 3.1 CG Competibility Class: Aromatic Hydrocarbon 3.2 Formula: p-C ₆ H ₄ (CH ₃) ₂ 3.3 HMO/UM Designation: 3.2/1307 3.4 DOT ID No.: 1307 3.5 CAS Registry No.: 106-42-3		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless 4.3 Odor: Like benzene; characteristic aromatic		
5. HEALTH HAZARDS				
5.1 Personal Protective Equipment: Approved canister or air-supplied mask; goggles or face shield; plastic gloves and boots. 5.2 Symptoms Following Exposure: Vapors cause headache and dizziness. Liquid irritates eyes and skin. If taken into lungs, causes severe coughing, distress, and rapidly developing pulmonary edema. If ingested, causes nausea, vomiting, cramps, headache, and coma. Can be fatal. Kidney and liver damage can occur. 5.3 Treatment of Exposure: INHALATION: remove to fresh air; administer artificial respiration and oxygen if required; call a doctor. INGESTION: do NOT induce vomiting; call a doctor. EYES: flush with water for at least 15 min. SKIN: wipe off, wash with soap and water. 5.4 Threshold Limit Value: 100 ppm 5.5 Short Term Inhalation Limits: 300 ppm for 30 min. 5.6 Toxicity by Ingestion: Grade 3; LD ₅₀ = 50 to 500 mg/kg 5.7 Late Toxicity: Kidney and liver damage. 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary. 5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin. 5.10 Odor Threshold: 0.05 ppm 5.11 IDLN Value: 10,000 ppm				

6. FIRE HAZARDS 6.1 Flash Point: 81°F C.C. 6.2 Flammable Limits in Air: 1.1%-6.6% 6.3 Fire Extinguishing Agents: Foam, dry chemical, or carbon dioxide 6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective. 6.5 Special Hazards of Combustion Products: Not pertinent 6.6 Behavior in Fire: Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back. 6.7 Ignition Temperature: 870°F 6.8 Electrical Hazard: Class I, Group D 6.9 Burning Rate: 5.8 mm/min. 6.10 Adiabatic Flame Temperature: Data not available 6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available		7. CHEMICAL REACTIVITY 7.1 Reactivity With Water: No reaction 7.2 Reactivity with Common Materials: No reaction 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Molar Ratio (Reactant to Product): Data not available 7.8 Reactivity Group: 32	
8. WATER POLLUTION 8.1 Aquatic Toxicity: 22 ppm/96 hr/bluegill/TL ₅₀ /fresh water 8.2 Waterfowl Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): 0 lb/lb in 5 days 8.4 Food Chain Concentration Potential: Data not available		9. SHIPPING INFORMATION 9.1 Grades of Purity: Research: 99.99%; Pure: 99.8%; Technical: 99.0% 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Open (flame arrester) or pressure-vacuum	

10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-T-U																													
11. HAZARD CLASSIFICATIONS																													
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12. PHYSICAL AND CHEMICAL PROPERTIES																													
12.1 Physical State at 16°C and 1 atm: Liquid 12.2 Molecular Weight: 106.16 12.3 Boiling Point at 1 atm: 280.9°F = 138.3°C = 411.5°K 12.4 Freezing Point: 55.9°F = 13.3°C = 286.5°K 12.5 Critical Temperature: 649.4°F = 343.0°C = 616.2°K 12.6 Critical Pressure: 509.4 atm = 34.65 psia = 3.510 MN/m ² 12.7 Specific Gravity: 0.861 at 20°C (liquid) 12.8 Liquid Surface Tension: 28.3 dynes/cm = 0.0283 N/m at 20°C 12.9 Liquid Water Interfacial Tension: 37.8 dynes/cm = 0.0378 N/m at 20°C 12.10 Vapor (Gas) Specific Gravity: Not pertinent 12.11 Ratio of Specific Heats of Vapor (Gas): 1.071 12.12 Latent Heat of Vaporization: 150 Btu/lb = 81 cal/g = 3.4 x 10 ⁵ J/kg 12.13 Heat of Combustion: -17,558 Btu/lb = -8754.7 cal/g = -406.41 x 10 ⁴ J/kg 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.18 Heat of Polymerization: Not pertinent 12.25 Heat of Fusion: 37.83 cal/g 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: 0.34 psia																													
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ETHYLBENZENE

ETB

Common Synonyms Phenylthane EB		Liquid Colorless Sweet, gasoline-like odor
Floats on water. Flammable, irritating vapor is produced.		
Avoid contact with liquid and vapor. Keep people away. Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves). Shut off ignition sources and call fire department. Stop discharge if possible. Stay upwind and use water spray to "knock down" vapor. Isolate and remove discharged material. Notify local health and pollution control agencies.		
Fire	FLAMMABLE. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves). Extinguish with dry chemical, foam, or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.	
Exposure	CALL FOR MEDICAL AID. VAPOR Irritating to eyes, nose and throat. If inhaled, will cause dizziness or difficult breathing. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. LIQUID Will burn skin and eyes. Harmful if swallowed. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. DO NOT INDUCE VOMITING.	
Water Pollution	HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. Fouling to shoreline. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.	
1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Mechanical containment Should be removed Chemical and physical treatment		2. LABEL 2.1 Category: Flammable liquid 2.2 Class: 3
3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Aromatic hydrocarbon 3.2 Formula: C ₈ H ₁₀ CH ₃ 3.3 IMO/UN Designation: 3.3/1175 3.4 DOT ID No.: 1175 3.6 CAS Registry No.: 100-41-4		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless 4.3 Odor: Aromatic
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Self-contained breathing apparatus; safety goggles. 5.2 Symptoms Following Exposure: Inhalation may cause irritation of nose, dizziness, depression. Moderate irritation of eye with corneal injury possible. Irritates skin and may cause blisters. 5.3 Treatment of Exposure: INHALATION: If ill effects occur, remove victim to fresh air, keep him warm and quiet, and get medical help promptly; if breathing stops, give artificial respiration. INGESTION: induce vomiting only upon physician's approval; material in lung may cause chemical pneumonitis. SKIN AND EYES: promptly flush with plenty of water (15 min. for eyes) and get medical attention, remove and wash contaminated clothing before reuse. 5.4 Threshold Limit Value: 100 ppm 5.5 Short Term Inhalation Limits: 200 ppm for 30 min. 5.6 Toxicity by Ingestion: Grade 2; LD ₅₀ = 0.5 to 5 g/kg (rat) 5.7 Late Toxicity: Data not available 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect is temporary. 5.9 Liquid or Solid Irritant Characteristics: Causes smarting of the skin and first-degree burns on short exposure; may cause secondary burns on long exposure. 5.10 Odor Threshold: 140 ppm 5.11 IDLH Value: 2,000 ppm		

6. FIRE HAZARDS 6.1 Flash Point: 80°F D.C., 59°F C.C. 6.2 Flammable Limits in Air: 1.0%-6.7% 6.3 Fire Extinguishing Agents: Foam (most effective), water fog, carbon dioxide or dry chemical. 6.4 Fire Extinguishing Agents Not to be Used: Not pertinent 6.5 Special Hazards of Combustion Products: Irritating vapors are generated when heated. 6.6 Behavior in Fire: Vapor is heavier than air and may travel considerable distance to the source of ignition and flash back. 6.7 Ignition Temperature: 860°F 6.8 Electrical Hazard: Not pertinent 6.9 Burning Rate: 5.8 mm/min. 6.10 Adiabatic Flame Temperature: Data Not Available (Continued)	10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-T-U 11. HAZARD CLASSIFICATIONS 11.1 Code of Federal Regulations: Flammable liquid 11.2 NAS Hazard Rating for Bulk Water Transportation: <table border="1"> <thead> <tr> <th>Category</th> <th>Rating</th> </tr> </thead> <tbody> <tr> <td>Fire</td> <td>3</td> </tr> <tr> <td>Health</td> <td></td> </tr> <tr> <td>Vapor Irritant</td> <td>2</td> </tr> <tr> <td>Liquid or Solid Irritant</td> <td>2</td> </tr> <tr> <td>Poisons</td> <td>2</td> </tr> <tr> <td>Water Pollution</td> <td></td> </tr> <tr> <td>Human Toxicity</td> <td>1</td> </tr> <tr> <td>Aquatic Toxicity</td> <td>3</td> </tr> <tr> <td>Aesthetic Effect</td> <td>2</td> </tr> <tr> <td>Reactivity</td> <td></td> </tr> <tr> <td>Other Chemicals</td> <td>1</td> </tr> <tr> <td>Water</td> <td>0</td> </tr> <tr> <td>Salt Reaction</td> <td>0</td> </tr> </tbody> </table> 11.3 NFPA Hazard Classification: <table border="1"> <thead> <tr> <th>Category</th> <th>Classification</th> </tr> </thead> <tbody> <tr> <td>Health Hazard (Blue)</td> <td>2</td> </tr> <tr> <td>Flammability (Red)</td> <td>3</td> </tr> <tr> <td>Reactivity (Yellow)</td> <td>0</td> </tr> </tbody> </table>	Category	Rating	Fire	3	Health		Vapor Irritant	2	Liquid or Solid Irritant	2	Poisons	2	Water Pollution		Human Toxicity	1	Aquatic Toxicity	3	Aesthetic Effect	2	Reactivity		Other Chemicals	1	Water	0	Salt Reaction	0	Category	Classification	Health Hazard (Blue)	2	Flammability (Red)	3	Reactivity (Yellow)	0
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8. WATER POLLUTION 8.1 Aquatic Toxicity: 26 ppm/96 hr/bluegill/TL ₅₀ /fresh water 8.2 Waterfowl Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): 2.8% (theor.), 5 days 8.4 Food Chain Concentration Potential: None																																					
9. SHIPPING INFORMATION 9.1 Grades of Purity: Research grade: 99.98%; pure grade: 99.5%; technical grade: 99.0% 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Open (flame arrester) or pressure-vacuum																																					
6. FIRE HAZARDS (Continued) 6.11 Stoichiometric Air to Fuel Ratio: Data Not Available 6.12 Flame Temperature: Data Not Available																																					

KEROSENE

KRS

<p>Common Synonyms</p> <p>Illuminating of Kerosine Range of Fuel oil No. 1 Jet Fuel: JP-1</p>	<p>Watery liquid</p> <p>Colorless</p> <p>Fuel oil odor</p> <p>Floats on water.</p>	
<p>Stop discharge if possible. Call fire department. Avoid contact with liquid. Isolate and remove discharged material. Notify local health and pollution control agencies.</p>		
Fire	<p>Combustible. Extinguish with dry chemical, foam, or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.</p>	
Exposure	<p>CALL FOR MEDICAL AID.</p> <p>LIQUID Irritating to skin and eyes. Harmful if swallowed. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. DO NOT INDUCE VOMITING.</p>	
Water Pollution	<p>Dangerous to aquatic life in high concentrations. Floating to shoreline. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.</p>	
<p>1. RESPONSE TO DISCHARGE (See Response Methods Handbook)</p> <p>Mechanical containment Should be removed Chemical and physical treatment</p>		<p>2. LABEL</p> <p>2.1 Category: None 2.2 Class: Not pertinent</p>
<p>3. CHEMICAL DESIGNATIONS</p> <p>3.1 CG Compatibility Class: Miscellaneous Hydrocarbon Mixtures 3.2 Formula: C₁₂H₂₆+s 3.3 IMO/UN Designation: 3.3/1223 3.4 DOT ID No.: 1223 3.5 CAS Registry No.: 8008-20-8</p>		<p>4. OBSERVABLE CHARACTERISTICS</p> <p>4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless to light brown 4.3 Odor: Characteristic</p>
<p>5. HEALTH HAZARDS</p>		
<p>5.1 Personal Protective Equipment: Protective gloves; goggles or face shield. 5.2 Symptoms Following Exposure: Vapor causes slight irritation of eyes and nose. Liquid irritates stomach; if taken into lungs, causes coughing, distress, and rapidly developing pulmonary edema. 5.3 Treatment of Exposure: ASPIRATION: enforce bed rest; administer oxygen; call a doctor. INGESTION: do NOT induce vomiting; call a doctor. EYES: wash with plenty of water. SKIN: wipe off and wash with soap and water. 5.4 Threshold Limit Value: 200 ppm 5.5 Short Term Inhalation Limits: 2500 mg/m³ for 60 min. 5.6 Toxicity by Ingestion: Grade 1: LD₅₀ = 5 to 15 g/kg 5.7 Late Toxicity: Data not available 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight stinging of the eyes or respiratory system if present in high concentrations. The effect is temporary. 5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause stinging and reddening of the skin. 5.10 Odor Threshold: 1 ppm 5.11 IDLM Value: Data not available</p>		

<p>6. FIRE HAZARDS</p> <p>6.1 Flash Point: 100°F (min.)C.C. 6.2 Flammable Limits In Air: 0.7%-5% 6.3 Fire Extinguishing Agents: Foam, dry chemical, or carbon dioxide 6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective 6.5 Special Hazards of Combustion Products: Not pertinent 6.6 Behavior in Fire: Not pertinent 6.7 Ignition Temperature: 444°F 6.8 Electrical Hazard: Not pertinent 6.9 Burning Rate: 4 mm/min. 6.10 Adiabatic Flame Temperature: Data not available 6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available</p> <p>7. CHEMICAL REACTIVITY</p> <p>7.1 Reactivity With Water: No reaction 7.2 Reactivity with Common Materials: No reaction 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Molar Ratio (Reactant to Product): Data not available 7.8 Reactivity Group: 33</p> <p>8. WATER POLLUTION</p> <p>8.1 Aquatic Toxicity: 2990 ppm/24 hr/bluegill/TL₅₀/fresh water 8.2 Waterfowl Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): 53%, 5 days 8.4 Food Chain Concentration Potential: None</p> <p>9. SHIPPING INFORMATION</p> <p>9.1 Grades of Purity: Light hydrocarbon distillate: 100% 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Open (flame arrester)</p>	<p>10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-T-U</p> <p>11. HAZARD CLASSIFICATIONS</p> <p>11.1 Code of Federal Regulations: Combustible liquid 11.2 NAS Hazard Rating for Bulk Water Transportation:</p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Category</th> <th style="text-align: left;">Rating</th> </tr> </thead> <tbody> <tr> <td>Fire.....</td> <td>2</td> </tr> <tr> <td>Health</td> <td></td> </tr> <tr> <td>Vapor Irritant.....</td> <td>1</td> </tr> <tr> <td>Liquid or Solid Irritant.....</td> <td>1</td> </tr> <tr> <td>Poisons.....</td> <td>1</td> </tr> <tr> <td>Water Pollution</td> <td></td> </tr> <tr> <td>Human Toxicity.....</td> <td>1</td> </tr> <tr> <td>Aquatic Toxicity.....</td> <td>1</td> </tr> <tr> <td>Aesthetic Effect.....</td> <td>3</td> </tr> <tr> <td>Reactivity</td> <td></td> </tr> <tr> <td>Other Chemicals.....</td> <td>0</td> </tr> <tr> <td>Water.....</td> <td>0</td> </tr> <tr> <td>Sol Reaction.....</td> <td>0</td> </tr> <tr> <td>11.3 NFPA Hazard Classification:</td> <td></td> </tr> <tr> <td>Category</td> <td>Classification</td> </tr> <tr> <td>Health Hazard (Blue).....</td> <td>0</td> </tr> <tr> <td>Flammability (Red).....</td> <td>2</td> </tr> <tr> <td>Reactivity (Yellow).....</td> <td>0</td> </tr> </tbody> </table> <p>12. PHYSICAL AND CHEMICAL PROPERTIES</p> <p>12.1 Physical State at 15°C and 1 atm: Liquid 12.2 Molecular Weight: Not pertinent 12.3 Boiling Point at 1 atm: 392-500°F = 200-260°C = 473-533°K 12.4 Freezing Point: -50°F = -45.6°C = 227.6°K 12.5 Critical Temperature: Not pertinent 12.6 Critical Pressure: Not pertinent 12.7 Specific Gravity: 0.80 at 15°C (liquid) 12.8 Liquid Surface Tension: 23-32 dynes/cm = 0.023-0.032 N/m at 20°C 12.9 Liquid Water Interfacial Tension: 47-49 dynes/cm = 0.047-0.049 N/m at 20°C 12.10 Vapor (Gas) Specific Gravity: Not pertinent 12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent 12.12 Latent Heat of Vaporization: 110 Btu/lb = 60 cal/g = 2.5 X 10⁴ J/kg 12.13 Heat of Combustion: -18,540 Btu/lb = -10,300 cal/g = -431.24 X 10⁴ J/kg 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.25 Heat of Fusion: Data not available 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: 0.1 psia</p> <p style="text-align: center;">NOTES</p>	Category	Rating	Fire.....	2	Health		Vapor Irritant.....	1	Liquid or Solid Irritant.....	1	Poisons.....	1	Water Pollution		Human Toxicity.....	1	Aquatic Toxicity.....	1	Aesthetic Effect.....	3	Reactivity		Other Chemicals.....	0	Water.....	0	Sol Reaction.....	0	11.3 NFPA Hazard Classification:		Category	Classification	Health Hazard (Blue).....	0	Flammability (Red).....	2	Reactivity (Yellow).....	0
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Other Chemicals.....	0																																						
Water.....	0																																						
Sol Reaction.....	0																																						
11.3 NFPA Hazard Classification:																																							
Category	Classification																																						
Health Hazard (Blue).....	0																																						
Flammability (Red).....	2																																						
Reactivity (Yellow).....	0																																						

OILS, FUEL: 1-D

OOD

<p>Common Synonyms Diesel oil (light)</p>	<p>Oil liquid Yellow-brown Lube or fuel of odor</p> <p>Floats on water.</p>
<p>Stop discharge, if possible. Call fire department. Avoid contact with liquid. Isolate and remove discharged material. Notify local health and pollution control agencies.</p>	
Fire	<p>Combustible. Extinguish with dry chemical, foam or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.</p>
Exposure	<p>CALL FOR MEDICAL AID.</p> <p>LIQUID Irritating to skin and eyes. Harmful if swallowed. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. DO NOT INDUCE VOMITING.</p>
Water Pollution	<p>Dangerous to aquatic life in high concentrations. Fouling to shoreline. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.</p>
<p>1. RESPONSE TO DISCHARGE (See Response Methods Handbook)</p> <p>Mechanical containment Should be removed Chemical and physical treatment</p>	<p>2. LABEL</p> <p>2.1 Category: None 2.2 Class: Not pertinent</p>
<p>3. CHEMICAL DESIGNATIONS</p> <p>3.1 CG Compatibility Class: Miscellaneous Hydrocarbon Mixtures</p> <p>3.2 Formula: Not applicable</p> <p>3.3 IMO/UN Designation: 3.1/1270</p> <p>3.4 DOT ID No.: 1270</p> <p>3.5 CAS Registry No.: Data not available</p>	<p>4. OBSERVABLE CHARACTERISTICS</p> <p>4.1 Physical State (as shipped): Liquid 4.2 Color: Light brown 4.3 Odor: Characteristic</p>
<p>5. HEALTH HAZARDS</p> <p>5.1 Personal Protective Equipment: Protective gloves; goggles or face shield.</p> <p>5.2 Symptoms Following Exposure: INHALATION causes headache and slight dizziness. INGESTION causes nausea, vomiting, and cramping; depression of central nervous system ranging from mild headache to anesthesia, coma, and death; pulmonary irritation secondary to exhalation of solvent; signs of kidney and liver damage may be delayed. ASPIRATION causes severe lung irritation with coughing, gagging, dyspnea, substernal distress, and rapidly developing pulmonary edema; later, signs of bronchopneumonia and pneumonitis; acute onset of central nervous system excitement followed by depression.</p> <p>5.3 Treatment of Exposure: INGESTION: do NOT induce vomiting; seek medical attention. ASPIRATION: enforce bed rest; administer oxygen. EYES: wash with copious quantity of water. SKIN: remove solvent by wiping and wash with soap and water.</p> <p>5.4 Threshold Limit Value: No single value applicable.</p> <p>5.5 Short Term Inhalation Limits: Data not available</p> <p>5.6 Toxicity by Ingestion: Grade 1; LD₅₀ = 5-15 g/kg</p> <p>5.7 Late Toxicity: Data not available</p> <p>5.8 Vapor (Gas) Irritant Characteristics: Slight smarting of eyes or respiratory system if present in high concentrations. The effect is temporary.</p> <p>5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of skin.</p> <p>5.10 Odor Threshold: 0.7 ppm</p> <p>5.11 IDLH Value: Data not available</p>	

<p>6. FIRE HAZARDS</p> <p>6.1 Flash Point: 100°F C.C.</p> <p>6.2 Flammable Limits in Air: 1.3%-8%</p> <p>6.3 Fire Extinguishing Agents: Dry chemical, foam, or carbon dioxide</p> <p>6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective.</p> <p>6.5 Special Hazards of Combustion Products: Not pertinent</p> <p>6.6 Behavior in Fire: Not pertinent</p> <p>6.7 Ignition Temperature: 350-825°F</p> <p>6.8 Electrical Hazard: Not pertinent</p> <p>6.9 Burning Rate: 4 mm/min.</p> <p>6.10 Adiabatic Flame Temperature: Data not available</p> <p>6.11 Stoichiometric Air to Fuel Ratio: Data not available</p> <p>6.12 Flame Temperature: Data not available</p>	<p>10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-T-U</p>								
<p>7. CHEMICAL REACTIVITY</p> <p>7.1 Reactivity With Water: No reaction</p> <p>7.2 Reactivity with Common Materials: No reaction</p> <p>7.3 Stability During Transport: Stable</p> <p>7.4 Neutralizing Agents for Acids and Caustics: Not pertinent</p> <p>7.5 Polymerization: Not pertinent</p> <p>7.6 Inhibitor of Polymerization: Not pertinent</p> <p>7.7 Molar Ratio (Reactant to Product): Data not available</p> <p>7.8 Reactivity Group: 33</p>	<p>11. HAZARD CLASSIFICATIONS</p> <p>11.1 Code of Federal Regulations: Combustible liquid</p> <p>11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed</p> <p>11.3 NFPA Hazard Classification:</p> <table style="width: 100%; border: none;"> <tr> <td style="text-align: right;">Category</td> <td style="text-align: right;">Classification</td> </tr> <tr> <td style="text-align: right;">Health Hazard (Blue)</td> <td style="text-align: right;">0</td> </tr> <tr> <td style="text-align: right;">Flammability (Red)</td> <td style="text-align: right;">2</td> </tr> <tr> <td style="text-align: right;">Reactivity (Yellow)</td> <td style="text-align: right;">0</td> </tr> </table>	Category	Classification	Health Hazard (Blue)	0	Flammability (Red)	2	Reactivity (Yellow)	0
Category	Classification								
Health Hazard (Blue)	0								
Flammability (Red)	2								
Reactivity (Yellow)	0								
<p>8. WATER POLLUTION</p> <p>8.1 Aquatic Toxicity: 204 mg/1/24 hr/Juvenile American shad/TL₅₀/salt water</p> <p>8.2 Waterfowl Toxicity: 20 mg/kg LD₅₀ (mallard)</p> <p>8.3 Biological Oxygen Demand (BOD): Data not available</p> <p>8.4 Food Chain Concentration Potential: None</p>	<p>12. PHYSICAL AND CHEMICAL PROPERTIES</p> <p>12.1 Physical State at 15°C and 1 atm: Liquid</p> <p>12.2 Molecular Weight: Not pertinent</p> <p>12.3 Boiling Point at 1 atm: 380-560°F = 193-293°C = 466-566°K</p> <p>12.4 Freezing Point: -30°F = -34°C = 240°K</p> <p>12.5 Critical Temperature: Not pertinent</p> <p>12.6 Critical Pressure: Not pertinent</p> <p>12.7 Specific Gravity: 0.81-0.85 at 15°C (liquid)</p> <p>12.8 Liquid Surface Tension: 23-32 dynes/cm = 0.023-0.032 N/m at 20°C</p> <p>12.9 Liquid Water Interfacial Tension: 47-49 dynes/cm = 0.047-0.049 N/m at 20°C</p> <p>12.10 Vapor (Gas) Specific Gravity: Not pertinent</p> <p>12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent</p> <p>12.12 Latent Heat of Vaporization: 110 Btu/lb = 60 cal/g = 2.5 X 10⁷ J/kg</p> <p>12.13 Heat of Combustion: -18,540 Btu/lb = -10,300 cal/g = -431.24 X 10³ J/kg</p> <p>12.14 Heat of Decomposition: Not pertinent</p> <p>12.15 Heat of Solution: Not pertinent</p> <p>12.16 Heat of Polymerization: Not pertinent</p> <p>12.17 Heat of Fusion: Data not available</p> <p>12.18 Limiting Value: Data not available</p> <p>12.19 Reid Vapor Pressure: Data not available</p>								
<p>9. SHIPPING INFORMATION</p> <p>9.1 Grades of Purity: Diesel fuel 1-D (ASTM)</p> <p>9.2 Storage Temperature: Ambient</p> <p>9.3 Inert Atmosphere: No requirement</p> <p>9.4 Venting: Open (flame arrester)</p>	<p style="text-align: center;">NOTES</p>								

OILS, FUEL: 2-D

OTD

Common Synonyms Diesel oil, medium	Oily liquid Floats on water.	Yellow-brown	Lube or fuel oil odor
Stop discharge if possible. Call fire department. Avoid contact with liquid. Isolate and remove discharged material. Notify local health and pollution control agencies.			
Fire	Combustible. Extinguish with dry chemical, foam, carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.		
Exposure	CALL FOR MEDICAL AID. LIQUID Irritating to skin and eyes. Harmful if swallowed. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED, and victim is CONSCIOUS, have victim drink water or milk. DO NOT INDUCE VOMITING.		
Water Pollution	Dangerous to aquatic life in high concentrations. Floating to shoreline. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.		
1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Mechanical containment Should be removed Chemical and physical treatment	2. LABEL 2.1 Category: None 2.2 Class: Not pertinent		
3. CHEMICAL DESIGNATIONS 3.1 CO Compatibility Class: Miscellaneous Hydrocarbon Mixtures 3.2 Formula: Not applicable 3.3 IMO/UN Designation: 3.1/1270 3.4 DOT ID No.: 1270 3.5 CAS Registry No.: Data not available	4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Light brown 4.3 Odor: Characteristic		
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Protective gloves; goggles or face shield. 5.2 Symptoms Following Exposure: INGESTION causes nausea, vomiting, and cramping; depression of central nervous system ranging from mild headache to anesthesia, coma, and death; pulmonary irritation secondary to exhalation of solvent; signs of kidney and liver damage may be delayed. ASPIRATION causes severe lung irritation with coughing, gagging, dyspnea, substernal distress, and rapidly developing pulmonary edema; later, signs of bronchopneumonia and pneumonitis; acute onset of central nervous system excitement followed by depression. 5.3 Treatment of Exposure: INGESTION: do NOT induce vomiting. ASPIRATION: enforce bed rest; administer oxygen; seek medical attention. EYES: wash with copious quantity of water. SKIN: remove solvent by wiping and wash with soap and water. 5.4 Threshold Limit Value: No single TLV applicable. 5.5 Short Term Inhalation Limits: Data not available 5.6 Toxicity by Ingestion: Grade 1; LD ₅₀ = 5-15 g/kg 5.7 Late Toxicity: Data not available 5.8 Vapor (Gas) Irritant Characteristics: Slight smarting of eyes or respiratory system if present in high concentrations. The effect is temporary. 5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of skin. 5.10 Odor Threshold: Data not available 5.11 IDLH Value: Data not available			

6. FIRE HAZARDS 6.1 Flash Point: 125°F C.C. 6.2 Flammable Limits in Air: 1.3%-6.0% 6.3 Fire Extinguishing Agents: Dry chemical, foam, or carbon dioxide 6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective 6.5 Special Hazards of Combustion Products: Not pertinent 6.6 Behavior in Fire: Not pertinent 6.7 Ignition Temperature: 490-545°F 6.8 Electrical Hazard: Not pertinent 6.9 Burning Rate: 4 mm/min. 6.10 Adiabatic Flame Temperature: Data not available 6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available
7. CHEMICAL REACTIVITY 7.1 Reactivity With Water: No reaction 7.2 Reactivity with Common Materials: No reaction 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Molar Ratio (Reactant to Product): Data not available 7.8 Reactivity Group: 33
8. WATER POLLUTION 8.1 Aquatic Toxicity: 204 mg/l/24 hr/Juvenile American shad/TL ₅₀ /salt water 8.2 Waterfowl Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): Data not available 8.4 Food Chain Concentration Potential: None
9. SHIPPING INFORMATION 9.1 Grades of Purity: Diesel fuel 2-D (ASTM) 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Open (flame arrester)
NOTES

10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-T-U								
11. HAZARD CLASSIFICATIONS 11.1 Code of Federal Regulations: Combustible liquid 11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed 11.3 NFPA Hazard Classification: <table style="width: 100%; border: none;"> <tr> <td style="text-align: right;">Category</td> <td style="text-align: right;">Classification</td> </tr> <tr> <td style="text-align: right;">Health Hazard (Blue)</td> <td style="text-align: right;">0</td> </tr> <tr> <td style="text-align: right;">Flammability (Red)</td> <td style="text-align: right;">2</td> </tr> <tr> <td style="text-align: right;">Reactivity (Yellow)</td> <td style="text-align: right;">0</td> </tr> </table>	Category	Classification	Health Hazard (Blue)	0	Flammability (Red)	2	Reactivity (Yellow)	0
Category	Classification							
Health Hazard (Blue)	0							
Flammability (Red)	2							
Reactivity (Yellow)	0							
12. PHYSICAL AND CHEMICAL PROPERTIES 12.1 Physical State at 15°C and 1 atm: Liquid 12.2 Molecular Weight: Not pertinent 12.3 Boiling Point at 1 atm: 540-640°F = 282-338°C = 555-611°K 12.4 Freezing Point: 0°F = 18°C = 255°K 12.5 Critical Temperature: Not pertinent 12.6 Critical Pressure: Not pertinent 12.7 Specific Gravity: 0.87-0.90 at 20°C (liquid) 12.8 Liquid Surface Tension: Data not available 12.9 Liquid Water Interfacial Tension: Data not available 12.10 Vapor (Gas) Specific Gravity: Not pertinent 12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent 12.12 Latent Heat of Vaporization: Not pertinent 12.13 Heat of Combustion: -19,440 Btu/lb = -10,800 cal/g = -452.17 X 10 ³ J/kg 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.26 Heat of Fusion: Data not available 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: Data not available								

POLYCHLORINATED BIPHENYL

PCB

<p>Common Synonyms PCB Chlorinated biphenyl Arochlor Halogenated waxes Polychloropolyphenyls</p>		<p>Oily liquid to solid powder</p> <p>Light yellow liquid, or white powder</p> <p>Weak odor</p>
<p>Sinks in water.</p>		
<p>Stop discharge if possible. Keep people away. Avoid contact with liquid and solid. Call fire department. Isolate and remove discharged material. Notify local health and pollution control agencies.</p>		
<p>Fire</p>	<p>Combustible. Extinguish with water, foam, dry chemical, or carbon dioxide.</p>	
	<p>CALL FOR MEDICAL AID.</p> <p>LIQUID OR SOLID Irritating to skin and eyes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water.</p>	
<p>Exposure</p>	<p>HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.</p>	
<p>Water Pollution</p>	<p>1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Issue warning-water contaminant Should be removed Chemical and physical treatment</p>	
<p>2. LABEL</p> <p>2.1 Category: None 2.2 Class: Not pertinent</p>		<p>3. CHEMICAL DESIGNATIONS</p> <p>3.1 CG Competibility Class: Not listed 3.2 Formula: $(C_{12}H_{10-x}Cl_x)_n$ 3.3 IMO/UN Designation: Not listed 3.4 DOT ID No.: 2915 3.5 CAS Registry No.: 1336-36-3</p>
<p>4. OBSERVABLE CHARACTERISTICS</p> <p>4.1 Physical State (as shipped): Liquid or solid 4.2 Color: Pale yellow (liquid); colorless (solid) 4.3 Odor: Practically odorless</p>		<p>5. HEALTH HAZARDS</p> <p>5.1 Personal Protective Equipment: Gloves and protective garments. 5.2 Symptoms Following Exposure: Acne from skin contact. 5.3 Treatment of Exposure: SKIN: wash with soap and water. 5.4 Threshold Limit Value: 0.5 to 1.0 mg/m³ 5.5 Short Term Inhalation Limits: Data not available 5.6 Toxicity by Ingestion: Grade 2, oral rat LD₅₀ = 3980 mg/kg 5.7 Late Toxicity: Causes chromosomal abnormalities in rats, birth defects in birds 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause severe irritation of eyes and throat and cause eye and lung injury. They cannot be tolerated even at low concentrations. 5.9 Liquid or Solid Irritant Characteristics: Contact with skin may cause irritation. 5.10 Odor Threshold: Data not available 5.11 IDLH Value: 5 to 10 mg/m³</p>

<p>6. FIRE HAZARDS</p> <p>6.1 Flash Point: >280°F 6.2 Flammable Limits in Air: Data not available 6.3 Fire Extinguishing Agents: Water, foam, dry chemical, or carbon dioxide 6.4 Fire Extinguishing Agents Not to be Used: Not pertinent 6.5 Special Hazards of Combustion Products: Irritating gases are generated in fires. 6.6 Behavior in Fire: Not pertinent 6.7 Ignition Temperature: Data not available 6.8 Electrical Hazard: Not pertinent 6.9 Burning Rate: Data not available 6.10 Adiabatic Flame Temperature: Data not available 6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available</p>	<p>10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) II</p>
<p>7. CHEMICAL REACTIVITY</p> <p>7.1 Reactivity With Water: No reaction 7.2 Reactivity with Common Materials: No reaction 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Molar Ratio (Reactant to Product): Data not available 7.8 Reactivity Group: Data not available</p>	<p>11. HAZARD CLASSIFICATIONS</p> <p>11.1 Code of Federal Regulations: ORM-E 11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed 11.3 NFPA Hazard Classification: Not listed</p>
<p>8. WATER POLLUTION</p> <p>8.1 Aquatic Toxicity: 0.278 ppm/96 hr/bluegill/TL₅₀/fresh water 0.005 ppm/336-1080 hr/pinfish/TL₅₀/salt water 8.2 Waterfowl Toxicity: LD₅₀ 2000 ppm (mallard duck) 8.3 Biological Oxygen Demand (BOD): Very low 8.4 Food Chain Concentration Potential: High</p>	<p>12. PHYSICAL AND CHEMICAL PROPERTIES</p> <p>12.1 Physical State at 15°C and 1 atm: Solid 12.2 Molecular Weight: Not pertinent 12.3 Boiling Point at 1 atm: Very high 12.4 Freezing Point: Not pertinent 12.5 Critical Temperature: Not pertinent 12.6 Critical Pressure: Not pertinent 12.7 Specific Gravity: 1.3—1.8 at 20°C (liquid) 12.8 Liquid Surface Tension: Not pertinent 12.9 Liquid Water Interfacial Tension: Not pertinent 12.10 Vapor (Gas) Specific Gravity: Not pertinent 12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent 12.12 Latent Heat of Vaporization: Not pertinent 12.13 Heat of Combustion: Not pertinent 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.18 Heat of Fusion: Data not available 12.20 Limiting Value: Data not available 12.27 Reid Vapor Pressure: Data not available</p>
<p>9. SHIPPING INFORMATION</p> <p>9.1 Grades of Purity: 11 grades (some liquid, some solids) which differ primarily in their chlorine content (20%-88% by weight) 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Open</p>	<p>NOTES</p>

JOHN P. CUMMINGS, PH.D., R.E.A., R.E.P., J.D.

Education

B.S. - Chemistry, Saint Michael's College, Winooski, Vermont

M.C.E. - Environmental Engineering, University of Toledo, Toledo, Ohio

Ph.D. - Chemistry - University of Texas, Austin, Texas

J.D. - Law - University of Toledo, Toledo, Ohio

GRADUATE - Industrial College of the Armed Forces, Washington, D.C.

Affiliations

Sigma XI - RESA

American Chemical Society

American Society for Testing Materials

Governmental Refuse, Collection and Disposal Association.

National Solid Waste Management Association

American Bar Association

Phi Alpha Delta

Registrations and Certifications

Ohio Registered Attorney

California Registered Environmental Assessor

EPA Certified Asbestos Inspector and Management Planner

U.S. Board of Military Appeals Attorney

U.S. Department of Defense Certified Fallout Shelter Analyst

U.S. District Court Registered Attorney

40 Hour EPA Approved Hazardous Waste Operations Training

Registered Environmental Professional

Professional Experience

Mr. Cummings brings to SCS over thirty years of experience, project management, planning, regulatory affairs, implementation of legislative programs and policies. He has a strong background in hazardous/toxic waste management, pollution abatement implementation, solid waste management, resource recovery and recycling, legal aspects of OSHA and EPA litigation as well as product liability. He also has an extensive technical background in chemistry, ceramic, paper, and plastic materials. He is a patentee.

JOHN P. CUMMINGS (Continued)

Other experience includes:

- Legal counsel for several small businesses for environmental legal matters including permitting, completion of abatement orders, and determination of compliance with federal, state, and local environmental regulation.
- Manager, Environmental Affairs - Responsible for company environmental matters, permitting, recycling, resource recovery, hazardous solid waste management. Prime contact with customers and governmental agencies.
- Legal Counsel, Owens-Illinois, Inc. - Responsible for all OSHA and EPA Compliance and Litigation.
- Engineered, built, managed, and evaluated the first resource recovery from Municipal Solid Waste Plant for the EPA.
- Developed hazardous material reduction programs for several production operations.
- Performed recycling audits, system analysis, and source reduction programs for 15 facilities.
- Director of analytical services for Owens-Illinois, Inc.
- Consulting on resource recovery or recycling, utilization of waste products, hazardous waste plans, handling, packaging, transportation and disposal of solid, hazardous and toxic materials, legal counsel to several small firms, environmental audits.
- Risk Management - Assess risks, claims, asbestos risks, approved settlement payments, organized insurance treaties.
- Produced the County Hazardous Waste Management Plans for six Northern California counties.
- Developed the Environmental Impact Report for four Northern California county Hazardous Waste Management Plans.
- Developed risk assessment programs for two major industries.
- Completed over 100 environmental assessments and developed remediation actions when required.
- Reviewed disposal procedure for five San Francisco peninsula hospitals of medical (red bag) water.

JOHN P. CUMMINGS (Continued)

- Directed the preparation of Lake County Hazardous Waste Management Plan which included land disposal of medical waste in a sanitary landfill.
- Reviewed possible use of Susanville incineration facility for medical waste disposal.

G - 1/91

JOHN N. ALT, C.E.G.

Education

B.A. - San Jose State University 1971
Geology/Natural Resources

Graduate Studies - San Jose State University 1971-1974
30 units in Engineering Geology

Professional Licenses

Registered Geologist - California
Certified Engineering Geologist - California

Professional Experience

Mr. Alt has over eighteen years of experience in hydro-geology and engineering geology investigations. Over the past five years, many of these investigations have been directed toward the assessment and mitigation of soil and groundwater contamination. Selected examples of his experience are summarized below:

- o Project Manager for Preliminary Assessment and Site Characterization Investigations of a site located in Mountain View, California and included on the State Superfund List. The project involved defining the lateral and vertical extent of several plumes of industrial solvents and required the installation of monitoring, test, and extraction wells screened in various aquifers underlying the site. Soil gas surveys were used to help define the extent of off-site migration of the shallow plume. A part of the project involved evaluating the contribution of up-gradient sources, to the groundwater contamination below the site. Preliminary Feasibility Studies were also carried out to assess cleanup alternatives for both contaminated soil and groundwater.
- o Involved in a Feasibility Study of a site in Sunnyvale, California that contained shallow groundwater contaminated with various solvents. The project involved the layout of extraction wells and the technical and economic review of various cleanup technologies. Two were selected for pilot testing.
- o Involved in a project to review the use of oils and solvents and help design procedures for recycling at the Subic Bay Naval Base in the Philippines.
- o Served as engineering geologist for the preparation of a groundwater SWAT report for a landfill site in Monterey County.

JOHN N. ALT (Continued)

- o Directed the installation of numerous vadose and groundwater monitoring wells. Collected soil and groundwater samples following quality control protocol in the collection and handling of the samples.
- o Carried out numerous environmental site assessments related to the conversion of agricultural or industrial property to residential and/or commercial use. Assessments included review of historical records, interpretation of aerial photographs, interview, field reconnaissance, and sampling.
- o Directed numerous geologic and active fault studies for residential development.
- o Project Manager for investigations and mitigation of seismic, volcanic and slope stability hazards at large hydroelectric sites in Ecuador, Chile, Columbia, Costa Rica, and Venezuela.
- o Carried out active fault studies for the Aswan High Dam in Egypt and proposed nuclear power plant sites in Southern Iran.

G - 7/89

J. DON McCLENAGAN

Education

B.A. - Rice University, Houston, Texas
National Merit Scholar
1981 Geology
Emphasis on Field Mapping and Structural Analysis

Certification

Completion of 40 hour Hazardous Waste Site Operation Training Program - May 12, 1989.
Completion of 8 hour Hazardous Waste Management Program - May 18, 1990.
Completion of 16 hour Underground Storage Tank Installation Program - Sept. 15, 1989.

Affiliations

Member of National Water Well Association.

Professional Experience

Mr. McClenagan brings to SCS Engineers exceptional writing ability and is experienced at technical writing and editing.

Mr. McClenagan adds to the SCS staff considerable experience in field reconnaissance and mapping. He has conducted detailed field mapping, accurately pinpointing particular features.

Mr. McClenagan has conducted numerous preliminary site assessments in their entirety; tasks ranged from off-site research and on-site survey to meaningful information analysis and final report.

He has supervised underground storage tank removals, associated sampling, and subsequent contamination-extent investigations.

Mr. McClenagan is responsible for and has completed subsurface site contamination studies consisting of research, trenching, permitting, regulatory review, soil boring, and monitoring well installation and sampling. He is adept at economical and accurate determination of contamination extent.

Mr. McClenagan designs, installs, and field fits remediation systems including: groundwater extraction/treatment, vapor extraction, bioremediation, and land farming.

He is familiar with federal, state, and local regulations and practices pertaining to hazardous waste.

NELS R. JOHNSON

Education

B.S. - University of California, at Davis
1984 Civil Engineering
Emphasis - Structural

Affiliations

American Society of Civil Engineers

Registration

California Registered Professional Engineer

Professional Experience

Mr. Johnson brings to SCS Engineers over five years of Project Management and engineering experience on various facility and industrial projects. His duties included; civil/structural design, specification and proposal writing, construction cost estimating and in-house checking.

Mr. Johnson adds to the SCS staff considerable technical experience regarding seismic analysis of structures and equipment.

He has a strong background of the Local, State and Federal standards and code requirements regarding building construction.

Mr. Johnson has conducted numerous preliminary site assessments in their entirety; tasks ranged from off-site research and on-site survey to information analysis and final report.

He has designed numerous shoring systems for underground storage tank removals.

Mr. Johnson headed the production of a Trade Fair Seminar on the seismic considerations of Plastic Tanks.

He has developed "Double Containment" systems for trenching, sumps and bulk storage tanks in new and retrofit conditions.

VIORICA-ADRIANA CONSTANTINESCU

Education

- M.S. - Geology and Geophysics,
College of Geology, Bucharest, Romania, 1980
- M.S. - Mathematics,
College of Mathematics, Bucharest, Romania, 1988

Education Continuation

- Fortran Programming, 1980
- Statistic Analysis of Geological and Geophysical data, 1984

Professional Experience

Ms. Constantinescu brings to SCS considerable experience in Geological Studies of raw materials and groundwater bearing strata. She has performed studies of fluid movement and transport of dissolved substances in a subsurface environment, and analyses of groundwater contaminant transport problems and aquifer restoration designs. She also has an extensive background in mathematics, in the field of Operational Researches, Model Analysis and Data Processing.

Some of the projects in which she has been involved with include:

- Project Manager for Groundwater Detection, using geological and geoelectrical methods, and contamination studies in the oil fields.
- Conducted site surveys for determination of optimum location of nuclear power plants in Romania.
- Coordinated monitoring program for geological wells to locate anthracite in coal fields.
- Conducted geological surveys for determination of water influence in location of bauxite lenses.

Ms. Constantinescu has developed proposals, designed and implemented vadose and groundwater sampling/monitoring plans for the evaluation of potential impact of contaminants upon subsurface environmental systems.

Ms. Constantinescu has completed subsurface site contamination studies consisting of research, trenching, permitting, regulatory review, soil borings, and monitoring well installation and sampling.

APPENDIX 3

**Statement of Qualifications
(under separate cover)**

**STATEMENT OF QUALIFICATIONS
SITE ASSESSMENTS FOR HAZARDOUS
OR TOXIC MATERIALS IN REAL ESTATE
TRANSACTIONS OR DEVELOPMENT PROJECTS**

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CONTENTS

Section	Page
1 Introduction.....	1
2 Corporate Experience and Qualifications.....	2
3 Personnel Qualifications.....	5
4 SCS Company Facilities.....	7

Table 1 SCS Site Assessment Projects

Table 2 Selected SCS Projects related to Underground Storage Tank
Assessment and Design

Table 3 SCS Offices and Key Personnel

SECTION 1

INTRODUCTION

SCS Engineers (SCS) is a consulting engineering firm specializing in the design, development, and evaluation of systems for the management of hazardous waste, solid waste, and wastewater. Since its inception in 1970, approximately 90 percent of the firm's work has been in these specialty fields.

SCS was founded to provide comprehensive engineering services with emphasis on environmental quality control. The firm is committed to excellence in professional services to public and private clients. The varied experience and special knowledge of the firm's principals and technical staff enable us to solve problems of a widely diversified nature.

The firm of SCS Engineers is comprised of approximately 250 staff including registered engineers, geologists, chemists and other scientific, technical and support staff. The founders and principals of the firm are registered in nearly all states and in many engineering and geological disciplines.

The following sections describe SCS's corporate experience and personnel capabilities in greater detail.

We welcome the opportunity to apply our multi-disciplinary talents to solving both common and unusual environmental problems.

SECTION 2

CORPORATE EXPERIENCE AND QUALIFICATIONS

SCS is comprised of engineers, scientists, economists, urban planners, and other professionals with wide experience in environmental, civil, mechanical, chemical, cost, and systems engineering. The company's expertise is devoted to solving environmental quality and pollution control problems that affect us today, and to preventing their occurrence in the future.

Routine services offered by the firm include the following:

- Toxic and hazardous waste assessments related to real estate transactions
- Real Estate site audits
- Asbestos inspection and management
- Asbestos abatement plans
- Underground storage tank site assessments and precision testing
- Hazardous waste inventory and management programs from origin to disposal
- Hydrogeologic evaluations of hazardous & toxic waste sites
- Closure plans, permitting and closure construction monitoring, post-closure monitoring
- Municipal and industrial solid waste management
- Municipal & industrial wastewater treatment and disposal, including sludges
- Resource recovery from waste materials
- Physical and chemical sampling, testing, and analysis
- Broad-based environmental data management
- Economic analysis
- Environmental impact assessment
- ~~Nationally scoped investigations, surveys, & monitoring~~

SCS specializes in projects requiring engineering and scientific expertise in all aspects of pollution control, including sampling, characterization, treatment, reuse/recovery, and disposal. In addition, SCS has significant experience in predicting and assessing the potential impacts of pollution problems on human health and the environment.

SCS has performed numerous projects to determine the presence of hazardous or toxic materials on developed industrial and commercial property or undeveloped properties. This qualifications package provides summary descriptions of our experience and capabilities in the following areas:

- Hazardous waste site assessments
- Underground storage tank assessment and design

Hazardous Waste Site Assessments

Most buyers and many lenders are currently requiring environmental audits on properties prior to loan approval to minimize risk to their investments. SCS has been performing chemical, hazardous waste and asbestos site assessments for these transactions for over 10 years. We have performed environmental site assessments for private industry, local, state, and federal government, and others. These site assessments were developed using such methods as records searches, questionnaires, telephone surveys, air photo review, field investigations, drilling and sampling, and chemical laboratory analyses. In a typical project, after the initial data gathering phase is completed, the information is reviewed to determine if additional investigations are necessary at the site. In some cases, contaminants are found to exist and remedial measures such as ground water treatment, soil excavation and removal, and free product recovery are recommended and implemented.

Selected SCS hazardous waste site assessment projects related to real estate transactions are shown on Table 1.

Storage Tank Assessment and Design

SCS has worked on leaking underground storage tank (UST) problems for the past several years, well before state and national attention began to focus on the issue. In 1983, SCS was assigned by the Environmental Protection Agency (EPA) to document the causes of underground tank leaks due to environmental conditions. We are presently working with EPA to compile a large data base on the environmental impacts of both underground and aboveground leaking tanks. This and other SCS work will contribute to the formulation of national regulations regarding hazardous materials stored in underground tanks.

SCS has performed site assessments where abandoned underground tanks have been discovered. In many cases, these tanks are emptied and are removed from the site as quickly as possible to reduce construction delays or close of escrow complications. Where possible, the extent of contamination from leaking tanks is determined at the time of removal. Very often, however, soil and groundwater are affected far from the initial source of product or waste leakage.

In addition to site assessments utilizing the methods described above, SCS Engineers also conducts tank integrity testing with the Petro Tite and Horner EZY-Chek System. We have testing technicians with experience in nearly all types of tank testing, tank construction and monitoring system retrofitting. Our engineers have designed fuel systems ranging from single below ground tanks to complex above and below-ground systems for a wide range of fuel products.

Table 2 briefly describes selected projects related to the storage of chemicals in underground tanks.

SECTION 3

PERSONNEL QUALIFICATIONS

SCS staff professionals include environmental, mechanical, industrial, chemical, electrical, civil & systems engineers; economists & cost analysts; chemists, physicists, soil scientists, biologists, and environmental scientists; geologists/hydrogeologists; computer scientists; policy analysts; and specialists in other disciplines. Many of our professionals have interdisciplinary backgrounds, as well as multidisciplinary training and experience.

From its professional staff of qualified specialists, SCS has developed a project team with the appropriate experience and educational background to successfully perform hazardous waste site assessments.

Qualifications of key SCS personnel with regard to hazardous site assessment and underground storage of hazardous chemicals are summarized below.

John P. Cummings, Office Director, is a California Registered Environmental Assessor, a National Registered Environmental Professional, and an EPA certified Asbestos Inspector and Management Planner. He has performed site assessments (with complete asbestos, PCB, toxic and hazardous materials characterizations) for several major law firms, real property brokers and national financial institutions.

Dr. Cummings is qualified by over thirty years of experience in project management. He has a strong background in hazardous/toxic waste management, pollution abatement implementation, solid waste management, resource recovery and recycling, and the legal aspects of OSHA and EPA litigation. Besides holding a Ph.D. in chemistry, he is an attorney and has practiced environmental law. Dr. Cummings has recently been involved in the preparation of County Hazardous Waste Management Plans for five Northern California counties.

Lisa A. Polos, Project Scientist, is a California Registered Environmental Assessor and has over nine years of experience in chemical testing and project management. She has assisted many clients on the type of chemical test program that will provide the information needed. She has been involved in property surveys, asbestos and PCB surveys, and characterization of hazardous waste sites. Ms. Polos recently was Project Manager for all laboratory and industrial hygiene work at an abandoned landfill that is now a high-rise office park. She currently is involved in several site assessments for a major lender on industrial properties.

Thomas Dong, Senior Project Engineer, provides SCS with technical and engineering skills in hazardous solid and liquid waste management, environmental engineering and chemistry, and laboratory analysis.

Mr. Dong has participated in many projects related to storage of hazardous materials in underground tanks. He was involved in initiating an underground tank leak detection program for a major paint company. He has also been involved in determining the extent of gasoline contamination from underground storage tanks at a southern California construction site. For the EPA, he was responsible for providing cost estimates for leak detection and secondary containment for new and retrofit underground storage tanks. Mr. Dong currently serves as a special advisor to several industrial development companies in California. He is routinely called on to evaluate site environmental conditions based on historical evidence and on-site exploration and chemical analyses.

In addition to the lead staff shown, SCS can draw on the talents of the remainder of the technical and support staff from throughout the country. Where projects are from a client's headquarters, we have successfully supported them through our regional office locations. Each SCS office has the skill required to perform site assessments related to underground storage tanks.

SECTION 4

SCS COMPANY FACILITIES

OFFICE FACILITIES

Since its formation in 1970, SCS Engineers has grown to a staff of approximately 150 employees located in eight offices nationwide. This growth reflects the firm's ability to successfully provide quality professional services demanded by clients in government, the military, and private industry. A table of office locations and key staff are shown in Table 3.

ENVIRONMENTAL MONITORING EQUIPMENT

SCS possesses equipment necessary for real estate site assessments and other waste management facilities. Included are the following:

- TIP Vapor Analyzer (Photovac)
- Foxboro Organic Vapor Analyzer (OVA)
- TEI Organic Vapor Monitor (OVM)
- Noncontaminating sample pumps and collection apparatus, personal sampling pumps, dosimeters
- Toxic gas detector, (absorbent) colormetric tubes
- Combustible gas meters, vacuum/pressure gauges, ground water detection meters
- Groundwater submersible pumps, bladder pumps, bailers
- Water quality test equipment including conductance, temperature, pH test devices
- Additional equipment for field sampling of surface water, ground water, sludges, soils, plants, sediments (fresh water and marine), hazardous wastes, and wastewaters.
- Water level measurement devices, remote data logging and monitoring equipment with computer interface.

CHEMICAL LABORATORY

The SCS Laboratory is located in Long Beach, California. This facility houses several chromatographs including Varian models 2700 and 2400, a Perkin-Elmer 280 Atomic Absorption Spectrophotometer, and various other spectrophotometric equipment in an area isolated from the main wet chemistry laboratory. In addition to these instruments, the laboratory is well equipped to perform analyses on water, wastewater, sludges, soils, plants, leachates, and other types of samples. The lab is state approved to perform organic analyses common in site assessment evaluations. Laboratory capabilities include:

- Gas chromatography (ECD, FID, TCD, PID, Hall Detector - packed and capillary columns interfaced to a Nelson 2600 software system running on a Compaq PC
- Atomic absorption and emission spectroscopy
- Total organic carbon (TOC)
- Flameless AA analysis
- Laboratory-scale treatment feasibility studies
- Landfill gas analysis including H₂, He, CO₂, N₂, O₂, CH₄, and other hydrocarbons.

The lab is California State-approved for various hazardous waste analyses.

LIBRARY

The main SCS technical library is located in our Long Beach office. This library currently contains approximately 25,000 volumes and is growing at the rate of over 250 titles per month (primarily on microfiche). In lieu of a traditional card catalog, the SCS library uses a proprietary, computerized library catalog system, called SCS-Autolib. Autolib allows the library and the project staff to access library holdings by key words, title, author, corporate author, sponsor, and EPA, organization or NTIS number, via computer terminals in the library and throughout the SCS offices.

PRODUCTION FACILITIES

SCS has a modern Production Department staffed with well-trained production personnel. Significant equipment includes many IBM compatible microcomputers, laser printers, and up-to-date drafting equipment. We maintain company-wide report formats and drafting standards to ensure a quality reporting style.

TABLE 1 - SCS SITE ASSESSMENT PROJECTS

<u>CLIENT</u>	<u>PROJECT TITLE</u>	<u>PROJECT DESCRIPTION</u>
Union Bank	Confidential Site	Site reconnaissance, historical records search, air photo review for large industrial parcel.
Confidential	Source identification and water discharge mitigation measures	Investigate sources of gasoline in groundwater being pumped from an excavation prior to construction of a high-rise office building. Interface with regulatory agencies and design water treatment system so that construction can proceed without interruption.
Levitz Furniture	Investigation of subsurface contamination due to gasoline leak into pump pit	Drill 3 on-site borings to determine level of contamination in soil and groundwater. Analyze samplings and provide detail report.
Marriott Corporation	Hazardous substance investigation for site of new Marriott Hotel	Perform field investigation including test pits, magnetometer survey, sampling, and laboratory analysis to define the extent of contamination at the old sumpsite. Assess the degree of hazard and risk and recommend solution for developing a hotel on the site.

<u>CLIENT</u>	<u>PROJECT TITLE</u>	<u>PROJECT DESCRIPTION</u>
Spieker Partners	Confidential Site - Livermore, California	Perform site soil gas survey, drill monitoring well, review aerial photos, conduct regulatory agency records search.
Trammel Crow Company	Subsurface soils investigation for 17.2 acre parcel at the Kraft-Humko Plant	Perform drilling, sampling, and analyses of soils retrieved from the site to determine the presence of hazardous contaminants.
The Koll Company	Confidential Site	Prepare preliminary site assessment for hazardous/toxic substances at an industrial site.
The Irvine Company	Baseline environmental audit of soil and water quality	Perform soils and hydrogeological investigation of selected properties slated for development as an industrial and commercial office park. Information obtained will form a data base concerning background environmental quality as exists prior to development. Assess the environmental impacts of adjacent industrial land uses on the client's property.

CLIENT

PROJECT TITLE

PROJECT DESCRIPTION

Milne Truck Lines

Site assessment and remedial actions prior to sale of properties

Conduct complete site evaluations for the presence of leaks or spills for underground tanks. The work has included tank testing, new fuel system design and installation, removal and remedial actions at leaking tank sites, tank monitoring system design and installation.

State of California,
Department of General Services, Office of the State Architect

PCB Consulting Services - Northern California

Investigate electrical equipment at various state agencies to identify equipment items containing PCB and PCB-contaminated dielectric fluids. Assess institutional reporting and recordkeeping. Where necessary, take samples of dielectric fluids for analysis.

Schurgin Development

Environmental audit of proposed shopping center

Perform drilling, logging, and sampling of ten on-site borings. Perform laboratory analyses of soil samples to verify that hazardous materials do not exist on the site. Prepare written report for submittal to Chase Manhattan Bank for approval.

White, Swallow and Co.

Hazardous Waste Investigation

Sample subsurface soils and analyze for hazardous waste components.

CLIENT

PROJECT TITLE

PROJECT DESCRIPTION

Torrance Industrial
Redevelopment Agency

Preliminary assessment of
groundwater contamination

Conduct on-site
investigation to determine
possible sources of
groundwater
contamination. Drill four
on-site borings to
monitor groundwater
depth, flow, and level of
contamination.

EnviroGroup
Stonestown Mall

Environmental assessment
at two sites in Stonestown
Mall

Conduct test boring,
chemical testing and
contamination assessment
at former auto
dealership.

Trammel-Crow
Company

Preliminary site assessment
of oil well property

Perform site investigation
to determine the extent
of surface and subsurface
contamination from
petroleum hydrocarbons
that may have leaked
from the well into
surrounding soils.

Sand Dollar
Development

Hazardous Waste
Investigation

Perform preliminary
hydrogeological
assessment to determine
the presence and/or
extent of hazardous
waste constituents.

CLIENT

PROJECT TITLE

PROJECT DESCRIPTION

MKB Industries

Design of Air Injection System, Ramada Inn Hotel facilities

Prepare construction documents including plans and specifications for an air injection system to protect Ramada Inn Hotel facilities from landfill gas migration from adjacent former organic refuse disposal site. Following design observe construction, perform initial start-up and balancing, and certification of system construction.

Trammel-Crow Company

Landfill Gas Control Design and Construction

Design, construct, and operate an air injection system to protect a new industrial building in Commerce, California, from methane migration from an adjacent inactive landfill. The system is to consist of 30 injection wells, blowers, and monitoring, automated detection and alarm facilities.

Duke, Gerstel, Shearer & Bregante

Interior Gas Investigation of 13 houses

Conduct a survey of the interiors of 13 houses to determine hydrocarbon levels. The houses are located in an area reported to overlay fill soils containing decomposing organic materials.

CLIENT

John Alexander
Company

PROJECT TITLE

Preliminary site
investigation at Fry Steel
site

PROJECT DESCRIPTION

Drill 4 on-site borings to
20 feet. Retrieve soil
samples to determine if
the site contains any
hazardous materials.

TABLE 2 - SELECTED SCS PROJECTS RELATED TO UNDERGROUND STORAGE TANK ASSESSMENT AND DESIGN

<u>CLIENT</u>	<u>PROJECT TITLE</u>	<u>PROJECT DESCRIPTION</u>
Kraft, Inc.	Environmental Support Services	Assist client with underground storage tank problems at several prospective new purchase sites.
Crumpler and Kruger Commercial Real Estate	Fuel Tank Area Contamination Investigation	Conduct subsurface soil investigation and chemical analyses as required for preliminary assessment of contamination from underground tanks.
Monterey County	Precision Tank Testing	Perform Horner EZY-Chek tests on 30 fuel and oil tanks in Monterey County.
Trammel - Crow Company	Preliminary Site Investigation to determine the presence of fuel-related contaminants in soils from underground storage tanks.	Perform drilling of 8 exploration holes; retrieve soil samples and analyze for fuel and related constituents.
U.S. Environmental Protection Agency, Office of Solid Waste, Economic and Policy Analysis Branch	Analysis of Hazardous Waste Storage in Underground Tanks	Develop and apply risk & cost models to support regulatory impact analyses for pending federal regulations of underground tank storage for hazardous waste.

<u>CLIENT</u>	<u>PROJECT TITLE</u>	<u>PROJECT DESCRIPTION</u>
Gelco Leasing, Inc.	Site assessment prior to purchase - Freight Terminal	Perform subsurface investigation to detect possible site contamination, tank precision testing.
Department of the Navy, Public Works Department, Pacific Missile Test Center, Point Mugu, CA	Testing of underground fuel tanks on San Nicolas Island	Test six underground fuel storage tanks for leakage.
Research Consultant Consortium	Comments on proposed underground tank monitoring regulations	Research and prepare comments on underground tank monitoring regulations proposed by the California Water Resources Control Board.
Buchalter, Nemer, Fields, Chrystie & Younger	Underground tank inspection program	Prepare master plan to investigate potentially leaking underground storage tanks. Obtain plot plans, determine exact tank locations and propose drilling and sampling plan for approval by Regional Water Quality Control Board.
Merced County	Conduct remedial design investigation at leaking UST site.	Drill and sample several test borings and wells at a leaking gasoline tank site; prepare site remedial design, support County in implementation.

CLIENT

PROJECT TITLE

PROJECT DESCRIPTION

Golden Grain Macaroni Company

Manteca Bean Company - Warehouse Fuel Tank Assessment

Following removal of three underground tanks, fuel was identified beneath a gasoline tank, remedial action investigations are on-going, sale of property is planned pending cleanup.

U.S. Environmental Protection Agency, Industrial Environmental Research Lab (for the Office of Solid Waste, Hazardous and Industrial Waste Div. - Washington, DC)

Assessment of the Technical, Environmental and Safety Aspects of storage of hazardous waste in underground tanks

Evaluate the use of underground tanks for storage of hazardous waste, including characterization of tanks, assessment of current storage practices, review of existing studies regarding damage and spill events, and current management practices comparison of safety aspects to environmental considerations, evaluation of current leak testing methods, and preparation of potential management alternatives.

Bureau of Engraving and Printing

Design of Hazardous Materials Product Storage Area

Provide consulting services for site investigation and design of hazardous product storage area and dispensing facilities. Includes study of alternatives for storage methods, fire protection, lighting, and security systems.

CLIENT

PROJECT TITLE

PROJECT DESCRIPTION

Kraft, Inc.

Site Assessment -
Chehalis, Washington

Evaluate potential environmental liability of abandoned underground storage tanks:

- obtain brief history of site
- obtain preliminary geology information to determine depth to groundwater
- selectively place borings and take soil samples
- analyze samples for fuel-related constituents
- assess data and make recommendations.

Petroleum Contractors

Underground Tank Investigation at Flying Tiger Terminal

Perform geological and hydrogeological investigations into a leaking underground gasoline tank.

**STATEMENT OF QUALIFICATIONS
UNDERGROUND STORAGE TANKS**

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SECTION 1

INTRODUCTION

This statement of qualifications is presented to demonstrate SCS Engineers (SCS) capabilities in the planning, engineering and implementation of underground storage tank programs.

SCS was founded in 1970, and has grown to a staff of over 100 environmental professionals. The corporate headquarters is located in Long Beach, California. Additional offices are located in the Bay Area at Dublin, California; Seattle, Washington; Covington, Kentucky; and Reston, Virginia in the Washington, D.C. area; Phoenix, Arizona; Tampa, Florida; and Upper Nyack, New York.

SCS is staffed with engineers, geologists, scientists, economists, urban planners and other professionals with wide ranging experience in environmental, civil, mechanical, chemical, geological, geotechnical, cost and systems engineering. The company's expertise is devoted to solving those environmental quality and pollution control problems that affect us today and to prevent their occurrence in the future.

SCS support services include an extensive research library, reproduction capabilities, laboratory (chemical and soils) facilities, and data processing equipment necessary to complete our diverse waste management and underground storage tank assignments.

SECTION 2

SCS EXPERIENCE AND QUALIFICATIONS

INTRODUCTION

Routine services offered by the firm include:

- underground tank system audits, site evaluations
- tank monitoring plans formulated and submitted to regulatory agencies
- design and installation of monitoring devices including wells, sensors, leak preventors, etc.
- precision tank testing
- preparation of operation and maintenance manuals for monitoring systems
- tank closure plan preparation, supervision and coordination of removal and replacement, removal only or retrofit projects
- site cleanup and remedial action
- regulatory compliance and permitting aspects of waste management
- air pollution abatement
- hydrogeologic investigations
- environmental impact assessment
- wastewater/water pollution abatement
- prototype pollution abatement equipment design and evaluation.
- physical and chemical sampling, testing, and analysis.

SCS specializes in projects requiring expertise in all aspects of pollution control and process residuals monitoring, sampling, characterization, storage, treatment, reuse/recovery, and disposal. A key element in the implementation of waste management plans in these projects is an assessment of the associated costs.

UNDERGROUND STORAGE TANK INVESTIGATIONS

SCS Engineers is currently engaged in both national and local underground storage tank investigations encompassing a diverse variety of scientific disciplines. The staff of professionals at SCS has exceptional knowledge and experience with respect to tank storage of hazardous materials. This expertise is broad, extending from design of tank storage facilities to assessments of hazardous waste storage practices and state-of-the-art subsurface monitoring methods. The firm is nationally recognized for its work on underground storage of hazardous materials, such as tank facilities design, development and implementation of leak detection programs for such facilities, site investigation, underground contamination characterization and assessment, and design of remedial action programs. This specialized experience is combined with our thorough knowledge of existing and proposed underground tank regulations. The following brief presentation describes our level of involvement in these studies.

National Level

SCS Engineers has been an active participant in projects which address potential problems involving underground storage tank system leaks on a nationwide level for clients such as the U.S. EPA, Department of the Navy, and Department of the Army.

The SCS offices in Reston, Virginia, and Long Beach, California, are currently involved with the LUST survey which was originated by the EPA Office of Solid Waste. This project emphasizes the documentation of underground storage tank leaks. It is SCS's responsibility to systematically compile, verify, and assess documents related to any underground storage tank system releases of hazardous liquids within a 25-state area.

The agencies and scientists working on this survey have gathered considerable information regarding potential problems when hazardous substances are stored underground. In addition, we are continually gaining expertise in the selection of mitigation and soil and water decontamination measures.

Local Level

The Dublin and Long Beach Offices are presently under contract for projects with private clients who have hundreds of underground storage tanks. These tanks range in capacity from 500 to 40,000 gallons, and are fabricated from a variety of materials including fiberglass and steel. Our scientists, engineers, and geologists are involved in virtually every phase of the investigative process. The discussion below presents factual examples of our overall involvement in these studies.

Preparation of Work Plans

Each separate client's needs are best served by a specific work plan addressing the number of underground tanks, their respective location, tank contents, local and site-specific geology, and governing state, county, and/or city regulations. Thorough work plans are developed and discussed with the cognizant regulatory offices prior to implementation.

Tank Integrity Testing

Three types of tank integrity testing are typically approved by local authorities: Petro-Tite, Horner EZY-Chek, and Hunter Leak Lokator. We have experience with all three. Each has its own advantages and disadvantages including ease of use, compatibility with tank contents, accuracy, and cost. We currently operate the Horner System in-house, but routinely apply other devices where appropriate. Occasionally, due to site design uncertainties or operational failures, tank isolation is necessary to identify a "failing" test rate or to clarify inconclusive test results. We routinely arrange for these services through pre-qualified subcontractor firms.

Site Geology and Hydrogeology

Prior to most investigations, preliminary geological information is gathered and assessed. Such initial data include general types of sediments/deposits, approximate depth to known aquifers and perched water tables, general direction of ground water flow, soil types and other geotechnical information.

Drilling

SCS Engineers has worked with many drilling companies in California and across the United States, and is very knowledgeable about the types of rigs available and their selected uses. We have worked with bucket augers, air and mud rotary, diamond core, hollow stem augers, etc. Most of the underground tank work has been with hollow stem (8-and 10-inch) augers to facilitate taking undisturbed soil samples for geological evaluation and chemical analysis. We have used conventional vertical test borings as well as slant drilling techniques.

Well Placement/Development

The installation of monitoring wells is a common occurrence in any underground tank program, specifically vadose zone or backfill monitoring well installations and ground water monitoring wells. SCS is a leading company in vadose zone monitoring techniques. While the use of vadose zone monitoring may seem to be unproven with respect to underground tanks, it is a technology that we have employed over the past

15 years in ongoing projects at sanitary landfills for methane gas sensing and migration control. Groundwater and vadose wells are placed such that leaks from tanks will be detected early, thereby negating massive cleanup problems at a later date.

Design and Implementation of Monitoring System

Depending on local regulations and the client's specific needs at a site, a long term monitoring system is designed and installed. Some monitoring techniques we have recommended and implemented include:

- vadose zone monitoring with vapor sensors or periodic sampling and analysis
- groundwater monitoring well installation, periodic sampling and analysis
- in-tank fluid level sensor with controller and printer for inventory control
- daily inventory reconciliation (SCS provides training and program review typically to site staff)
- periodic tank integrity testing
- pipeline leak detectors

Tank Closure and Removal

Where tanks clearly leak, cannot be repaired, or where various factors such as age, marginal use or non-use make them candidates for removal, SCS has initiated many closure and removal projects for clients. Specific tasks are required by law to remove tanks including:

- closure plan preparation
 - tank neutralizing
 - tank and piping excavation
 - backfill and compaction of excavation, repaving
 - soil sampling and chemical testing
 - coordination and tracking of tank, backfill and soil disposal
 - closure report preparation and notification to regulatory agency.
-

Occasionally, local regulations allow for in-place filling of tanks where removal is either dangerous, extremely expensive or where no possible environmental harm can occur.

Specific California UST projects performed by SCS Engineers are presented in Appendix A.

SECTION 3

PERSONNEL QUALIFICATIONS

SCS Engineers staff exhibits a broad range of expertise in the physical and engineering sciences necessary to address the issues associated with product or waste releases from tank systems.

SCS staff professionals include environmental, mechanical, industrial, chemical, process, electrical, civil, and systems engineers; economists and cost analysts; chemists; physicists; biologists; and environmental scientists. Through a combination of training and experience, many of SCS's staff members have acquired the multidisciplinary backgrounds which are so valuable in environmental assessment work.

Presented below are capsule resumes of key personnel involved in underground storage tank work.

John P. Cummings, Ph.D., R.E.A., R.E.P., Project Director operates the Dublin office of SCS Engineers serving the needs of our central and northern California clients. He has conducted monitoring efforts throughout California and the mid-west, and is familiar with soil and groundwater conditions in virtually all portions of the Western States. In addition Dr. Cummings maintains contact with numerous key state and local regulatory agencies in order to stay current on the application of specific tank monitoring requirements, tank removals, and remediation in each part of the state and across the country. Dr. Cummings is thoroughly familiar with remedial action technology, having applied cleanup measures on numerous sites contaminated by fuel, hydrocarbons, solvents and other hazardous substances.

In Dr. Cummings 30 plus years of experience, he has been involved in groundwater-related studies and hazardous waste studies throughout the United States and extensively in California, Texas, Ohio, and Michigan. For the past several years he has been involved in underground storage tank efforts at approximately 150 different locations for petroleum/chemical companies, oil companies, freight firms, laundry services, chemical manufacturers, and other tank owners.

Kent A. Madenwald, P.E., R.E.A., R.E.P., Senior Project Engineer, is a Professional Engineer with over 30 years experience in the geological and engineering fields. For SCS, Mr. Madenwald is the Project Manager for several clients overseeing the planning and implementation of monitoring programs and annual testing compliance for as many as 200 underground storage tanks in the State of California.

Previous experience includes groundwater and pollution studies in oil field operations resulting in brine collection and injection wells for a pressure maintenance program, installation of a gas transmission and storage system including three compressor stations and seven underground storage wells, and land reclamation studies for lignite mines resulting in land reforestation and reduced leaching of soils into the groundwater supply.

Kenneth V. LaConde, Project Director, has served as Project Director of major underground tank investigation programs in Southern California. In addition, he is the Director of the SCS Analytical Laboratory located in a separate facility in Long Beach, California. Mr. LaConde established the SCS laboratory in Long Beach in 1975. He is currently leading the efforts on several projects involving leaking underground solvent and gasoline tanks, both of which have resulted in highly contaminated soils and groundwater. Carbon absorption treatment and air stripping are being employed as remedial action measures.

Mr. LaConde's experience includes research and bench-scale testing regarding the use of powdered and granulated activated carbon (PAC) for removal of selected organics from leather tannery wastewaters; evaluating the effects of biodegradation on chemical preservatives used in fresh packing operations in the apple industry; removal of toxic organo-tin from drydock wastewaters at Naval shipyards; and assessment of the degree of hazard of surface impoundments for explosives.

Thomas Dong, Senior Project Engineer, provides SCS with technical and practical experience in environmental chemistry and hazardous waste management. He has been involved in many SCS projects related to hazardous waste characterization and management. In addition, Mr. Dong is well versed in laboratory procedures and instrumental analysis. His background in this field includes atomic absorption spectrophotometry, gas chromatography, total organic carbon, infrared and UV/VIS spectrophotometry.

Mr. Dong is currently working on several projects dealing with the problem of underground storage tank leaks. He is evaluating the extent of lateral and vertical contamination at a construction site. He is well acquainted with groundwater and soil sampling techniques as well as air quality surveying using organic vapor monitors. In addition, Mr. Dong is participating in an EPA-funded project to determine the extent of local government intervention for regulating underground tanks. All 50 states plus U.S. territories will be surveyed to determine the number of actual cases in each state.

Christopher G. Ward, Geologist/Tank Specialist, is a geologist with an extensive background in the identification and control of fuel leaks from underground tanks. He has conducted field investigations at fuel leaks and spills where extensive contamination exists. He is very familiar with available remedial action technologies. Mr. Ward is also a Certified Tank Tester using the Petro-Tite system and has supervised large and small tank integrity testing programs.

Krishan K. Saigal, P.E., Chief Design Engineer, has more than 20 years of experience in the design of waste management facilities. He is responsible for preparation, development, coordination, and drafting of engineering and financial studies, reports, plans, and specifications.

Mr. Saigal has designed numerous chemical, fuel, and wastewater underground storage tanks for waste treatment facilities. His responsibilities on these projects also included preparation of the associated specifications, cost estimates, and O and M manuals. For the U.S. Navy, Mr. Saigal is presently involved in testing existing underground fuel storage tanks for leakage.

In addition, he was responsible for the preliminary design and engineering study of a hazardous waste treatment facility for Beale Air Force Base, California; and design of hazardous waste storage and disposal facilities for the Environmental Protection Corp. in Bakersfield, California.

Lori T. Tagawa, Field Geologist, has a diverse background in geology and environmental hydrogeology. She has experience in designing and implementing risk management assessments, including comprehensive geologic and hydrologic site characterizations, ground water monitoring systems, and recovery programs. As a geologist in Redondo Beach, California, Ms. Tagawa directed field studies assessing the aerial extent and degree of ground water contamination from leaking underground storage tanks in several southern California locations.

Anne S. Childress, Geologist, has been involved in the preparation of monitoring work plans for underground storage tanks. She has been involved in the removal, closure and clean-up of a waste oil tank in Gardens, California. She has prepared cost estimates for various clean-up programs.

Detailed resumes of the key personnel can be found in Appendix B.

SECTION 4

SCS SUPPORT FACILITIES

CHEMICAL LABORATORY

The chemical laboratory is located in a separate facility in Signal Hill, California. This facility houses Varian 2700 and 2400 Gas Chromatographs, a Perkin-Elmer 280 Atomic Absorption Spectrophotometer, and various other spectrophotometric equipment in an area isolated from the main wet chemistry laboratory. In addition to these instruments, the laboratory is well equipped to perform analyses on water, wastewater, sludges, soils, plants, leachates, and other types of samples. Laboratory capabilities include:

- o Gas chromatography ECD-, FID-, TCD-packed and capillary columns interfaced with a HP 2900A Integrator
- o Atomic absorption and emission spectroscopy
- o Total organic carbon (TOC)
- o Flameless AA analysis
- o Spectrophotometric methods
- o Complete water quality analysis
- o Automated COD analysis
- o EPA and California CAM hazardous and toxic waste extractions/analysis
- o Food research and analysis
- o Physical and chemical soil analysis
- o Solid, liquid, and air sampling
- o Laboratory-scale treatment feasibility studies
- o Landfill gas analysis including H₂, He, CO₂, N₂, O₂, CH₄ and other hydrocarbons.

The SCS Laboratory is directed by Mr. Ken LaConde, is approved by the California Regional Water Quality Board, and is a State of California certified Hazardous Waste Laboratory.

ENVIRONMENTAL MONITORING EQUIPMENT

SCS possesses most of the equipment necessary for site assessments at tank facilities. Included are:

- o Foxboro Organic Vapor Analyzer (OVA)
- o PhotoVac "TIP" organic vapor analyzer
- o HNN 101 organic vapor analyzer
- o Noncontaminating sample pumps and collection apparatus, personal sampling pumps, dosimeters
- o Toxic gas detector, (absorbent) colormetric tubes
- o Combustible gas meters, vacuum/pressure gauges, ground water detection meters
- o Mobile gas chromatograph

FIELD EXPLORATION AND TESTING EQUIPMENT

- o Mobile Minuteman portable drill rig, capable of 30- foot, 3-inch-diameter boring in areas inaccessible to larger drilling equipment
- o Various pumping, soil and water sampling equipment
 - ISCO bladder pump with Teflon or poly lines
 - submersible pump (4" wells) stainless steel, 1/2 HP
 - Tri-Loc hand pump
 - various trash, centrifugal pumps
 - teflon, PVC, acrylic bailers
 - "steam" cleaner with water tank and trailer
 - water level sensors
 - pH, conductivity, temperature probes
 - Honda 110 or 220 volt portable generator

- various portable storage tanks, controls and pumps
- hand auger equipment

COMPUTER, LIBRARY AND PRODUCTION FACILITIES

Each SCS office maintains a computer center with equipment ranging from micro computers to HP 3000 minicomputers with ancillary devices. The computer systems support multilevel security, which is based on organizational structure of accounts, groups and files. Data is stored for complete integrity and privacy of client information.

Each SCS office has access to the main technical library located in Long Beach which contains over 30,000 volumes (along with its own in-house library). Additionally, the offices have unlimited use of the fine technical university libraries located in their area.

All SCS offices are equipped with a modern production department staffed with well-trained personnel.

UNDERGROUND STORAGE TANKS PROJECTS
IN CALIFORNIA 1987-89

<u>CLIENT</u>	<u>PROJECT TITLE</u>	<u>PROJECT DESCRIPTION</u>
STATE OF CALIFORNIA, DEPARTMENT OF CORRECTIONS SACRAMENTO, CA SUBCONTRACTOR TO: ERNST AND YOUNG SACRAMENTO, CA	HAZARDOUS MATERIALS PRACTICES EVALUATION (0189283)	EVALUATE HAZARDOUS MATERIALS STORAGE AND HANDLING PRACTICES AT DEPARTMENT OF CORRECTIONS STATE PRISON FACILITIES. GA- THER INFORMATION THROUGH SITE VISITS AND QUESTIONNAIRES. IDENTIFY AREAS OF NON-COMPLI- ANCE WITH REGULATIONS AND STANDARD PRACTICES AND RECOM- MEND IMPROVEMENTS.
COUNTY OF MERCED, PUBLIC WORKS DEPARTMENT MERCED, CA	UNDERGROUND TANK INVESTIGATION (0387001)	REVIEW EXISTING DATA AND GA- THER SOIL AND GROUNDWATER DATA. PREPARE WORK PLAN FOR THREE SITES WHERE UNDERGROUND TANKS HAVE BEEN PREVIOUSLY PULLED. CONDUCT TEST PIT WORK, HAND AUGER HOLE(S), TEST BORINGS, INSTALL MONITORING WELLS, ANALYZE SOIL AND WATER SAMPLES AND PREPARE ENGINEER- ING REPORT. PREPARE CLEAN-UP PLANS.
COUNTY OF MERCED, DEPARTMENT OF PUBLIC WORKS MERCED, CA	MERCED COUNTY - TASK 5B (0387001-02)	PERFORM FEASIBILITY STUDY AND DESIGN OF A REMEDIATION PRO- GRAM FOR FUEL RELEASE PROBLEM AT THE CENTRAL FIRE STATION.
COUNTY OF MONTEREY SALINAS, CA	TANK TESTING - MONTEREY COUNTY, CALIFORNIA (0387005)	PERFORM PRECISION TANK TEST OF 33 TANKS FOR THE PARK, PUBLIC WORKS AND BUILDING AND GROUNDS DEPARTMENTS.
WINTERS COMPANY SAN JOSE, CA	WINTERS COMPANY - DALY CITY (0387009)	PERFORM SAMPLING AND ANALYSIS OF ONE VADOSE WELL THREE TIMES PER YEAR FOR THE WASTE OIL TANK AT THE DALY CITY FACILITY.
VIKING FREIGHT SYSTEM SAN JOSE CA #P	VIKING FREIGHT - MONITORING (0387010)	PERFORM SAMPLING AND ANALYSES OF GROUNDWATER MONITORING WELLS ON A QUARTERLY OR SEMI- ANNUAL BASIS AT VARIOUS SITES.
VIKING FREIGHT SYSTEM SAN JOSE, CA	UNDERGROUND TANK INVESTIGA- TION - SALINAS, CALIFORNIA (0387010-01)	DEVELOP AN UNDERGROUND TANK MONITORING WORKPLAN AND SUBMIT TO MONTEREY COUNTY.
VIKING FREIGHT SYSTEM SAN JOSE, CA	VIKING - SAN LEANDRO (0387010-02)	DEVELOP AN UNDERGROUND TANK MONITORING PLAN AND SUBMIT TO ALAMEDA COUNTY.
VIKING FREIGHT SYSTEM SAN JOSE, CA	GROUNDWATER MONITORING - EUREKA, CALIFORNIA (0387010-30)	PERFORM SEMI-ANNUAL SAMPLING AND ANALYSIS OF TWO GROUND- WATER MONITORING WELLS.
VIKING FREIGHT SYSTEM SAN JOSE, CA	ANNUAL TANK TEST - GARDENA, CALIFORNIA (0387010-33)	PERFORM ANNUAL PRECISION TANK TEST ON TWO UNDERGROUND TANKS AT THE GARDENA SITE. REPORT RESULTS TO CLIENT.
VIKING FREIGHT SYSTEM SAN JOSE, CA	VIKING - PETALUMA, CALIFORNIA (0387010-42)	PROVIDE SEMIANNUAL WATER SAM- PLING AND ANALYSIS OF SEVEN GROUNDWATER MONITORING WELLS.

UNDERGROUND STORAGE TANKS PROJECTS
IN CALIFORNIA 1987-89

<u>CLIENT</u>	<u>PROJECT TITLE</u>	<u>PROJECT DESCRIPTION</u>
GOLDEN GRAIN FOODS SAN LEANDRO, CA	ODOR/SHEEN TESTS - SAN LEAN- DRO, CALIFORNIA (0387011)	PERFORM WEEKLY ODOR/SHEEN TESTS AND RECORD WATER LEVELS ON THREE GROUNDWATER MONITOR- ING WELLS.
YELLOW FREIGHT SYSTEM OVERLAND PARK, KS	YELLOW FREIGHT - OAKLAND, CALIFORNIA (0387012-01)	PERFORM WELL SAMPLING, CHEMI- CAL ANALYSIS AND TANK TESTING AT THE OAKLAND FACILITY. MAY LEAD TO BORINGS AND CLOSURE OF ONE TANK. COMPLETE CONTAMI- NATION REMEDIATION PROGRAM.
YELLOW FREIGHT SYSTEM OVERLAND PARK, KS	YELLOW FREIGHT - SOUTH SAN FRANCISCO (0387012-02)	SEMI-ANNUAL WATER SAMPLING, ANALYSIS AND REPORT ON THREE GROUNDWATER MONITORING WELLS.
YELLOW FREIGHT SYSTEM OVERLAND PARK, KS	YELLOW FREIGHT - SUNNYVALE (0387012-08)	CONDUCT A SITE INVESTIGATION, PRECISION TEST TWO TANKS, AND PERFORM REMEDIAL ACTIONS, IF NECESSARY.
YELLOW FREIGHT SYSTEM OVERLAND PARK, KS	YELLOW FREIGHT - SACRAMENTO (0387012-44)	PROVIDE ANNUAL TANK TESTING.
YELLOW FREIGHT SYSTEM OVERLAND PARK, KS	YELLOW FREIGHT - BARSTOW (0387012-45)	PROVIDE ANNUAL TANK TESTING.
YELLOW FREIGHT SYSTEM OVERLAND PARK, KS	YELLOW FREIGHT - FRESNO (0387012-47)	PROVIDE ANNUAL TANK TESTING.
YELLOW FREIGHT SYSTEM OVERLAND PARK, KS	YELLOW FREIGHT - FONTANA (0387012-48)	PROVIDE ANNUAL TANK TESTING.
YELLOW FREIGHT SYSTEM OVERLAND PARK, KS	YELLOW FREIGHT - GARDENA (0387012-49)	PROVIDE ANNUAL TANK TESTING.
YELLOW FREIGHT SYSTEM OVERLAND PARK, KS	YELLOW FREIGHT - ORANGE (0387012-54)	PROVIDE ANNUAL PRECISION TANK TEST.
YELLOW FREIGHT SYSTEM OVERLAND PARK, KS	YELLOW FREIGHT - SALINAS (0387012-58)	PERFORM ANNUAL PRECISION TANK TESTING.
ENVIROGROUP LAFAYETTE, CA	UNDERGROUND STORAGE TANK ASSESSMENT - SAN FRANCISCO (0387016)	CONDUCT SITE ASSESSMENT AT UNDERGROUND TANK SITE PRIOR TO SITE SALE OR RELEASING BY OWNER. DRILL 3 TEST BORINGS TO AN ESTIMATED 30 FEET, PERFORM CHEMICAL TESTING, AND EVALUATE EXTENT OF SUB- SURFACE CONTAMINATION.
VERL'S CONSTRUCTION CASTRO VALLEY, CA	VERL'S CONSTRUCTION (0387017)	COLLECT SOIL SAMPLES AND HAVE ANALYSES PERFORMED AFTER TANK REMOVALS AT VARIOUS BAY AREA SITES.
VARIOUS CLIENTS DUBLIN, CA	MISCELLANEOUS TANK TEST PROJECTS (0387099)	PERFORM ONE-TIME TANK TEST EFFORTS FOR VARIOUS CLIENTS IN CALIFORNIA.
ENVIROGROUP LAFAYETTE, CA	GAS STATION (0388002)	SAMPLE AND ANALYZE SOIL AT SITE TO DETERMINE EXTENT OF CONTAMINATION.

UNDERGROUND STORAGE TANKS PROJECTS
IN CALIFORNIA 1987-89

<u>CLIENT</u>	<u>PROJECT TITLE</u>	<u>PROJECT DESCRIPTION</u>
COUNTY OF NEVADA NEVADA CITY, CA	UNDERGROUND STORAGE TANK SERVICES (0388035)	EVALUATE TEN UNDERGROUND STOR- AGE TANKS. PERFORM ONSITE E- VALUATION AND PRECISION TEST- ING. PREPARE REPORT OUTLINING RECOMMENDATIONS FOR REMEDIA- TION AND LONGTERM MONITORING PLANS.
VERL'S CONSTRUCTION HAYWARD, CA	VERL'S CONSTRUCTION, INC. (0388038)	GENERAL UST AT VARIOUS SITES.
VERL'S CONSTRUCTION HAYWARD, CA	UNDERGROUND TANK REMOVALS (0388038-01)	PROVIDE SITE SUPERVISION AT VARIOUS SITES, INCLUDING SAM- PLE COLLECTION AND ANALYSES AND PREPARATION OF REPORTS.
LABORERS TRAINING CENTER SAN RAMON, CA	FUEL OIL SPILL, SAN RAMON, CALIFORNIA (0388043)	INVESTIGATE AND REMEDIATE 200- GALLON DIESEL FUEL SPILL.
PROCESS CONSTRUCTION HAYWARD, CA	UNDERGROUND GAS TANK LEAKAGE (0388044)	PERFORM EXPLORATION AND REMEDATION OF CONTAMINATION RELATED TO UNDERGROUND GAS TANK LEAKAGE.
PURE GRO COMPANY SACRAMENTO, CA	REMOVAL OF HAZARDOUS MATERIAL STORAGE TANKS - VISALIA, CALIFORNIA (0388048)	WRITE INSTRUCTIONS FOR DE- STROYING THREE SODIUM CHLORATE TANKS. OBTAIN AND ANALYZE THREE SAMPLES FOR PRODUCT IDENTIFICATION.
LANDMARK DEVELOPMENT CUPERTINO, CA	KENYON PLACE UNDERGROUND TANK REMOVAL - SANTA CLARA, CALIFORNIA (0389061-01)	DESIGN UNDERGROUND STORAGE TANK REMOVAL. TAKE SAMPLES FROM BENEATH TANK AS REQUIRED BY CITY/COUNTY ORDINANCES. HAVE SOIL ANALYZED FOR DIESEL. PREPARE REPORT WITH FINDINGS, SUMMARY AND RECOMMENDATIONS FOR REMEDIATION, IF REQUIRED.
I. C. F. STUDIO CITY, CA	LABORATORY SERVICES (0688018)	PERFORM MISCELLANEOUS ANALYSES ON WATER SAMPLES.
HANEY COMPANY SIGNAL HILL	UNDERGROUND STORAGE TANK INVESTIGATION (0688022)	SUPERVISE REMOVAL OF UNDER- GROUND TANKS AND PERFORM LABORATORY ANALYSES AS REQUIRED.

UNDERGROUND STORAGE TANKS PROJECTS
IN CALIFORNIA 1987-89

<u>CLIENT</u>	<u>PROJECT TITLE</u>	<u>PROJECT DESCRIPTION</u>
LABORERS TRAINING CENTER SAN RAMON CA	LABORERS TRAINING CENTER (0388005)	OBTAIN PERMIT TO REMOVE 560-GAL GASOLINE TANK. COLLECT SAMPLE FROM TANK AREA. ANALYZE SAMPLE. DISPOSE OF TANK. REPORT RESULTS.
WEST COAST TANK CAMPBELL, CA	WEST COAST TANK - TAXI-TAXI (0388019-01)	OBTAIN EIGHT SOIL SAMPLES FROM EXCAVATION UNDER FOUR TANKS. ANALYZE FOR GASOLINE, LEAD AND WASTE OIL. REPORT RESULTS TO CLIENT POSSIBLY RESULTING IN INSTALLTION OF GROUND WATER WELLS.
PURE GRO COMPANY WEST SACRAMENTO, CA	PUREGRO CO - TRACY (0388022)	SUPERVISE THE REMOVAL OF A 550-GAL UNDERGROUND STORAGE TANK AT THE TRACY FACILITY. COLLECT SOIL SAMPLE FROM EXCAVATION, ANALYZE AND REPORT RESULTS TO CLIENT.
LADBROOK RACING, INC. LIVONIA, MI	GOLDEN GATE FIELD PHASE II; ALBANY, CALIFORNIA (0388023-01)	TEST THREE UNDERGROUND STORAGE TANKS. REVIEW BORINGS AND WELL ANALYSIS FOR CONTAMINANTS IN THE LOCAL AREA. COMPLETE A SOIL GAS SURVEY OF THE INSTALLATION. REMOVE LEAKING TANKS IF FOUND.
DEPARTMENT OF THE ARMY, SACRAMENTO DISTRICT, CORPS OF ENGINEERS SACRAMENTO, CA	UNDERGROUND STORAGE TANK REPLACEMENT, REMOVAL, SITE REMEDIATION - OAKLAND ARMY BASE (0388028)	PERFORM UNDERGROUND TANK TESTING, DESIGN TANK REPLACEMENT, PREPARE SPECIFICATIONS FOR TANK REMOVAL AND DISPOSAL, COLLECT AND ANALYZE SAMPLES, BACKFILL, DESIGN CONTINUOUS INVENTORY SYSTEM, AND DEFINE REMEDIATION REQUIREMENTS.
DEPARTMENT OF THE ARMY, SACRAMENTO DISTRICT, CORPS OF ENGINEERS SACRAMENTO, CA	SOIL SAMPLING AND REMEDIATION AND RESTORATION PLAN - OAKLAND ARMY BASE (0388028-01)	CONDUCT SOIL BORINGS, COLLECT AND ANALYZE SOIL AND/OR WATER SAMPLES, PROVIDE PRELIMINARY REMEDIATION PLAN AND RECOMMEND REMEDIAL ACTIONS.
CALIFORNIA OFFICE OF THE STATE ARCHITECT SACRAMENTO, CA SUBCONTRACTOR TO: YEI ENGINEERS HAYWARD, CA	OPEN END UNDERGROUND STORAGE TANK SERVICES - NORTHERN CALIFORNIA (0388029)	PREPARE DESIGN DOCUMENTS. PERFORM DESIGN-RELATED SURVEY AND INVESTIGATIONS AT ACTIVE AND ABANDONED UNDERGROUND TANK SITES ON STATE PROPERTY IN NORTHERN CALIFORNIA.
HERTZ PENSKE READING, PA	UNDERGROUND TANK REMOVAL (0388034)	SUPERVISE REMOVAL OF UNDERGROUND TANKS AT TWO SITES: SAN LEANDRO AND SOUTH SAN FRANCISCO. COLLECT SAMPLES AND ANALYZE. PREPARE REPORT OF FINDINGS AND PROVIDE ANY RECOMMENDATIONS.
HERTZ PENSKE READING, PA	UNDERGROUND TANK REMOVAL - SAN LEANDRO, CALIFORNIA (0388034-01)	SUPERVISE REMOVAL OF UNDERGROUND TANKS. COLLECT SAMPLES AND ANALYZE. PREPARE REPORT OF FINDINGS AND RECOMMENDATIONS.

Education

B.S. - Central Michigan University, Mt. Pleasant, 1981
Geology

M.S. - University of Kentucky, Lexington, 1985
Geology

Post-Graduate - California State University, Los Angeles, 1986
Hydrogeology

Professional Licenses

Registered Geologist - California

Affiliations

National Water Well Association
Association for Women Geoscientists
South Coast Geological Society

Professional Experience

Ms. Childress has been involved in numerous SCS projects related to hazardous waste characterization and management. Some of the projects she has participated in are summarized below:

- Designed and implemented comprehensive (geologic and hydrologic) site characterizations, ground water monitoring systems, and recovery programs.
- Directed field studies assessing the areal extent of gasoline plumes and degree of ground water contamination from leaking underground storage tanks (LUST). These studies involved retrieval and analysis of soil and water samples to further define contamination sources.
- Directed site assessment studies including site inspection and drilling programs to identify potential on-site hazardous waste conditions.
- Directed installation and development of well systems for monitoring of ground water and emissions of gaseous vapors.
- Involved in the coordination and implementation of cleanup and disposal of contaminated soil and ground water at various hazardous waste sites.

- Produced cost estimates for various site assessment and cleanup programs regarding underground tanks.
- Developed and implemented on-site soil treatment systems for contaminated soil including vapor extraction.
- Produced and implemented work plans for SWAT characterization of southern California solid waste facilities.
- Directed and implemented large-scale underground tank investigations at various airport facilities.

Ms. Childress has participated in certified health and safety programs in compliance with OSHA Standard 29 CFR 1910.120. She is knowledgeable in incident response operations, team functions, personnel safety, and field equipment. Ms. Childress is able to recognize and evaluate potential chemical and physical hazards and associated risks in field operations; discuss and use of personnel protective equipment such as respiratory protection and protective clothing; use and interpret direct-reading instruments; and examine and establish Standard Operating Safety Guidelines to ensure safe and effective response operations.

JOHN P. CUMMINGS, PH.D., R.E.A.**Education**

B.S. - Chemistry, Saint Michael's College, Winooski, Vermont

M.C.E. - Environmental Engineering, University of Toledo, Toledo, Ohio

Ph.D. - Chemistry - University of Texas, Austin, Texas

J.D. - Law - University of Toledo, Toledo, Ohio

GRADUATE - Industrial College of the Armed Forces, Washington, D.C.

Affiliations

Sigma XI - RESA

American Chemical Society

American Society for Testing Materials

Governmental Refuse, Collection and Disposal Association.

National Solid Waste Management Association

American Bar Association

Phi Alpha Delta

Registrations and Certifications

Ohio Registered Attorney

California Registered Environmental Assessor

EPA Certified Asbestos Inspector and Management Planner

U.S. Board of Military Appeals Attorney

U.S. Department of Defense Certified Fallout Shelter Analyst

U.S. District Court Registered Attorney

40 Hour EPA Approved Hazardous Waste Operations Training

Professional Experience

Mr. Cummings brings to SCS over thirty years of experience, project management, planning, regulatory affairs, implementation of legislative programs and policies. He has a strong background in hazardous/toxic waste management, pollution abatement implementation, solid waste management, resource recovery and recycling, legal aspects of OSHA and EPA litigation as well as product liability. He also has an extensive technical background in chemistry, ceramic, paper, and plastic materials. He is a patentee.

JOHN P. CUMMINGS (Continued)

Other experience includes:

- o Legal counsel for several small businesses for environmental legal matters including permitting, completion of abatement orders, and determination of compliance with federal, state, and local environmental regulation.
- o Manager, Environmental Affairs - Responsible for company environmental matters, permitting, recycling, resource recovery, hazardous solid waste management. Prime contact with customers and governmental agencies.
- o Legal Counsel, Owens-Illinois, Inc. - Responsible for all OSHA and EPA Compliance and Litigation.
- o Engineered, built, managed, and evaluated the first resource recovery from Municipal Solid Waste Plant for the EPA.
- o Developed hazardous material reduction programs for several production operations.
- o Performed recycling audits, system analysis, and source reduction programs for 15 facilities.
- o Director of analytical services for Owens-Illinois, Inc.
- o Consulting on resource recovery or recycling, utilization of waste products, hazardous waste plans, handling, packaging, transportation and disposal of solid, hazardous and toxic materials, legal counsel to several small firms, environmental audits.
- o Risk Management - Assess risks, claims, asbestos risks, approved settlement payments, organized insurance treaties.
- o Produced the County Hazardous Waste Management Plans for six Northern California counties.
- o Developed the Environmental Impact Report for four Northern California county Hazardous Waste Management Plans.
- o Developed risk assessment programs for two major industries.
- o Completed over 50 site environmental assessments and developed remediation actions when required.

Education

B.S. - California State University, Long Beach, 1976
Zoology

M.S. - University of Southern California, 1979
Environmental Engineering

Affiliations

American Society of Limnology and Oceanography
Institute of Environmental Sciences

Professional Experience

Mr. Dong provides SCS with strong technical skills and practical experience in environmental chemistry; assessment of solid and liquid hazardous waste treatment, disposal, and management; toxicological effects of chemicals used in organic chemical manufacturing industries; and a good working knowledge of regulations pertaining to storage of hazardous materials in underground tanks. Recent projects in which he has participated are shown below.

- Determining the extent of gasoline contamination at a construction site located in the San Fernando Valley. Soil and water samples were retrieved from eight on-site wells to locate the source and volume of the gasoline plume. A portable OVA and draeger tubes were used to determine levels of hydrocarbons being emitted into the atmosphere. Recommendations for cleanup and/or removal of contaminated soils/water have been submitted.
- For a major southern California paint company, he was involved in initiating a leak detection program for underground tanks containing acetone and methyl ethyl ketone (MEK). Drilling and sampling are currently being accomplished to determine the extent of contamination at the plant. Data will be submitted to the local Regional Water Quality Control Board for review and recommendations.
- For EPA, he was involved in providing cost estimates for leak detection and secondary containment for new and retrofit applications regarding underground storage tanks. This recent report is currently being used as a basis for evaluating the economic criteria associated with upgrading current installations.
- Participation in a nationwide EPA-funded project to determine the extent of local government intervention for regulating underground storage tanks. All 50 states plus U.S. territories were surveyed to determine the number of actual cases in each state.

- Hazardous waste characterization of host tenants at Vandenberg Air Force Base, including an on-site interview with personnel to determine quantities and management practices.
- Collection, storage, and transfer of PCBs and PCB-contaminated materials from more than 75 state institutions in California; study recommended the best management and cleanup procedures.
- Performing an industrial survey of users, manufacturers, and generators of hazardous materials in the San Fernando Valley, California. Best management practices were formulated to protect ground water sources within the community.
- Identifying potential synthetic lining materials that could be used for upgrading utility waste disposal sites.
- Developing closure/post-closure plans for an Army munitions factory located in Pine Bluff, Arkansas.
- Team member for NEESA's NACIP study at Miramar Naval Air Station, and Marine Corps Base Camp Pendleton. He was responsible for gathering information regarding past hazardous waste storage, transfer, and processing operations.

KENNETH V. LACONDE, VICE PRESIDENT

Education

B.S. - St. Mary's College, 1964
Chemistry

Affiliations

Institute of Food Technology
American Chemical Society

Registrations

California Registered Environmental Assessor (REA-01106)

Professional Experience

Mr. LaConde joined SCS Engineers in 1974 with 14 years of experience in private industry. Mr. LaConde provides SCS with proven technical expertise in organic and inorganic chemistry. He has extensive experience in solid and hazardous waste management, project management and administration, municipal and industrial sludge management, chemical sampling and analysis, industrial waste treatment and disposal, quality assurance systems, and product development. Mr. LaConde currently manages most of SCS's projects related to the management of leaking underground storage tanks, and is responsible for SCS's analytical laboratory.

Mr. LaConde has led several SCS investigations of leaking underground storage tanks. For one project, the client encountered gasoline in ground water while excavating for a major high rise project. Mr. LaConde directed efforts to identify the spill sources, and developed remedial actions including ground water treatment with air stripping and activated charcoal. This work was based on his earlier research using powdered activated carbon to remove organic tin from drydock wastewater and organic pesticides from apple wash water.

On another project, Mr. LaConde led investigations to establish the extent of MEK, acetone, and lacquer thinner in soils and ground water due to leaking tanks at a manufacturing facility. Remedial actions were also devised under his direction.

Mr. LaConde has served as Project Manager on many multimillion dollar research efforts including studies of wastewater effluent from the Canned and Preserved Fruits and Vegetables Industry and the Miscellaneous Foods and Beverages Industry.

He has also served as Project Manager for an EPA study of municipal wastewater treatment sludge utilization and land treatment practices. During this project, over 100 municipally operated sewage treatment plants and 48 state offices handling solid waste matters were contacted to locate nine

study sites. Working closely with EPA and three nationally and internationally known soil scientists, the project team sampled sludges, soils, and plants at each site for physical, chemical, bacteriological, parasitological, and viral examination. Over 8,000 data points were statistically assessed in terms of perceived and measured environmental impacts. Recommendations for proper soil and sludge management practices were provided.

For the Tanners Council of America, Mr. LaConde directed a 5-year demonstration project to evaluate the environmental effects of disposing of tannery sludges by land treatment.

As Laboratory Director, Mr. LaConde currently supervises a modern facility equipped with three gas chromatographs, a TOC analyzer, and an atomic absorption spectrophotometer. The laboratory is currently engaged in many research projects and investigations of site conditions at hazardous waste disposal sites. Under Mr. LaConde's direction, the SCS laboratory conducts EP toxicity tests per RCRA procedures, hazardous waste analyses per the California Assessment Manual (CAM), and the identification and quantification of contaminants in soils and ground water.

Presentations and Publications

- LaConde, K. V., and C. J. Schmidt. In-plant Control Technology for the Fruits and Vegetables Processing Industry. Presented at the 7th Annual Food Waste Symposium, Atlanta, Georgia, April 1976.
- Clements, E. V., C. J. Schmidt, and K. V. LaConde. Wastewater Characterization and Treatment Alternatives for the Fruit and Vegetable Processing Industry. Presented at the 30th Purdue Industrial Waste Conference, May 8, 1975.
- Otte, A. D., and K. V. LaConde. Environmental Assessment of Municipal Sludge Utilization at Nine Locations in the United States. Presented at the 9th Annual Conference on Food, Fertilizer, and Agricultural Residues, April 28, 1978.
- LaConde, K. V., C. L. Eaker, R. J. Lofy, and R. P. Stearns. A Preliminary Assessment of Cadmium Addition to Agricultural Lands Via Commercial Phosphate Fertilizers. Contract No. 68-01-4625, EPA Office of Solid Waste, SW-708, September 1978.
- LaConde, K. V., R. J. Lofy, and R. P. Stearns. Municipal Sludge Agricultural Utilization Practices - An Environmental Assessment. Contract No. 68-01-3265, EPA Office of Solid Waste, SW-709, September 1978.
- LaConde, K. V. Study of Rum Distilling Waste Treatment and By-Product Recovery Technologies. SCS Engineers, January 1979.

KENT A. MADENWALD, P.E., R.E.A.

Education

B.S. - Lamar University, 1957
Geology/Mechanical Engineering

M.S. - University of North Dakota, 1962
Geological Engineering

Professional Licenses

Professional Engineer - Wisconsin
Registered Environmental Assessor - California
40 Hour EPA Approved Hazardous Waste Operations Training

Professional Experience

Mr. Madenwald brings to SCS over thirty years of experience in the geological and engineering disciplines. Professional highlights include:

- o Project Manager for underground tank removal, remedial action and site closure for Milne Truck Lines throughout the western United States. Site contamination remediated in Reno, Nevada area terminal and ongoing ground water monitoring implemented; major aeration completed at Phoenix, Arizona terminal.
- o Project Manager for underground tank monitoring and remedial actions for Yellow Freight System at 16 terminals in the western United States. Tank removals, repairs, retrofitting, tank integrity testing and large scale soil and groundwater remedial actions have been performed.
- o Project Manager for various site assessments including a horse race track, city redevelopment agency, chemical companies, lending institutions, and oil field operations.
- o Directed design and construction of various projects in Mobil refinery in St. Louis, Missouri. Included were: redesign of coker heater; redesign of river barge unloading and transmission system; rehabilitation of three - 100,000 barrel storage tanks; acted as Chief Engineer on as needed basis.
- o Regional Geologist for Pure Oil Company in Western Canada doing wide area stratigraphic studies, prospect evaluation, and wellsite supervision.

KENT A. MADENWALD (Continued)

- o Ground water and pollution studies in oil field operations in North Dakota and Canada, resulting in brine collection and injection wells for pressure maintenance program. Gas studies to develop gas collection system and gas plant for sulfur scrubbing.
 - o Developed soil stabilization plan for commercial development. Included housing septic tank drainage study and design. Resulted in sanitary sewer and small treatment plant installation.
 - o Slope studies of Missouri River for development of Lake Sacacawea in North Dakota.
 - o Land reclamation studies for lignite mines, resulting in land reforestation and reduced leaching of soils into ground water supply.
 - o Project Manager for \$42,000,000 gas transmission and storage system for Mississippi River Gas Transmission Company. Resulted in increased throughput and eliminating flow upsets. Included were three compressor stations and seven underground storage wells. System was put on-line within budget and one week from expected completion.
 - o Directed design and construction of new filter cellars, ruh cellars, fermenting cellars, and government cellars for Jos. Schlitz brewery in California. Also designed and installed new CO₂ collection and purification system.
- Plant Engineer for Miller Brewing Company, Azuza facility. Project Manager for Design and Construction of Utilities area for new Miller Brewery at Irwindale, California. Project Manager for \$10 million dollar N.I.C. budget.
- o Design and installation of wastewater treatment systems for major industrial laundry firm, consisted of DAF, inclined plate settlers and ultrafiltration systems.
 - o Plant layout, industrial engineering consultant for various corporate clients.
 - o Chief Engineer for American Cryogenics, Inc. Designed and fabricated large (100 ton +) air separation plants. Designed and fabricated first high pressure (10,000 p.s.i.) trailers for NASA.

KRISHAN K. SAIGAL, VICE PRESIDENTEducation

B.E. - Gujarat University, India, 1956
Civil Engineering

M.S. - Case Institute of Technology, Cleveland, Ohio, 1959
Civil Engineering

Professional Licenses

Professional Engineer - New York, Ohio, California, and Arizona

Affiliations

Water Pollution Control Federation

Professional Experience

Mr. Saigal provides SCS with an extensive background in waste management, sewage collection and treatment, and water pollution control. His professional experience includes preparation of plans and specifications for sewage collection systems, sewage treatment plants, water and sewerage facilities, activated sludge plants, and pump stations.

Prior to joining SCS, Mr. Saigal served as Project Manager/Department Head at VTN Consolidated, Inc., Irvine, California. During his 2 years at VTN, he was responsible for the following projects:

- Coordination of field and office work for the construction of a water pollution control center for Aliso Water Management Agency (AWMA).
- Preparation of a revenue program for the city of Vacaville, California.
- Preparation of a cost allocation study for AWMA.
- Preparation of an operation and maintenance manual for AWMA coastal treatment plant.
- Preparation of plans and specifications for 18 small sewage treatment plants in Saudi Arabia.

Other projects which are representative of Mr. Saigal's 22 years of experience include the following:

- Project Manager responsible for the design and preparation of plans and specifications for a low-pressure sewer system for the towns of Camberia, Pendleton, and Wheatfield, New York.

10/88/G

KRISHAN K. SAIGAL (continued)

- Project Manager responsible for coordinating field and office work for the construction of a water pollution control center in Niagara County, New York.
- Plans and specifications for a 14-mgd activated sludge plant, including tertiary treatment, sludge thickeners, thermal sludge conditioning, vacuum filtration, and incineration for Niagara County Sewer District No. 1, New York.
- Plans and specifications for an interceptor and sewage treatment plant for the village of Geneva-on-the-Lake, Ohio.
- Plans and specifications for interceptors, force mains, and pump stations for both Erie County Sewer District No. 4 and the town of Grand Island, New York.
- Engineering report on the expansion of Easterly Sewage Treatment Plant, Cleveland, Ohio.
- Preliminary engineering report on sanitary sewerage system improvements for the city of Troy, Ohio.
- Preliminary engineering report for sewage collection and treatment facilities at Conneaut, Ohio.
- Preliminary report on advanced waste treatment facilities for Southerly Wastewater Pollution Control Center, Cleveland, Ohio.
- Design of photographic wastewater treatment facilities.
- Design and preparation of plans and specifications for landfill gas recovery and migration control systems for numerous landfills in California, Washington, and Maryland.
- Design and preparation of plans and specifications for landfill gas collection and utilization to produce electric power at Oxon Cove Landfill, Oxon Hill, Maryland.
- Design and preparation of plans and specifications for four vehicle wash facilities including sand-oil separators, water recycling, and oil recovery at Fort Irwin, California.

LORI T. TAGAWA

Education

B.A., University of Colorado, Boulder, 1982
Geology

M.S., California State University, Long Beach
Geology (in progress)

Affiliations

Geological Society of America
Association of Women Geoscientists
National Water Well Association

Professional Experience

Ms. Tagawa brings to SCS a background in hydrogeology and geology; project management; subsurface site and remedial investigations; solid waste assessment test (SWAT) proposal preparation and implementation, and final report preparation; aquifer characterization; secondary recovery of free-floating petroleum products atop water table.

Ms. Tagawa has 5 years of experience in ground water hydrology, aquifer characterization, and geochemical evaluations of hydraulic systems, with specialization in the assessment of ground water systems beneath inactive landfills, development and implementation of ground water monitoring plans, including identification and remediation of leachate plumes. She is experienced in the assessment and abatement of underground fuel and solvent leaks including secondary product recovery, soil and ground water analysis, and contaminated soil and ground water treatment and mitigation.

Specific project work includes the following:

- Project Manager/Hydrogeologist for Water SWAT in Riverside, California. Project involved evaluation of existing ground water and surface water conditions, recommendations for revised ground water monitoring well network, and assessment of potential for leachate generation at a recently closed landfill. Work included implementation of a recommended ground water monitoring network, including drilling and completing 20 monitoring wells, ground and surface water sampling, hydrogeologic analyses, and report preparation.
- Project Manager/Hydrogeologist for two Water SWATs in Oceanside, California. Evaluated existing hydrogeologic data, field monitoring of water levels and water quality to identify existing ground water conditions and flow regime, and recommended sites and designs for new ground water monitoring plan; assisted in development of closure plan for this recently closed landfill. Work also involved field reconnaissance to evaluate the local structural geology.

9/88/G

LORI T. TAGAWA (continued)

- Project Manager/Hydrogeologist for Water SWAT in Carson, California. Evaluated local geology and review hydrogeologic data obtained during previous investigations at this closed landfill situated next to an abandoned petroleum refinery. Evaluation of existing ground water monitoring system, delineation of petroleum product plume, and development of remediation program.
- Project Manager/Hydrogeologist involving an emergency investigation of a JP-5 pipeline leak that spilled over 10,000 gallons of product to the subsurface. Responsibilities included conducting all field activities, interfacing with appropriate regulatory personnel, and developing environmental impact assessment reports based upon geologic and hydrogeologic parameters in compliance with local, county, and state regulations.
- Project Manager/Hydrogeologist for several (10) underground storage tank compliance programs, Long Beach, California. Preparation and implementation of leak detection programs, tank monitoring programs, and remedial action plans. Preparation of site investigation report for local and state agencies for the insurance of proper permits for the storage of hazardous material underground.
- Project Hydrogeologist initiating underground hazardous material storage permitting requirements for a major corporation in Los Angeles County. Work included definition of site geology and hydrology, supervision of drilling and precision tank testing procedures, soil and ground water collection, and installation of water and vapor monitoring systems.
- Project Manager for preconveyance audits for many facilities in southern California. Assessment was conducted as part of land acquisition procedures to assess facilities. Work involved facility walk through, drilling and sampling of borings, water sampling, and final report preparation. Final report was used by clients to reconsider purchase of properties.
- Project Geologist involved in initiating leak detection programs for several chemical companies in the Los Angeles area with underground storage tanks containing acetone, methyl ethyl ketone (MEK), naph spirit, isobutanol, special hi-flash naph, wash thinner, toluol, butyl cellosolve (EB), etc. Drilling and soil sampling was done to determine the areal extent of contamination.
- Hydrogeologist in recovery/pollution abatement project involving recovery of free product (gasoline) on the water table and cleanup of associated contaminated aquifer, Orange County, California. Work included defining the extent and dynamics of the hydrocarbon plume, installing abatement system, monitoring the effectiveness of the system through water level and product thickness measurements,

LORI T. TAGAWA (continued)

ground water sampling and analyses, and maintaining contact with all regulatory agencies. Preparation of monthly status reports for the EPA and RWQCB.

- Hydrogeologist on other recovery/pollution abatement projects (including soils mitigation) in Los Angeles, Orange, Riverside, and San Diego Counties.
- Hydrogeologist investigating a site in Hollywood, California, that was contaminated with petroleum hydrocarbons from a service station's leaking underground storage tanks. Work included installation of 40 vapor and ground water monitoring wells, obtaining soil samples and water samples, ambient air monitoring, permitting, and communication with county and state regulatory agencies. Also involved in the design of recovery and abatement system using dual pumping and carbon adsorption techniques.
- Implemented a hazardous waste inventory and compliance assessment for the Nevada Department of Transportation. Determined type and amount of hazardous waste generated for 15 field maintenance stations. Current management and ultimate disposition of the sites were also determined and recommendations were made according to state and federal regulations.
- Geologist in charge of drilling, logging, and completion of 15 landfill gas wells for the purpose of monitoring landfill gas levels in overlying and surrounding properties in accordance with state and local ordinances.
- Sampling and inventorying electrical equipment for the presence of PCBs and PCB-contaminated materials from several state-owned institutions in California. Managed and processed data about physical and chemical conditions at over 1,500 locations and recommended appropriate PCB management and cleanup measures.

Ms. Tagawa has participated in a certified health and safety program in compliance with OSHA Standard 29 CFR 1910.120. She is knowledgeable in incident response operations, team functions, personnel safety, and field equipment. Ms. Tagawa is able to recognize and evaluate potential chemical and physical hazards and associated risks in field operations; discuss and use personnel protective equipment such as respiratory protection and protective clothing; use and interpret direct-reading instruments; and examine and establish Standard Operating Safety Guidelines to ensure safe and effective response operations.

Publications

Tagawa, L. T. Standard Handbook of Hazardous Waste Treatment and Disposal.
(In Press.)

9/88/G

CHRISTOPHER G. WARD

Education

B.A. - New England College, 1981, Geology

Professional Licenses

Professional/Certified Geologist, Arkansas, Florida, Virginia (pending)
Certified Petro-Tite Tank Integrity Tester
Commonwealth of Virginia, Building Inspector (Residential and General)

Professional Experience

Mr. Ward has a solid background in geology and soils, hazardous waste investigations, geotechnical investigations, materials testing and inspection, environmental site assessments (ESAs), underground tank testing, and corrective action design and construction for soil and ground-water contamination.

Typical project experience includes:

- o Turn-key approach to an underground storage tank (UST) leak. The project encompassed the testing of two 10,000-gallon fuel oil tanks and the identification of the leakage source, performance of a site assessment, and development of a corrective action plan. Oversight was provided for the installation of a ground-water treatment and oil recovery system, including weekly monitoring of the system.
- o Management of more than 300 Environmental Site Assessments for public and private clients in five East Coast states, including primary client contact, cost proposals, supervision of site assessments, soil borings, ground-water monitoring well installations, and interpretation of laboratory analyses.
- o Investigation of an UST leak for the Fairfax County (VA) school system including installation of monitoring wells, interpretation of hydrogeologic data, design and implementation of a product recovery system, and monthly monitoring reports.
- o Primary author of SCS's underground storage tank qualifications package and lecture series for business and property owners.
- o Management of a polychlorinated biphenol (PCB) survey at a military installation in Virginia including development of procedures and safety guidelines for conducting the survey, sampling of transformers, development of a data base for final results, and a training procedures manual for use by other military installations and SCS offices nationwide.

CHRISTOPHER G. WARD (continued)

- o Management of Spill, Prevention, Control, and Countermeasure (SPCC) plans for businesses in the Greater Washington (DC) metropolitan area.
- o Performance of a site risk and remediation assessment and development of a corrective action plan for a product line leak at a service station in Harrisonburg, VA. The project included installation and monitoring of a free-product recovery system as part of the initial abatement procedures.
- o Permeability testing to include drilling test holes, performing slug tests, determining soil permeability, and predicting migration rates for contingency plan petroleum spills.
- o Permeability testing and monitoring well installation at a hazardous waste spill site including rock coring and pressure permeability packer tests to depths of 500 feet to locate permeable zones for monitoring well design, and the installation of monitoring well clusters.
- o Performance of ESAs including geophysical surveys, installation of test and monitoring wells, and the performance of borehole geophysics and aquifer testing for the evaluation of hydrogeologic parameters.
- o Management of an asbestos monitoring project including development of personal protection equipment and guidelines for onsite workers at a construction site in northern Virginia where naturally-occurring asbestos was encountered. Property boundaries and personnel were monitored for asbestos as part of a health and safety program to meet county, state, and OSHA requirements.
- o Provision of engineering oversight for numerous UST removals including bidding assistance to retain contractors for clients, onsite contractor supervision, sample collection (soils and ground water), analytical testing including field screening and laboratory analyses, and closure reports.

**QUALIFICATIONS OF SCS ENGINEERS
IN LANDFILL AND SOLID WASTE
MANAGEMENT SERVICES**

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Covington, Kentucky
Kansas City, Missouri
Phoenix, Arizona
Reston, Virginia
Tampa, Florida
Columbus, Ohio
Norfolk, Virginia
Upper Nyack, New York**

March 1990

CONTENTS

<u>Section</u>		<u>Page</u>
1	Introduction	1
2	Corporate Experience	3
	Landfill Siting and Design	
	Landfill Gas (LFG) Control and Recovery	
	Transfer Station Studies and Design	
	Waste Pretreatment	
	Resource Recovery/Recycling	
	Solid Waste Collection Analysis	
	Calderon (SWAT) Programs	
3	Personnel	9
4	References	22

Appendix A - Resumes of Key SCS Personnel

SECTION 1

INTRODUCTION

BACKGROUND

SCS Engineers (SCS) is a consulting engineering firm specializing in the design, development, and evaluation of solid waste management systems. Since 1970, 70 percent of our work has been in the solid and hazardous waste field. The firm's founders, Robert P. Stearns and E.T. Conrad, are landfill experts and professional engineers registered in most states. Support staff include civil, mechanical, chemical and environmental engineers, hydrogeologists, geologists, chemists, biologists, environmental attorneys, and computer specialists.

Solid waste management and landfill services offered by SCS include:

- o Solid waste management planning for municipalities, counties, regional governments, and states.
- o Landfill siting, permitting, design, expansion, and closure.
- o Leachate and landfill gas migration monitoring and control.
- o Regulatory compliance, including California Subchapter 15 requirements, air and water solid waste assessment tests (SWATs), California Assembly Bill 2448 (Eastin) closure and post-closure requirements, California Assembly Bill 939 (Sher) Intergrated Waste Management Act of 1989, and EPA Subtitles C and D.
- o Transfer versus direct haul economic analysis.
- o Refuse collection productivity and cost assessments.
- o Waste transfer and resource recovery feasibility studies and design of facilities.
- o Waste collection routing optimization.
- o Market surveys for resource recovery and energy sales.
- o Solid waste quantity and composition assessments.
- o Landfill gas recovery and emission control.

- o Permitting, review, and design of facilities for waste disposal and treatment.
- o Development of methods to reduce the amount of hazardous waste in municipal solid waste landfills.
- o Design of modular incinerator installations.
- o Market surveys for energy and materials recovered from municipal refuse.
- o Development and implementation of recycling and source separation programs.

The specific objectives of our assignments vary depending on the needs of a particular client. SCS has conducted over 1700 solid waste design and study projects for private and governmental clients since 1970. This work has established SCS's prominence in the field.

A construction support company, a division of SCS Engineers, called SCS Field Services was formed in 1985 to support the growing demand to assist our clients in the implementation of landfill gas and other solid and hazardous waste related construction projects.

SCS solid waste management capabilities are described in greater detail in Section 2.

SECTION 2

CORPORATE EXPERIENCE

A description of SCS's solid waste management capabilities is presented below. A list of selected Solid Waste Management projects is provided in Table 2-1. Table 2-2 presents a partial list of cities where SCS has conducted solid waste collection projects.

SOLID WASTE MANAGEMENT PLANNING

SCS has been responsible for the preparation of many solid waste management plans for cities, counties, regional governmental associations, and states. Such plans typically include the following elements:

- o Identification of quantity and type of solid wastes generated.
- o Projecting the nature and amount of solid waste to be generated in the future.
- o Inventorying existing facilities and methods used to handle solid waste in a given jurisdiction.
- o Identifying current and projected laws and regulations that relate to waste management practices.
- o Defining the region's criteria and needs for future waste management systems in light of local physical conditions, regulations, and wastes to be handled.
- o Identifying alternative waste management methodologies, including source separation, recycling, waste-to-energy, composting, and lined landfills.
- o Evaluating the alternatives in terms of technical effectiveness, reliability, cost, probability of public acceptance, and other factors.
- o Developing recommendations for implementation, including associated schedules and financing needs.

SCS recently worked with the California Department of Conservation to estimate the current recycling rate of aluminum, glass, and plastic beverage containers, so that the effectiveness of the California Bottle Bill program can be measured in future years. We have recently conducted waste characterization studies in Burbank, Glendale, Santa Barbara, and Pasadena, among many other such projects in the United States. One goal of such studies is to determine the amount of household hazardous waste in municipal solid wastes.

LANDFILL ENGINEERING

SCS has an excellent landfill engineering team which has successfully engineered over 100 landfills since 1970. SCS's landfill engineering assignments typically involve many elements, including:

- o Siting of new landfills.
- o Design (including leachate and LFG migration and emission control).
- o Operations plans.
- o Preparation of permitting application packages and negotiations with regulatory officials.
- o Environmental impact assessment and preparation of Environmental Impact Reports (EIRs).
- o Closure/post-closure plans.
- o Remedial action investigations and designs.

A major portion of SCS's solid waste work involves sanitary landfill engineering. Within the past several years, SCS has worked on prospective new landfills and expansions to existing landfills in many California municipalities.

Virtually all our landfill projects entail evaluation and/or design of liner systems, leachate and gas collection networks, and closure planning. Thus, we are very familiar with current regulations and regularly deal with representatives of the local Regional Water Quality Control Boards and Air Pollution Control Districts, the California Waste Management Board, and local enforcement agencies throughout California.

On the basis of this extensive "hands-on" experience, SCS has often been retained to prepare design and operations manuals and to present training sessions. This exposure has led to SCS's participation on industry and government committees charged with developing and/or commenting on new state and federal regulations that control landfill siting, design, and operations. SCS professionals are frequently called on to provide expert testimony on legal proceedings that relate to landfill issues.

SOLID WASTE COLLECTION ANALYSIS

SCS is nationally recognized for its refuse collection productivity assessments. The firm has evaluated collection systems and equipment in virtually every state. This work

includes the following types of services:

- o Evaluation of refuse collection operations.
- o Cost comparisons of alternative collection systems.
- o Development and evaluation of collection alternatives, such as:
 - Conversion from backyard to curbside collection;
 - Reduction in collection frequency;
 - Reductions in crew size.
- o Evaluation of private versus municipal collection systems.
- o Recommendations to increase productivity.

SCS has performed waste collection, storage, transfer, and transportation projects for a variety of municipal, regional, military, and private clients. Based on the experience gained in the course of numerous waste collection projects, SCS has developed computer models (PROCOL and COSTCOL) to aid in the allocation of resources (vehicles, personnel, time) and routing of collection vehicles. These computer models enable us to:

- o Identify the optimal route length (number of stops).
- o Balance workloads for collection crews.
- o Select the optimal collection vehicle capacity.
- o Compare/quantify savings possible by modifying service levels, changing crew size, vehicles, etc.
- o Estimate resources (crews/equipment) and support costs necessary to service a community or service area.

The models form the cornerstone for an analysis technique developed and successfully used by SCS at many locations throughout the United States.

TRANSFER STATION STUDIES AND DESIGN

SCS has conducted many projects involving transfer stations and other waste processing facilities. Projects have ranged from preliminary designs and cost estimates to final plans and specifications.

In a project for the Metropolitan Service District (MSD) of Portland, Oregon, SCS developed a computer model to analyze alternative locations for transfer stations, and minimize total haul distances. Total waste management costs were computed and compared to those of the existing and alternative systems.

WASTE PRETREATMENT

Increasingly stringent discharge regulations have made it necessary to deal with pollutants at the source. Waste treatment generally involves a process or processes whereby the volume or toxicity is reduced, or the state (liquid, solid, or gas) is changed. The treated waste can then be reused or disposed in a safer or more cost-effective manner than the untreated waste.

SCS has designed waste treatment facilities, and is well qualified to evaluate unit processes in all areas of physical/ chemical wastewater treatment; including piping, pumping, clarification, storage, and recovery. Our experience includes chemical, physical, and biological treatment processes as well as incineration.

RESOURCE RECOVERY/RECYCLING

An increasing portion of SCS work has been in resource recovery. Work in this area includes the following:

- o Economic analysis of resource recovery systems.
- o Development of source separation programs.
- o Design of recycling facilities and systems.
- o Cost comparisons among alternative resource recovery systems.
- o Market surveys for materials and energy sales.
- o Waste characterization and quantity estimates.

LANDFILL GAS ENGINEERING

To date, SCS has performed over 900 landfill gas (LFG) projects which can be grouped into the following general topic areas:

- o Air quality and odor investigations/control.

- o LFG emission and migration investigation/control system design.
- o LFG recovery feasibility investigations.
- o Recovery facilities design.
- o Calderon air SWATs.

SCS is a leader in both research/development and design/construction efforts aimed at controlling and recovering LFG, and has developed several innovative gas detection methods and designs to control subsurface gas movement. Over \$400 million worth of property is protected by LFG control systems recommended and designed by SCS.

SCS has hands-on experience in the containment and control of landfill fires. SCS provides engineering, management and turn-key services. Typical tasks performed include the following:

- o On-site investigation and identification of landfill fire.
- o Plan and perform thermographic aerial surveys.
- o Plan and perform on-site thermographic surveys.
- o Analysis and interpretation of thermographic data.
- o Assess potential regulatory impacts (air, water quality, etc.).
- o Develop and implement boring and monitoring program.
- o Preparation and submittal of fire mitigation plan.
- o Implementation of mitigation plans including:
 - Injection of appropriate inert gases (CO₂, N₂);
 - Excavation and exposing of buried refuse;
 - Installation of fire breaks;
 - Addition of cover soil;
 - Surface and subsurface flooding of impacted areas.
- o Ongoing monitoring and regulatory reporting.
- o Repair and regrading of site surface and affected subsurface area.

CALDERON - SWAT PROGRAMS

From the time these regulations were being developed through implementation, SCS has assisted clients in meeting the technical requirements imposed by these laws. Working with Regional Water Quality Control Boards and Air Pollution Control Districts across the State of California, SCS has achieved air and groundwater SWAT compliance for numerous sites throughout California. Air and water samples are tested in the SCS Laboratory under very strict California Air Resources Board and State Water Resources Control Board/California Department of Health Services guidelines.

PERSONNEL QUALIFICATIONS

SCS employs a staff of engineers, geologists, hydrogeologists, chemists, and other professionals who are versed in the practical aspects of solid waste management. These personnel provide SCS with multidisciplinary teams which can respond to specific project requirements. Whether field investigations or research efforts, SCS Engineers has the right staff to fulfill the needs of the project.

Resumes of key personnel are presented in Appendix A.

TABLE 2.1

**Selected Solid Waste Management Projects
in California and the Western United States**

CLIENT	PROJECT DESCRIPTION
County of Sacramento, Dept. of Public Works, Solid Waste Management Division, Sacramento, CA.	EVALUATION OF SOLID WASTE DISPOSAL AND TRANSFER STATION OPERATIONS Evaluate Sacramento County's refuse transfer stations and landfill operations, including short and long-term recommendations for improved lower cost performance.
City of Redding, County of Shasta, CA.	JOINT SOLID WASTE MANAGEMENT STUDY/ ENVIRONMENTAL IMPACT REPORT Joint city/county landfill siting study, including geotechnical analysis, selection of a new site, preliminary design, and EIR preparation.
County of San Luis Obispo, San Luis Obispo, CA.	ENGINEERING AND OPERATING PLANS FOR LANDFILLS Hydrogeological studies at three landfill sites, and preparation of operational plans for three 3-ton per day (tpd) landfills.
California Waste Management Board Sacramento, CA.	SOLID WASTE COMPOSITION SURVEY - SAN FRANCISCO AREA Characterized the solid waste in four major San Francisco Bay Area waste sheds. Involved both quantity and composition estimation, as well as quantifying seasonal variation, determining per capita waste generation rates (residential), and quantifying solid wastes by source.

TABLE 2.1 - (Continued)

Selected Solid Waste Management Projects

CLIENT	PROJECT DESCRIPTION
<p>U.S. Environmental Protection Agency, Solid and Hazardous Waste Research Division, Cincinnati, OH. Subcontractor to: Tanners' Council of America</p>	<p>LAND TREATMENT OF TANNERY SLUDGE - A FIELD DEMONSTRATION PROJECT, SANTA CRUZ, CA</p> <p>Evaluate potential use of tannery sludges as a soil amendment on marginal soil for revegetation. Assess potential adverse impacts of tannery sludge land treatment. Design sampling program and perform laboratory analysis.</p>
<p>Electric Power Research Institute, Inc., Palo Alto, CA.</p>	<p>DISPOSAL OF POLYCHLORINATED BIPHENYLS (PCBS) AND PCB-CONTAMINATED MATERIALS</p> <p>Prepare a PCB disposal manual by documenting available PCB incineration and landfill technologies. Evaluation and assessment of PCB production, geographic distribution, storage facilities, and disposal facilities and requirements were included.</p>
<p>Southeast Regional Commission, Fresno County, CA.</p>	<p>ASSISTANCE IN PROCUREMENT OF FULL-SERVICE RESOURCE RECOVERY FACILITY SERVICES</p> <p>Evaluation of technical proposals from competing firms for a 420-tpd waste-to-energy facility. Negotiation with the selected firm on an agreement for waste flow guarantees in exchange for revenue sharing.</p>

TABLE 2.1 - (Continued)

Selected Solid Waste Management Projects

CLIENT	PROJECT DESCRIPTION
<p>California Waste Management Board, Sacramento, CA. Subcontractor to: Arthur Young & Company</p>	<p>INVESTIGATION OF MARKET FACTORS LIMITING RECYCLING AND RESOURCE RECOVERY</p> <p>Literature review on factors which inhibit the demand for secondary materials for three major commodities (secondary fibers, glass, and ferrous metals) and three minor commodities (plastics, tires and organics). Utilize findings to develop a secondary materials market profile and to identify actions to be taken by state agencies that will increase the demand for these materials.</p>
<p>City of San Diego, San Diego, CA.</p>	<p>NORTH CHOLLAS SANITARY LANDFILL PROJECT</p> <p>Prepare final design plans and specifications, assist client in obtaining all required permits/approvals for 1,000-tpd landfill.</p>
<p>County of San Bernardino, San Bernardino, CA.</p>	<p>DESIGN PLANS FOR SANITARY LANDFILL</p> <p>Engineering services for new 50-tpd sanitary landfill, including geotechnical investigations, access road, site improvements, drainage, and plan for staged landfill construction.</p>
<p>County of San Diego, San Diego, CA.</p>	<p>DESIGN PLANS FOR BONSALL SANITARY LANDFILL</p> <p>Engineering services for 500-tpd sanitary landfill, including subsurface investigations, access road, site improvement, drainage, and plans for staged landfill construction. Assistance in permitting provided.</p>

TABLE 2.1 - (Continued)

Selected Solid Waste Management Projects

CLIENT	PROJECT DESCRIPTION
Ventura Regional County Sanitation District, Ventura, CA.	<p>SOLID WASTE MANAGEMENT CONSULTING SERVICES</p> <p>Assistance in implementation of a county-wide solid waste management plan, encompassing sanitary landfill site selection, preliminary design, and system financing.</p>
County of Riverside, Riverside, CA.	<p>EVALUATION OF ALTERNATE SOLID WASTE DISPOSAL SITES AND TRANSFER STATIONS/EIR</p> <p>Study of potential solid waste disposal sites, including environmental impact assessment, citizen participation, economic feasibility.</p>
County of Kern, Bakersfield, CA.	<p>LANDFILL SITE SELECTION AND DESIGN</p> <p>Perform geotechnical investigations of five alternative sites and select one site. Prepare plans and specifications for new 1,000-tpd landfill.</p>
City of Industry, Industry, CA.	<p>LANDFILL GAS CONTROL AND RECOVERY SYSTEM (ASCE Outstanding Civil Engineering Achievement of 1981)</p> <p>Subsurface gas investigation, feasibility and economic studies for gas control and recovery system to serve an industrial conference and exhibit center and 27-hole golf course complex on a 500-acre landfill. Design, specifications, and construction inspection provided for gas extraction/recovery system to recover 400 cubic feet per minute (cfm) of landfill gas to provide space heating and hot water.</p>

TABLE 2.1 - (Continued)

Selected Solid Waste Management Projects

CLIENT	PROJECT DESCRIPTION
<p>City of Oceanside, Engineering Division, Oceanside, CA.</p>	<p>LANDFILL GAS MIGRATION CONTROL SYSTEM</p> <p>Provide complete plans and specifications to install a landfill gas migration control system. Project accomplished in three phases:</p> <ul style="list-style-type: none"> - Field investigation and preliminary design, - Final design and permitting, - Installation and start-up.
<p>Watson Energy Systems, Los Angeles, CA.</p>	<p>LANDFILL GAS EXTRACTION SYSTEM</p> <p>Extraction and testing of landfill gas to ascertain economic feasibility of full-scale recovery. Design of landfill gas extraction system including 26 wells, 800 cfm compressor, and gas-cleaning facilities for gas recovery and transport to adjacent oil refinery.</p>
<p>Syufy Enterprises, San Francisco, CA.</p>	<p>SIX-PLEX DRIVE-IN THEATRE, LANDFILL GAS CONTROL SYSTEM</p> <p>Subsurface monitoring at completed landfill to identify need for gas controls for drive-in theatre development. Designed forced gas extraction system consisting of gas extraction wells, membranes, barriers, and vents. Investigated feasibility of medium-BTU gas utilization for electrical generation. Performed design of gas extraction and utilization system. Performed routine LFG control system operations and maintenance.</p>

TABLE 2.1 - (Continued)

Selected Solid Waste Management Projects

CLIENT	PROJECT DESCRIPTION
City of Big Bear Lake, Big Bear Lake, CA.	<p>BIG BEAR VALLEY SOLID WASTE MANAGEMENT PLAN & ENVIRONMENTAL IMPACT REPORT.</p> <p>Assist in the development of a 15 year plan for handling solid waste. Investigate existing practices, develop cost estimates for alternative waste handling systems and recommend an action plan. Identify and evaluate alternatives for financing considering possibilities of public or private ownership of facilities. As part of a public participation program, prepare news releases and organize public meetings to discuss the plan's elements.</p>
MacDermid, Inc., Los Angeles, CA.	<p>PERMITTING ASSISTANCE</p> <p>Assist chemical manufacturer/formulator with permits for construction of a recycling facility for reclamation of copper.</p>
Department of Air Force, Headquarters, Space Division Los Angeles, CA.	<p>HAZARDOUS WASTE INVENTORY FOR VANDENBERG AIR FORCE BASE, CA, AND ITS TENANTS</p> <p>Compile hazardous waste inventory (solid and liquid wastes) for 18 facilities at VAFB for both normal and contingency conditions, assign EPA and California Department of Health definitions to each waste, combine hazardous waste inventory for the host base with those for all tenants.</p>

TABLE 2.1 - (Continued)

Selected Solid Waste Management Projects

CLIENT	PROJECT DESCRIPTION
Department of the Navy, Construction Battalion Center, Civil Engineering Lab, Port Hueneme, CA.	FACILITY REVIEW OF OPERATING NAVAL MODULAR STARVED-AIR HEAT RECOVERY INCINERATOR SYSTEMS Verify and augment findings of earlier Civil Engineering Laboratory research on heat recovery incinerators applicable to military installation solid waste.
City of Long Beach, Long Beach, CA.	COST ESTIMATION FOR REFUSE HAULING AND TRANSFER OPTIONS Evaluate the economics of alternative methods for transferring solid waste from Long Beach to available disposal sites.
U.S. Environmental Protection Agency, Office of Solid Waste, Washington, D.C.	TECHNICAL ASSISTANCE Assisted 15 state and local agencies in in development and implementing optimum solid waste transfer and disposal practices; e.g., in Nye County, Nevada, SCS recommended alternative waste disposal options, including transfer and landfill facilities.
City of Beverly Hills, Beverly Hills, CA.	ENGINEERING SERVICES FOR REFUSE TRANSFER STATION Prepared design, working drawings, and specifications, and provided services for a 250-tpd compaction type transfer station.

TABLE 2.1 - (Continued)

Selected Solid Waste Management Projects

CLIENT	PROJECT DESCRIPTION
South Bay Disposal Service, Torrance, CA.	RESOURCE RECOVERY AND REFUSE TRANSFER STATION ANALYSIS Assist in evaluating transfer station locations and cost estimates for site preparation. Consideration of alternatives for transfer station layout to optimize truck traffic and station efficiency. Assist in presentations before agencies responsible for permitting new transfer station.
Mesa Sand and Gravel, Inc., Boulder, CO.	DESIGN OF SANITARY LANDFILL IN BOULDER, COLORADO Prepare plans and specifications and permit applications for proposed 80-acre sanitary landfill to receive 600-tpd of waste.
City of Santa Fe, Santa Fe, NM.	SOLID WASTE DISPOSAL SITE INVESTIGATIONS Evaluation of alternative sites for a new sanitary landfill. Evaluation included assessments of hydrology, geology, soil conditions, potential environmental impacts, proximity to waste shed, and costs.
Midway Sand & Gravel Co., Seattle, WA.	LANDFILL CLOSURE Engineering/technical assistance for the finalization of closure plans for former City of Seattle landfill (1,500-tpd).

TABLE 2.2

Partial List of Cities Where SCS Has Conducted Solid
Waste Collection Projects

Municipality	Economic Analyses	Operating Condition Assessments	Time/Motion Studies
Albuquerque, NM		X	X
Atlanta, GA		X	X
Bedford, MA	X	X	X
Boston, MA	X	X	X
Bowie, MO	X		X
Brunswick, ME	X	X	X
Cincinnati, OH	X	X	X
Chicago, IL		X	X
Claremont, NH	X	X	X
Clear Lake, IA		X	X
Dallas, TX	X	X	X
Fairfax County, VA	X	X	X
Ft. Worth, TX	X	X	X
Greenbelt, MD	X		X
Long Beach, CA		X	X
Los Angeles, CA		X	X
Louisville, KY		X	
Madison, WI	X	X	X
Manhattan Beach, CA	X	X	X
Medford, OR	X	X	X
Memphis, TN	X	X	X
Miami, FL	X	X	X
Modesto, CA	X	X	X
Newport Beach, CA	X	X	X
New York, NY		X	X
Palo Alto, CA		X	
Phoenix, AZ	X	X	X
Reston, VA	X		X
Riverside, CA	X		
San Antonio, TX	X		
San Diego, CA	X	X	X
San Luis Obispo, CA	X	X	X
Santa Monica, CA		X	X
San Francisco, CA	X	X	X
Scottsdale, AZ	X	X	X

TABLE 2.2 - (Continued)

Partial List of Cities Where SCS Has Conducted Solid
Waste Collection Projects

Municipality	Economic Analyses	Operating Condition Assessments	Time/Motion Studies
Seattle, WA	X	X	X
Springfield, MA		X	X
St. Petersburg, FL		X	X
Tucson, AZ			X
University Park, TX	X	X	X
Washington, D.C.	X	X	X
West Hartford, CT	X	X	X

SECTION 4

COMPANY FACILITIES

Office Facilities

Since its formation in 1970, SCS Engineers has grown to a staff of over 250 people located in eleven offices nationwide: Dublin and Long Beach, California; Reston and Norfolk, Virginia; Bellevue, Washington; Covington, Kentucky; Phoenix, Arizona; Tampa, Florida; Columbus, Ohio; Upper Nyack, New York; and Kansas City, Missouri. This growth reflects the firm's ability to successfully provide quality professional services demanded by our private and governmental clients.

Chemical Laboratory

The SCS Laboratory is located in Long Beach, California. The laboratory is state certified and well equipped to perform analyses on water, wastewater, sludges, soils, plants, leachates, and specific wastes. Laboratory capabilities include:

- o Gas chromatography.
- o Atomic absorption and emission spectroscopy.
- o Flameless AA analysis.
- o Visible spectrophotometry and colorimetry.
- o Determination of classical water and waste parameters such as pH, turbidity, COD, TS, TDS, TSS, SS, DO, O&G, etc.
- o Physical and structural testing of soils - particle size distribution, cohesion, compactibility, dry compressive strength, permeability, optimum moisture content, and wetted compressive strength.
- o Leaching studies - RCRA extraction procedure, TEP procedure, 5-day shake test.
- o Field sampling and analysis capabilities, including groundwater, sludges, soils, plants, sediments, (fresh water and marine), hazardous wastes, and priority pollutants.
- o Analyses upon request, such as biodegradability, reducing sugars, petroleum waste products, bacteriological analyses, and bench-scale evaluations of water and wastewater treatment unit operations.

Computer Facilities

SCS maintains computer centers in two of its offices. In Long Beach, we have an Hewlett-Packard (HP) 3000 Series 33 System. The system has 512 kilobytes (kb) of memory, 120 million characters of on-line storage, tape processing, and a time-sharing environment. Remote job entry capabilities are present.

An HP 3000 Series III System is in use in the Reston, Virginia office. Capabilities of that system include 256 kb of main memory and 120 megabytes of disc storage.

Our computer centers support a variety of systems tailored specifically to the needs of the waste management industry. For example, the firm developed SCS-AEGIS, a massive data base which identifies the nature, quantities, and location of hazardous waste and wastewater generators nationwide. Waste management firms routinely use SCS-AEGIS to determine their existing market share, and to develop strategies for increasing it.

Library

The main SCS technical library is located in our Long Beach office. This library currently contains approximately 20,000 volumes. The library has recently converted from a traditional card catalog to an on-line data system. This conversion allows the library and the project staff to access library holdings by key words, title, author, corporate author, sponsor, or NTIS number. Use is made of the information retrieval systems available through NTIS, EPA's Solid Waste Information Retrieval System (SWIRS), a private subscription service, and EPA Information Retrieval Systems, such as STORET.

Graphics Facilities

Because of the importance of clear portrayal of information in the engineering disciplines SCS houses a fully equipped Graphics Design Department. Where technical analyses must be communicated to lay personnel or governmental officials (e.g., during a public hearing), use of graphics materials has proven to be especially helpful.

SECTION 5

REFERENCES

SCS Engineers welcomes inquiries of the following references who are familiar with solid waste management work of the firm and its key personnel:

1. Mr. Ed Haskins
Refuse Disposal Division Manager
County of Sonoma
Santa Rosa, California
(707) 527-2231
2. Mr. David Myers
Monterey Regional Waste Management District
Marina, California
(408) 384-5313
3. Mr. Carl Arness
Director of Public Works
City of Redding
Redding, California
(916) 246-1151
4. Mr. Arthur Krieger
Director of Public Works
City of Pasadena
Pasadena, California
(213) 577-4087
5. Mr. Robert Alpern
Senior Sanitary Engineer
Bureau of Sanitation
City of Los Angeles
Los Angeles, California
(213) 485-5347

APPENDIX A

Resumes of Key Personnel

MARK B. BEIZER, PROJECT DIRECTOR

Education

B.S. - University of California, Los Angeles, 1969
Engineering

Professional License

Registered Civil Engineer - California (C 22879), Texas (60507)

Affiliations

American Society of Civil Engineers
Air Pollution Control Association
Governmental Refuse Collection and Disposal Association
American Public Works Association
National Society of Professional Engineers

Professional Experience

Mr. Beizer has 18 years of experience in civil and environmental engineering, the last 9 of which have been in the waste management field, with particular emphasis in land disposal engineering. He currently directs all landfill and landfill gas (LFG) projects out of the SCS Long Beach office.

Mr. Beizer's experience ranges from hands-on participation in field and design work to direction of large solid waste management projects. This work has included literally hundreds of projects in the landfill and LFG fields, involving landfill siting, permitting, design and operations planning, and the design, field testing, and operation of LFG migration control, collection, and recovery systems. He has also provided expert testimony on landfill-related litigation, and regularly makes presentations at public hearings and before regulatory agencies.

Landfill project work has included:

Landfill and Transfer Station Siting--

- Siting studies for the cities of Phoenix and Yuma, Arizona, and the counties of San Diego, Kern (Bakersfield), and Shasta, California. These projects involved comprehensive surveys of potential sites, analyzing topographic, hydrogeologic, and land use information. Economic comparisons and environmental assessments were performed in order to prepare numerical and subjective site rankings.
- Transfer station siting and design for the cities of Los Angeles, Beverly Hills, and Newport Beach, California.

MARK B. BEIZER (continued)

- Conduct of seminars in disposal site selection and permitting procedures at locations throughout the state for the California Waste Management Board.
- Preparation of Environmental Impact Reports (EIRs) for new or expanded landfills in the City of Los Angeles (Potrero Canyon), Fresno (American Avenue), Burbank, and Ventura County, California.

Landfill Design and Operations--

- Design and operations plan preparation for 1,400-tpd Sacramento County Landfill.
- Design, operations plan, and permit acquisition for San Diego North Chollas Sanitary Landfill. Project involved design of storm drain under site to serve as spillway for upstream reservoir. Plans included site preparation, leachate collection, access roads, and gatehouse facilities. Permits received from Regional Water Quality Control Board and California Waste Management Board.
- Design of 600-tpd landfill in Boulder, Colorado.
- Design of new 200-tpd landfill in Thurston County, Washington, and design of closure plan for adjacent site.
- Conceptual designs for landfills in San Bernardino County, Whittier, Orange County (Santiago Canyon), and Clovis, California.

Landfill Closure--

- Closure plans for landfills in San Diego (South Miramar), Los Angeles (Harbor), Oceanside, and Fontana, California.
- Development of final cover designs and ground water monitoring systems for landfills in Riverside (Tequesquite), Oceanside, and Los Angeles, California.
- Design and construction management of excavation and redispasal of 400,000-cu-yd Avondale Landfill (Phoenix, Arizona); included design of double liner and leachate collection system.
- Remedial action (waste removal and/or site closure) for nine uncontrolled landfills in Phoenix, Arizona.

LFG Projects--

- Direction of over 200 projects related to the control or recovery of LFG in California and throughout the western United States.

MARK B. BEIZER (continued)

- Design, construction oversight, and ongoing operation of LFG collection/flaring systems at sites in Los Angeles, San Diego, San Bernardino, Oceanside, and Carson, California.
- Implementation of LFG control via air injection systems in Modesto, San Diego, Long Beach, Burbank, and Commerce, California.
- LFG extraction testing programs at over 20 landfills.

Solid Waste Assessment Tests (SWATs)--

- Calderon and Rule 1150.1 monitoring programs in Burbank, Oceanside, and Riverside, California; and landfill odor/toxic emissions monitoring and control projects in Chicago, Illinois, and at the BKK Hazardous Waste Landfill in California.
- Water Quality SWATs in Riverside, Oceanside, and Norwalk, California.

Prior to joining SCS, Mr. Beizer spent 8 years with the Los Angeles County Flood Control District, the last 4 as a Supervising Civil Engineer and Project Manager. He managed the District's involvement in the \$25,000,000 Pan Pacific Park and Retention Basin, overseeing design, right-of-way negotiations, community and political liaison, and preparation and processing of the EIR. Other projects included flood control channels and storm drains, debris basins, debris disposal areas, and the District's emergency response during the heavy storms of 1977-1978.

Mr. Beizer has substantial expertise in PERT/CPM scheduling systems and resource planning. He also has extensive public relations experience, having served as the District's spokesman to local communities and government entities on several projects and programs. He also served as an engineer in the District's Operation and Maintenance Division, performing engineering design, cost estimates, and construction inspection on numerous force account projects.

E. T. CONRAD, PE, PRINCIPAL

Education

B.S. - University of California, 1958, Engineering

Professional Licenses

Registered Civil Engineer - California
Registered Professional Engineer - Connecticut, Delaware, District of Columbia, Florida, Louisiana, Maryland, Massachusetts, Missouri, Maine, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Rhode Island, South Carolina, Tennessee, Vermont, Virginia, West Virginia, Wisconsin

Affiliations

American Society of Civil Engineers
National Society of Professional Engineers
American Public Works Association
Government Refuse Collection and Disposal Association
National Solid Waste Management Association

Professional Experience

As the managing principal of the Reston, Virginia office, Mr. Conrad is responsible for directing the firm's East Coast operation. He has 24 years experience in environmental engineering and management and 30 years experience in civil engineering and construction.

The majority of the environmental engineering experience has been in land disposal of solid and hazardous wastes and landfill gas control and recovery. He has been active in professional societies and citizen organizations. He has managed or directed more than 200 landfill and hazardous waste projects, ranging from site investigations and site selection studies to design, operations plans, corrective actions, closure plans and post-closure care practices, contingency plans, cost analyses, O&M manuals, design manuals, and research. Representative projects include:

- Design of and permitting for a landfill to dispose resource recovery facility residue and municipal solid waste bypass in Hudson County, NJ.
- Site selection study and design for a new debris landfill and a new sanitary landfill in Prince William County, VA.
- Development of leachate management, operating, closure, and end-use plans for three major landfills in the City of New York.
- Design and permitting of a regional landfill in Charles City County, VA.

E. T. CONRAD, PE (continued)

- Design and preparation of plans and specifications for clean-up of the Kryswaty Farm Superfund Site in New Jersey, under contract to the U.S. Corps of Engineers.
- Remedial Investigation/Feasibility Study for the Fulbright and Sac River Landfills in Springfield, MO, under contract to the primary responsible parties.
- For the U.S. Environmental Protection Agency (USEPA), provided technical and cost estimating support for development of regulations regarding landfills, surface impoundments, gas emissions, gas migration, and underground and aboveground storage tanks.
- Co-author of manuals for the USEPA:
 - Closure and Post-Closure Care of Hazardous Waste Disposal Sites Closed as Landfills;
 - Sanitary Landfill Design and Operation;
 - Sludge Landfill Practices; and
 - Closing and Upgrading Open Dumps.
- Consulting to the Town of Salem, NH, the Town of North Hempstead, NY, and the City of New York, NY, to control and extinguish subsurface fires in landfills.

Mr. Conrad has directed or managed more than 100 landfill gas (LFG) control and recovery projects throughout the south and east. Services have ranged from monitoring to investigations, feasibility studies, designs, construction, and startup operations. Projects include:

- Consulting regarding gaseous emissions from the Port Washington Landfill (a Superfund site). Activities have involved field testing and monitoring, LFG control facilities, a fume incinerator to control odors and destroy volatile organic emissions, literature research, expert testimony, negotiations with regulatory agencies and intervenor groups, and consulting in regard to the site's Superfund status.
- Investigations and designs to protect new and existing structures on and near landfills throughout the East Coast. The value of buildings being protected exceeds \$500,000,000.
- LFG recovery feasibility studies, including pump test programs for Hillsborough County, FL; Montgomery County, MD; the District of Columbia; Fairfax County, VA; and LFG developers in Connecticut, Florida, Massachusetts, New York, and North Carolina.
- Odor and LFG control studies and designs for three landfills in Florida.

E.T. CONRAD, PE (continued)

Publications:

- "I-66 Landfill Gas Recovery Feasibility Analysis." (co-authored with P. J. Carrico, L.Y. Montague, and E.R. Peterson), Fairfax County Division of Solid Waste, Fairfax, VA, November 1988.
- "Landfill Gas Trace Constituents: VOCs versus ROGs." (co-authored with W.G. Vogt), Proceedings, Government Refuse Collection and Disposal Association, Eleventh Annual International Landfill Gas Symposium, Houston, TX, March 22, 1988.
- "The Palm Beach County Landfill Gas Program." (co-authored with G. J. Maclean and Leila Nikkhou), Proceedings, Government Refuse Collection and Disposal Association, Tenth International Landfill Gas Symposium, West Palm Beach, FL, February, 1987.
- "The Use of the 'HELP' Model in Evaluating Alternative Leachate Mangement Plans for Three New York City Landfills." (co-authored with R.B. Gardner), Proceedings, National Solid Waste Management Association, Waste Tech '86 Conference, Chicago, IL, October 1986.
- "Old Bethpage Landfill Gas Recovery System Analysis." Prepared for Energy Tactics, Inc., Town of Oyster Bay, NY. September 1986.
- "Evaluation of the Integrity of the Hillsborough Heights Landfill and Potential Sources of Contamination." (co-authored with R.B. Gardner and Geraghty & Miller, Inc.), Hillsborough County Department of Solid Waste, Tampa, FL, July 1986.
- "Hillsborough Heights/Taylor Road Landfill Gas Recovery Program Feasibility Study." (co-authored with F.L. Flood), Hillsborough County Department of Solid Waste, Tampa, FL, June 1986.
- "Remedial Actions to Mitigate Against Radon Migration into Structures." (co-authored with R.W. Luce), Presented at National Science Week Regional Symposium, Indoor Radon in the Mid-Atlantic States, George Mason University, Fairfax, VA, May 1986.
- "Landfill Gas Migration from the I-66 Landfill; Fire Training Center." (co-authored with F.L. Flood and E.R. Peterson), Fairfax County Division of Solid Waste, Fairfax, VA, April 1986.
- "Control of VOC Emissions at a Landfill Site in New York: A Community Perspective." (co-authored with W.G. Vogt and J.J. Walsh), Proceedings, Government Refuse Collection and Disposal Association, 9th International Landfill Gas Symposium, Newport Beach, CA, March 1986.
- "Operations Plan Report, Edgemere Landfill." (co-authored with R. B. Gardner), New York City Department of Sanitation, November 1985.

E.T. CONRAD, PE (continued)

- "Landfill Design Report (for each landfill), Edgemere Landfill, Pennsylvania Avenue Landfill, Fountain Avenue Landfill." (co-authored with R.B. Gardner), New York City Department of Sanitation, November 1985.
- "Assessment of the Technical, Environmental, and Safety Aspects of Storage of Hazardous Wastes in Underground Tanks." (co-authored with D.H. Bauer), U.S. Environmental Protection Agency, Washington, DC, March 1984.
- "Design Criteria for Landfill Gas Recovery Systems." (co-authored with E.R. Bogardus), Presented at the American Society of Mechanical Engineers, Solid Waste Division, Seminar on Landfill Gas Recovery, New York City, NY, March 1983.
- "Operations and Management of Sanitary Landfills." Presented at the Government Refuse Collection and Disposal Association, Virginia Chapter Seminar on Sanitary Landfill Management, Charlottesville, VA, January 1983.
- "I-95 Sanitary Landfill Gas Recovery and Utilization Feasibility Study." (co-authored with J.J. Walsh, F.L. Flood, and E.R. Bogardus), Government of the District of Columbia, Washington, DC, December 1982.
- "Evaluation for Closure and Post-Closure Care Plans for Hazardous Waste Landfills." (co-authored with R.B. Gardner and B. Peterman), U.S. Environmental Protection Agency, Washington, DC, January 1982.
- "Remedial Actions for Open Dumps." (co-authored with W.H. Hassett), Journal of the Environmental Engineering Division, American Society of Civil Engineers, p. 1317-1325, December 1981.
- "Solid Waste Landfill Design and Operation Practices." (co-authored with J.J. Walsh, J. Atcheson and R.B. Gardner), U.S. Environmental Protection Agency, Washington, DC, April 1981.
- "Effects of Hazardous Wastes on Housing and Urban Development and Mitigation of Impacts." (co-authored with K.R. Boyer), U.S. Department of Housing and Urban Development, Washington, DC, October 1980.
- "Process Design Manual for Municipal Sludge Landfills." (co-authored with J.J. Walsh and R.P. Stearns), U.S. Environmental Protection Agency, Technology Transfer, Cincinnati, OH, October 1978.
- "Availability of Land for Solid Waste Disposal." (co-authored with G.L. Mitchell and J.T. Morgan), American Paper Institute, Washington DC, August 1978.
- "Identification, Evaluation, and Comparative Analysis of Onsite Wastewater Treatment and Disposal System," (co-authored with D.H. Bauer), Draft, U.S. Environmental Protection Agency, Cincinnati, OH, August 1978
- "Methane Gas Investigation and Controls." (co-authored with J.J. Walsh and C.D. Kepple), Frostburg Industrial Park, Frostburg, MD, May 1978.

E.T. CONRAD, PE (continued)

- "A Methodology for Determining Land Value and Associated Benefits Created from Dredged Material Containment," (co-authored with A.J. Pack), U.S. Army Engineers Waterways Experiment Station, Vicksburg, MS, May 1978.
- "Oil Spillage." (co-authored with J.J. Walsh and J.R. Lancaster, The Navy Civil Engineer, p. 4-6 and 22-24, Spring 1978.
- "Assessment of Industrial Hazardous Waste Management Practices: Leather Tanning and Finishing Industry." (co-authored with G.L. Mitchell and D.H. Bauer), for U.S. Environmental Protection Agency, Washington, DC, November 1976.
- "Energy Efficiency Improvement Target in the Textile Mill Products Industry: SIC 22," (co-authored with G.L. Mitchell), Federal Energy Administration, Washington DC, September 1976.
- Underground Liquid Waste Disposal, A Task Committee Report," (co-authored with D.L. Warner, et al.), by the Task Committee on Underground Liquid Waste Disposal of the Committee on Ground Water Hydrology of the Hydraulics Division, Journal of the Hydraulics Division, American Society of Civil Engineers, p. 421-435, March 1975.
- "Information System for Directing and Evaluating Solid Waste Management Activities." (co-authored with G.L. Mitchell), for the Government of the District of Columbia, July 1974.
- "Solid Waste Disposal in Selected Jurisdictions in Metropolitan Washington." (co-authored with C.D. Kepple et al.), a Report by the Task Force of the Environmental Engineering Committee, National Capital Section, American Society of Civil Engineers, Washington DC, May 1973.
- "Analysis of Federal Programs Affecting Solid Waste Generation and Recycling." (co-authored with D.E. Ross and R.P. Stearns), U.S. Environmental Protection Agency, Cincinnati, OH, April 1972.
- "Standards for Selection of Landfill Equipment." Solid Waste Management Refuse Removal Journal, November 1971.

JOHN P. CUMMINGS, PH.D., R.E.A.

Education

B.S. - Chemistry, Saint Michael's College, Winooski, Vermont

M.C.E. - Environmental Engineering, University of Toledo, Toledo, Ohio

Ph.D. - Chemistry - University of Texas, Austin, Texas

J.D. - Law - University of Toledo, Toledo, Ohio

GRADUATE - Industrial College of the Armed Forces, Washington, D.C.

Affiliations

Sigma XI - RESA

American Chemical Society

American Society for Testing Materials

Governmental Refuse, Collection and Disposal Association.

National Solid Waste Management Association

American Bar Association

Phi Alpha Delta

Registrations and Certifications

Ohio Registered Attorney

California Registered Environmental Assessor

EPA Certified Asbestos Inspector and Management Planner

U.S. Board of Military Appeals Attorney

U.S. Department of Defense Certified Fallout Shelter Analyst

U.S. District Court Registered Attorney

40 Hour EPA Approved Hazardous Waste Operations Training

Professional Experience

Mr. Cummings brings to SCS over thirty years of experience, project management, planning, public affairs, implementation of legislative programs and policies. He has a strong background in hazardous/toxic waste management, pollution abatement implementation, solid waste management, resource recovery and recycling, legal aspects of OSHA and EPA litigation as well as product liability. He also has an extensive technical background in chemistry, ceramic, paper, and plastic materials. He is a patentee.

JOHN P. CUMMINGS (Continued)

Other experience includes:

- o Engineered, built, managed, and evaluated the first resource recovery from Municipal Solid Waste Plant for the EPA.
- o Developed hazardous material reduction programs for several production operations.
- o Performed recycling audits, system analysis, and source reduction programs for 15 facilities.
- o Director of analytical services for Owens-Illinois, Inc.
- o Consulting on resource recovery or recycling, utilization of waste products, hazardous waste plans, handling, packaging, transportation and disposal of solid, hazardous and toxic materials, legal counsel to several small firms, environmental audits.
- o Manager, Environmental Affairs - Responsible for company environmental matters, permitting, recycling, resource recovery, hazardous solid waste management. Prime contact with customers and governmental agencies.
- o Legal Counsel - Responsible for all OSHA and EPA Compliance and Litigation.
- o Risk Management - Assess risks, claims, asbestos risks, approved settlement payments, organized insurance treaties.
- o Produced the County Hazardous Waste Management Plans for six Northern California counties.
- o Developed the Environmental Impact Report for four Northern California county Hazardous Waste Management Plans.
- o Developed risk assessment programs for two major industries.
- o Completed over 50 site environmental assessments and developed remediation actions when required.

RAYMOND L. GRIER, P.E., PROJECT MANAGER

Education

B.E. - University of Southern California, 1954
Engineering

Professional Licenses

Registered Civil Engineer - California
Registered Safety Engineer - California

Affiliations

Governmental Refuse Collection and Disposal Association
Past Member, International Board
Past Co-Chairman, Safety Committee

Professional Experience

Mr. Grier provides SCS with an extensive background in solid waste management and civil engineering design. His professional experience includes siting, permitting, design, and operation of transfer stations and landfills; waste handling equipment specifications, refuse generation and composition studies, and hazardous waste studies.

Projects representative of Mr. Grier's 30 years of experience include the following:

- Studies for siting, permitting, acquisition costs, design, operations, and closure for various transfer stations and landfills throughout California including Southgate Transfer Station, and the Palos Verdes, Mission Canyon, Scholl Canyon, Calabasas, and Spadra landfills. Landfill operations included direction of manpower scheduling, equipment utilization, filling sequence, and on-site construction of roads, drainages, and water distribution systems.
- Preparation of design of final grades for the Scholl Canyon and Palos Verdes landfills for determined end land use. The Palos Verdes landfill is used for the South Coast Botanic Gardens and the Scholl Canyon landfill is used as a tennis complex, clubhouse, restaurant, baseball diamond, and nine-hole golf course. Other aspects of closure planning include drainage design, revegetation, and erosion control measures.
- Management of a major equipment fleet. Responsible for equipment evaluation, selection, purchase, maintenance, and replacement. Evaluated manpower and equipment requirements. Established policy for scheduling major equipment repairs and the economic life cycle of operating equipment.

RAYMOND L. GRIER (continued)

- Safety Engineer for a large solid waste system including refuse transfer and disposal operations. Responsible for evaluating effect of work practices (including equipment operation and maintenance) on job safety. Also responsible for safety of customers at both transfer and landfill sites.
- Studies of long-term trends in refuse generation rates and refuse composition; included evaluation of methods, equipment, markets, and economics of recycling.
- Establishment of long-term operational plan for a large canyon fill, including sequence of refuse lifts, drainage construction, and location of areas of earth cover excavation and earth stock-piles.
- Prepared total conceptual plans for five operating landfills and sequential (staged) development plans for two landfills. Total capacity of the landfills in excess of 78×10^6 cubic yards.
- Project Manager for cleanup of a site contaminated with hazardous wastes.
- Determination of refuse composition, generation rates, and collection and haul costs.
- Evaluation of environmental impacts of proposed and ongoing operations and changes in operating parameters.
- Refuse settlement studies of the effects of operating conditions, equipment, earth cover, surcharge, weather, and time on in-place refuse density and settlement rates.
- Landfill designs including drainage, roads, auxiliary structures, water supply and distribution, and weigh scales.

Since joining SCS two years ago, Mr. Grier has been Project Manager on the following projects:

- Developed closure costs for 21 desert and mountain landfills for the County of San Bernardino, California.
- Evaluated system costs of a proposed refuse transfer station.
- Designed final landfill cover systems in California and Washington.
- Conducted studies to determine life cycle costs for landfills and incinerators.

RAYMOND L. GRIER (continued)

- Assisted with closure planning and evaluation of alternative cover designs for the Tequesquite Landfill.
- Directed a refuse characterization study in a three-city area.
- Directed a landfill evaluation study to develop strategies for reducing impacts on the use of adjoining property.
- Evaluated the relative operating characteristics and economics of different types of transfer equipment; prepared specifications for the selected equipment.
- Permitting and design of four transfer stations.
- Conducted a landfill siting study in the northern portion of San Diego County.
- Assisted with startup of the 5,000-tpd Bee Canyon Landfill.

STEVEN M. HAMILTON, R.E.A.

Education

B.S. - Zoology, University of Florida, 1978

M.S. - Environmental Management,
University of San Francisco, (ABT)

Professional License

Registered Environmental Assessor - California (00392)

Affiliations

Governmental Refuse Collection and Disposal Association
Air and Waste Management Association

Professional Experience

Mr. Hamilton has more than 10 years of environmental project experience, the last eight of which have been in the solid waste management field, with particular emphasis on landfill gas (LFG) recovery and migration and emission control. He currently directs solid waste and LFG projects out of SCS's Northern California office in Dublin.

Mr. Hamilton's experience ranges from hands-on participation in field and design work to direction of solid waste management projects. This work has involved over 100 projects on more than 80 sites throughout the United States. His responsibilities have included landfill ground water and LFG monitoring programs, ambient air and meteorological studies, and the testing, design, installation, and operation of LFG recovery and control systems. Mr. Hamilton has also provided liaison with site owners, operators, and regulatory agencies. Some of the projects in which he has been involved include:

- o Supervision of California Calderon Air Quality Solid Waste Assessment Tests (Air SWATS) at 43 landfills and hazardous waste sites throughout California.
- o Supervision of the design of two LFG emission control facilities in Northern California.

STEVEN M. HAMILTON (Continued)

- o Supervision of Water Quality Solid Waste Assessment Test (Water SWAT) activities at three landfills in Northern California
- o Operation of two LFG recovery facility wellfields in Northern California.
- o Confirmation studies (RI/FS) at two hazardous waste sites in California.
- o Design of an LFG mitigation system for a child care center on an inactive landfill in Northern California.
- o Design of a methane mitigation system for a hotel built on clean fill over San Francisco Bay marshlands.
- o Managing a preliminary industrial hygiene investigation into potential sources of hypersensitive pneumonitis in site employees at a composting facility in Northern California.
- o Testing over 20 landfills nationwide to determine economic feasibility of LFG recovery.
- o Redesign and repair of a LFG mitigation system in a 12-story office building on an inactive landfill in Northern California.
- o Development of a LFG safety program for the construction of a road and a bridge abutment on an inactive landfill in Northern California.
- o Permitting for LFG emission control and recovery systems in California.
- o Evaluation of LFG migration control systems at landfills in California and New York.
- o Design and installation of a LFG migration control system at a landfill in New York.
- o Design and installation of a meteorological station for a hazardous waste study in Alaska.
- o Managing a methane monitoring program at a water treatment facility in Northern California.
- o Conducting LFG surface flux studies at five landfills in Texas, California, Michigan, and New York.

STEVEN M. HAMILTON (Continued)

- o Technical review of a LFG surface flux testing procedure.
- o Coordination, permitting, and management of several mitigatory revegetation projects in Florida.

Safety Training

Health and safety training course following EPA requirements. Included training in physical, chemical, and toxicological properties of hazardous materials; hazard evaluation and control; selection and use of personal protective equipment; sampling and monitoring techniques and equipment; site entrance and decontamination procedures; and safety plan development.

Prior to joining SCS, Mr. Hamilton spent three years with Harding Lawson Associates in Novato, California, managing LFG projects firm-wide. From 1981 to 1985 Mr. Hamilton tested and operated LFG recovery facilities for GSF Energy, Inc. in Signal Hill, California, and from 1979 to 1980 he was a Research Team Leader at the Florida Keys Marine Institute in Key West, Florida.

KENNETH H. LISTER, SENIOR PROJECT GEOLOGIST

Education

B.S. - University of California, Los Angeles, 1967
Geology

M.S. - University of California, Los Angeles, 1970
Geology

Ph.D. - University of Kansas, Lawrence, 1974
Geology

Professional Licenses

Registered Geologist #4338 - California
Certified Petroleum Geologist #2977 - American Association of
Petroleum Geologists

Affiliations

American Association of Petroleum Geologists
Geological Society of America
National Water Well Association
Paleontological Association
Paleontological Society
Society of Economic Paleontologists and Mineralogists
South Coast Geological Society

Professional Experience

Dr. Lister has a broad background in geology including extensive experience in the industrial and academic fields. Projects he has been involved with at SCS are:

- Site investigations for proposed new landfills and landfill expansions in Riverside, San Diego, Imperial, and San Bernardino Counties, California, including assessment of potential environmental impacts.
- Solid Waste Assessment Test (SWAT) proposals/investigations at Mission and Maxon Landfills (Oceanside), Tequesquite Landfill (Riverside), Golden Eagle Refinery, Gardena Valley No. 6 Dump (Carson), Peck Road Gravel Pit (Monrovia), Church Dump (Wilmington), Torrance City Landfill, and others.
- Preparation of closure and post-closure maintenance plans for the City of San Diego and Imperial County Sanitation Company.
- Preparation of Initial Study and Negative Declaration for the San Bernardino Valley Municipal Water District.

KENNETH H. LISTER (continued)

- Project management of ground water investigation and remedial design, landfill closure, CEQA initial study, and landfill siting projects.
- Preparation of a manual for landfill leachate monitoring.
- Development of cost estimates for Superfund remediation work for sites in California and Texas.
- Design, implementation, and management of site investigations to identify soil and ground water contamination for Woodtek, Exide, the Henry Company, March Air Force Base, General Dynamics, and others.
- Development of site assessments and remediation programs for the Alhambra Redevelopment Agency, U.S. Army Corps of Engineers, Long Beach Unified School District, and numerous private clients.

Prior to joining SCS, Dr. Lister was District Geologist for Pennzoil Exploration and Production Company. He was in charge of petroleum exploration in eastern Texas, northern Louisiana, Arkansas, Mississippi, Alabama, Florida, and Georgia. Dr. Lister managed a drilling budget which averaged \$2 million per year and directed a staff of eight geologists in work involving geological mapping, geophysical data interpretation, regional geologic studies, economic and risk analyses, remote sensing, and the drilling and logging of exploratory wells.

He has also had experience in various aspects of stratigraphy, structural geology, basin analysis, clastic and carbonate sedimentology, reservoir engineering, geochemistry, and tectonics.

Dr. Lister has also been involved in geological and paleontological research and field work in Utah, Nevada, Kansas, New York, British Columbia, Bermuda, the Bahamas, Mexico, and a number of sites in California. Past research has involved stratigraphy, paleoecology, lacustrine systems, computer simulation, and sedimentary depositional systems.

Publications

Lister, K. H., 1971, Micropaleontology of Spittal Pond, Bermuda: Bermuda Biological Station for Research Spec. Publ. No. 9, p. 60-68.

Lister, K. H., 1974, Diversity Changes in a Quaternary Lacustrine Ostracode Community from the Great Salt Lake Basin, Utah: Geol. Soc. America Abstracts, v. 6, No. 2, p. 114.

Kern, J. P., Grimmer, J. C., and Lister, K. H., 1974, A New Fossil Spionid Tube, Pliocene and Pleistocene of California and Baja California: Jour. Paleontology, v. 48, No. 5, p. 978-982.

KENNETH H. LISTER (continued)

- Lister, K. H., 1974, The Significance of Temporal Changes in a Lacustrine Ostracode Community from the Great Salt Lake Basin, Utah: Geol. Soc. America Abstracts, v. 6, No. 7, p. 847-848. (Presented at the Paleontological Society Symposium: Structure and Classification of Ancient Communities.)
- Lister, K. H., 1975, Quaternary Freshwater Ostracoda from the Great Salt Lake Basin, Utah: Univ. Kansas Paleont. Contr. Paper 78, 34 p.
- Lister, K. H., 1976, The Significance of Temporal Changes in a Pleistocene Lacustrine Ostracode Association from the Great Salt Lake Basin, Utah: In Structure and Classification of Paleocommunities, R. W. Scott and R. West (eds.), Dowden, Hutchinson, and Ross, p. 192-211.
- Lister, K. H., 1981, Paleocology of the Miocene Barstow Formation Insect Fauna, Calico Mountains, California: American Assoc. Petroleum Geologists Bulletin, v. 65, No. 5, p. 949 (abstract).
- Lister, K. H., In Preparation, Fresh Water Ostracoda from Rancho La Brea, Los Angeles County, California.

JOSEPH J. MILLER, P.E., SENIOR PROJECT ENGINEER

Education

B.S. - California Polytechnic State University, San Luis Obispo, 1980
Environmental Engineering

Professional License

Registered Civil Engineer - California (C 042598)

Affiliations

Air Pollution Control Association
Governmental Refuse Collection and Disposal Association

Experience

Mr. Miller provides SCS with a strong background in environmental engineering with emphasis in waste management. Since joining SCS, he has been involved in projects entailing virtually all aspects of the municipal solid waste field, including collection, disposal, transfer, recycling, and resource recovery. His experience in each of the above topic areas is summarized below.

Refuse Collection and Transfer--

Mr. Miller currently manages virtually all of the projects in SCS's Long Beach office relating to municipal waste collection in SCS's Long Beach office. These projects include identifying opportunities for improving collection efficiency, and time-and-motion and rate review studies. Selected projects include:

- Acting as Project Manager during a performance audit of a private collection firm operating in Santa Clara County, California. During this study, SCS reviewed pertinent operations data and observed collection practices on a number of representative residential and commercial routes. Based on the above, recommendations for improving collection efficiency were made.
- Acting as Project Manager for a rate review study in Santa Barbara County, California, which involved collection of time-and-motion data on routes served by five private franchise haulers operating in the County. Data were used to determine the actual costs of collection service provided to area residents and businesses.
- Evaluating the opportunities for a private refuse collection firm in Alameda County, California, to improve collection productivity by reducing crew sizes from three to two men on various routes. The study determined the feasibility of implementing both automated and semiautomated refuse collection throughout the service area.

JOSEPH J. MILLER (continued)

- Managing a refuse collection study for the City of Colton, California. The purpose of this project was to make recommendations for improving residential and commercial collection service and to compare the levels of service and costs that would result if collection services were to be exclusively provided by private haulers or municipal crews.
- Participation in a refuse collection efficiency study, Pasadena California. This study evaluated collection productivity (via a time-and-motion study), the cost of the city's collection services, and the effectiveness of current personnel and data management practices.

In addition to the above collection studies, Mr. Miller has participated in various refuse transfer projects, including those listed below:

- Assisting in a feasibility study for a proposed waste transfer station, Denver, Colorado. Duties included assessing present and future collection and disposal practices, preparing preliminary design plans and capital cost estimates for 300-, 600-, and 900-tpd transfer facilities, and determining waste haul costs for three proposed site locations.
- Participation in the preliminary design of a 600-tpd refuse transfer station, Palo Alto, California. Duties included assessing materials flow equipment requirements and costs, determining transfer haul costs, and assisting in overall station design and layout.

Landfill/Municipal Waste Disposal--

Mr. Miller has been involved in a number of municipal landfill projects involving site selections and development of closure plans and closure costs. He has also participated in projects relating to alternative methods of waste disposal, including incineration. These projects include:

- Managing a project to determine the estimated costs for: (1) closure of four currently active landfills; and (2) development of a new regional disposal site in Santa Barbara County, California. Capital expenditures and annual operating costs were determined for both landfill closure and development activities based on current regulatory requirements.
- Acting as Project Manager for a study to determine applicable regulatory requirements and estimated costs for excavation/removal and redispisal of a former landfill site in Palm Springs, California. Applicable requirements for both the excavation and preparation of the recipient site were determined.

JOSEPH J. MILLER (continued)

- Participation in a sanitary landfill site selection, Kern County, California. Responsibilities included preparing capital and refuse haul cost estimates, and environmental/socioeconomic assessments associated with landfill development at three candidate sites.
- Preparing a report containing guidelines for the formal closure of a completed landfill site in San Diego, California. The study evaluated the measures and associated costs required to achieve regulatory compliance with regard to proper surface drainage and ground water protection, and landfill gas migration and emission controls.
- Developing costs for the analysis of alternative refuse disposal technologies available to Yuba and Sutter Counties, California. This study evaluated alternatives such as landfill siting/development, landfill expansion, transfer stations, and implementation of a waste-to-energy facility.

Mr. Miller has also participated in several scoping studies to determine required closure actions for inactive disposal sites in Los Angeles County. These studies typically involved determining items necessary for compliance with California's Subchapter 15 and Water SWAT surface water, ground water and vadose zone monitoring requirements, provisions for placement of final cover, and subsurface landfill gas and air emissions monitoring. In each case, a range of probable costs for the various capital and annual action items was determined.

Environmental Impact Reports (EIRs)--

Mr. Miller has been actively involved in the preparation of various EIRs for proposed landfill development and expansion projects. He has participated in virtually all aspects of these EIR projects, including planning, preparation of technical portions of the text, overall document review, and presentations at the public hearing processes. Selected projects include:

- Acting as Project Manager for the preparation of two EIRs for proposed sanitary landfill expansions in Burbank and Simi Valley, California. Throughout those projects, he functioned as a liaison between government officials, subcontractors, and in-house staff. He also researched and authored several technical sections of those reports, and was active in public hearing presentations.
- Preparing the surface water, air quality, and public health sections of an EIR for the proposed expansion of a sanitary landfill in Fresno, California.

JOSEPH J. MILLER (continued)

- Assessing potential air quality and subsurface LFG migration impacts as part of the EIR processes for a proposed residential/commercial development in Ontario, California. The project site was located adjacent to a sanitary landfill.

Recycling/Resource Recovery--

Involvement in various recycling and resource recovery programs has played an important part in Mr. Miller's career in the solid waste management industry. Prior to joining SCS, Mr. Miller was involved as a limited partner with The Paper People, Inc., a private waste paper recycling and consulting firm. He was instrumental in organizing numerous source separation and recycling programs in central California. His work included planning for and implementing a new waste material buyback center in San Luis Obispo, California. His responsibilities also covered business management matters such as personnel management, secondary materials marketing, and analyzing comparative costs for all proposed new ventures.

Since joining SCS, Mr. Miller has continued his active role in the recycling/resource recovery field. Applicable projects with which he has been involved include the following:

- Acting as Project Manager for the development of a field sampling program used to help implement California's unique "Bottle Bill." During this project, field data were obtained to determine the non-recyclable weight fraction of typical loads of used beverage containers. This information was used to calculate payments on a weight basis to those delivering recyclable goods to redemption centers.
- Development of a number of pilot recycling programs for the City of Seattle, Washington. Duties included consulting with both civic leaders and members of the recycling community, and performing cost analyses for various curbside, drop-off, and mandatory recycling programs.

Municipal Waste Characterization Studies--

Proper characterization of municipal solid waste streams is an important part of planning for future waste collection, disposal, and recovery strategies. SCS Engineers is nationally recognized for its past involvement in waste characterization projects, and Mr. Miller has played an integral part in many of these studies. He currently manages all waste characterization studies performed out of the SCS Long Beach office. For example, he has managed a program to determine the quantities and composition of wastes used as fuel in a municipal solid waste incinerator serving the Los Angeles area. The focus of this study was to identify recyclable

JOSEPH J. MILLER (continued)

and heavy metal materials in the waste stream. Other waste composition studies in which he has participated include:

- Acting as Project Manager for a comprehensive solid waste stream assessment for the cities of Burbank, Glendale, and Pasadena, California. This study involved field sorting and weighing of various categories of residential and commercial solid waste, and preparation of a data base of the composition, quantity, quality, and geographic distribution of those wastes.
- Assisting in the development of a waste management plan for the Veterans Administration Hospital, Long Beach, California. Various alternatives for the disposal of institutional and infectious wastes were evaluated, including on-site incineration. The study also included a waste characterization survey to determine the quantity and heat content of combustible wastes.

Mr. Miller has also managed similar projects in Santa Barbara and Los Angeles Counties, California. One of these projects involved determining the composition of commercial wastes disposed of at the Puente Hills Landfill (the largest sanitary landfill in the western United States). The purpose of this study was to determine strategies for diverting recyclable materials that have historically been landfilled at that site.

Publications

Miller, J. J. "Does Curbside Recycling Make Sense for a Small Community?" Proceedings from the Technical Sessions of the GRCDA 23rd Annual International Seminar, Equipment Services and Systems Show, Denver, Colorado, August 1985.

Beizer, M.B., and J. J. Miller. "Air Quality in Residences Adjacent to an Active Hazardous Waste Disposal Site." Proceedings from the 78th Annual Meeting of the Air Pollution Control Association, Detroit, Michigan, June 1985.

DAVID E. ROSS, PROJECT DIRECTOR

Education

B.S. - University of California, Berkeley, 1967
Civil Engineering

M.S. - University of California, Berkeley, 1968
Civil Engineering

Professional Licenses

Registered Professional Engineer - California
Registered Professional Engineer - Nevada
Registered Environmental Assessor - California

Affiliations

American Society of Civil Engineers - Member
Governmental Refuse Collection and Disposal Association
Member, Editorial Board, Journal of Environmental Science and Health

Professional Experience

Mr. Ross provides SCS Engineers with proven technical and managerial capabilities in the field of environmental pollution control. His entire 19-year professional career has been devoted to the performance of solid and hazardous waste management projects. He is Director of SCS's Long Beach office, a Vice President, and has served on the firm's Board of Directors since 1976.

Mr. Ross began his professional career with the U.S. Public Health Service, Bureau of Solid Waste Management (now part of the Office of Solid Waste, U.S. Environmental Protection Agency), in Cincinnati, Ohio. There, he worked as a Project Officer for many federally funded solid waste demonstration projects covering refuse collection, processing, resource recovery, and refuse disposal.

In 1970, Mr. Ross joined the California Department of Health Services as a civil engineer. His primary assignment was to compile information for the state's first hazardous waste plan. Mr. Ross also worked on the management of used pesticide containers and investigations of improper sanitary land-fill operations.

Since joining SCS Engineers in 1971, Mr. Ross has participated in and managed over 400 projects related to solid and hazardous waste management, resource recovery, recycling, environmental impact assessment, and water quality protection. Most projects have involved politically sensitive issues, and many have induced public hearings.

DAVID E. ROSS (continued)

Selected solid waste projects directed or managed by Mr. Ross are summarized below.

<u>Client</u>	<u>Project Subject</u>
City of Long Beach, California	Compare the estimated costs of hauling refuse to remote landfills via direct haul in collection trucks versus use of a transfer system.
Fresno County, California	Technical support for negotiations between county and private contractor for guaranteed delivery of solid waste to a waste-to-energy incinerator, for associated revenue sharing, and other resource recovery matters.
California Pollution Control Financing Authority Sacramento, California	Review of waste composition/quantity data and supply agreements for North County Resource Recovery Facility in San Diego, California.
County of San Bernardino San Bernardino, California	Estimate future costs to close 18 County landfills in accordance with state regulations.
Pine Bluff Arsenal Pine Bluff, Arkansas	Prepare plans for closure and post-closure monitoring of 31 separate hazardous waste disposal sites on this Army base. Estimate costs for further site investigations and to implement closure actions.
City of Big Bear Lake and County of San Bernardino, California	Develop a 20-year plan for solid waste management (collection, incineration, disposal) for the city and adjacent county areas.
Proprietary Private Client	Project the volumes and types of solid wastes to be generated in Southern California as part of initial planning efforts on a major central waste processing facility.
California Waste Management Board Sacramento, California	Investigation of opportunities for increasing the demand for materials recoverable from municipal solid waste through recycling programs.

DAVID E. ROSS (continued)

<u>Client</u>	<u>Project Subject</u>
City of San Diego, California	Design of a new landfill with methane gas and leachate controls.
Metropolitan Waste Disposal Montebello, California	Prepare preliminary design of a transfer station; assist in permit application discussions.
California Waste Management Board Sacramento, California	Prepare and present seminar on procedures for siting a new sanitary landfill.
City of Whittier, California	Update of sanitary landfill design, originally prepared by SCS.
Lewis and Roca, Attorneys at Law Phoenix, Arizona	Investigation of refuse collection economics, comparing private with public operations.
City of San Diego, California	Design of methane gas control facilities for a housing complex near a landfill.
U.S. EPA San Francisco, California	Technical Assistance Panels prime contractor, Region IX. Through 1980, 94 separate federally financed solid and hazardous waste projects were performed under this \$1.3 million contract to SCS for municipalities in the west.
City of Santa Fe, New Mexico	Evaluation of resource recovery and recycling options, and search for a new sanitary landfill site.
Private Landfill Operator Northern California	Recommendation of methods to control birds at a landfill.
County of Riverside, California; County of Shasta, California	Two separate projects, both entailing location of a new sanitary landfill site, including response to public comments about proposed site locations.
Local Developer Los Angeles, California	Preparation of a preliminary design and an Environmental Impact Report for a proposed sanitary landfill.

DAVID E. ROSS (continued)

<u>Client</u>	<u>Project Subject</u>
U.S. Navy Pacific Division Pearl Harbor, Hawaii	Preparation of an updated version of Design Manual 5.10 - Solid Waste Disposal.
San Luis Obispo County, California	Comprehensive solid waste management study, including three sanitary landfill designs and development of the city's first source separation program.
Port of Long Beach Long Beach, California	Study of options for ship's garbage disposal.
Ventura County, California	Preparation of an EIR for expansion of a former hazardous waste disposal site to accommodate municipal refuse.
U.S. Navy	Study of unit waste handling operations suitable for use at Navy installations.
State Water Resource Control Board Sacramento, California	Investigation of water quality impacts from solid waste disposal.
Veterans Administration Medical Center Long Beach, California	Investigation of the feasibility of implementing a heat-recovery incinerator in cooperation with adjacent California State University campus.
City of Burbank, California	Preparation of an Environmental Impact Report for expansion of the city's sanitary landfill.

Successful completion of these and many other projects demonstrates Mr. Ross's expertise in solid waste management issues and management of complex projects.

A list of Mr. Ross's many technical publications is available on request. Mr. Ross developed and was principal lecturer for several university courses on solid waste management and resource recovery, and is available for similar speaking and lecturing assignments elsewhere.

KRISHAN K. SAIGAL, P.E., CHIEF DESIGN ENGINEER

Education

B.E. - Gujarat University, India, 1956
Civil Engineering

M.S. - Case Institute of Technology, Cleveland, Ohio, 1959
Civil Engineering

Professional Licenses

Professional Engineer - New York, Ohio, California, and Arizona

Affiliations

Water Pollution Control Federation

Professional Experience

Mr. Saigal provides SCS with an extensive background in waste management projects. His 25 years of professional experience include engineering studies, design, preparation of plans and specifications, construction cost estimations, construction contract administration, and operation and maintenance manuals for projects related to landfill design; landfill closure plans; landfill gas recovery and migration control; hazardous waste storage and land disposal facilities; and wastewater collection, pumping, and treatment. He has extensive experience in working with the local, state, and federal regulatory agencies responsible for implementation of pollution control projects.

Representative projects include the following:

- Preparation of plans and specifications for the design of an 80-acre landfill in Thurston County, Washington. Project included design of liner system, leachate control and collection facilities, a storm water retention basin, landfill gas migration control systems and a closure plan, and preparation of permit applications for various regulatory agencies.
- Participation in the design and preparation of plans for the landfill in Boulder, Colorado. Project included phased development, diversion of storm water, liner design, leachate control, and access roads.
- Preparation of plans, specifications, and cost estimates for landfill gas migration control systems for Encinitas and Gillespie landfills in the County of San Diego, California; Geer Road landfill in the County of Stanislaus, California; Santa Clara landfill, Oxnard, California; Oceanside landfill and Maxson Street landfill in the City of Oceanside, California; Hawks Prairie landfill,

KRISHAN K. SAIGAL (continued)

Thurston County, Olympia, Washington; Milliken landfill, San Bernardino County, California; Sunnyvale landfill, Sunnyvale, California; Sai Sio-Wan landfill, Hong Kong; Golden Eagle Refining Company, Carson, California; South Chollas landfill, San Diego, California; and Kapaa landfill, Honolulu, Hawaii.

- Member of value engineering team for Snohomish County landfill, Snohomish County, Washington. Specific responsibilities included evaluation of liner system, leachate collection and treatment, final cover system, and landfill gas control system.
- Plans and specifications for relocation of Avondale landfill, Avondale, Arizona. Project included design of liner system; leachate control, collection, and detection system; final cover system; permit applications for various regulatory agencies; and landfill gas venting system.
- Design and preparation of conceptual development plans for Sacramento County landfill. Project included excavation plan, fill plan, stage development plan, site closure plan, and site drainage system.
- Design and preparation of landfill closure plans for Mission landfill in Oceanside, California. Project included grading, final cover, site drainage, and landfill gas migration control.
- Plans, specifications, and cost estimates for landfill gas collection and electric power generation at Oxon Cove Landfill, Oxon Hill, Maryland.
- Project Manager responsible for coordinating the field and office work in the construction of landfill gas control projects for the City of Oceanside, California, and Stanislaus County, California.
- Feasibility investigation and preparation of preliminary design for pipeline for landfill gas delivery from the Toyon landfill (Los Angeles) to Glendale Municipal Power Plant.
- Supervision of landfill gas migration field investigations for private residential development in East Los Angeles County, and municipal park/commercial development in San Diego, County.
- Project Manager responsible for the design and preparation of plans and specifications for a low-pressure sewer system for the towns of Camberia, Pendleton, and Wheatfield, New York.
- Plans and specifications for interceptors, force mains, and pump stations for both Erie County Sewer District No. 4 and the town of Grand Island, New York.

KRISHAN K. SAIGAL (continued)

- Preliminary report on advanced waste treatment facilities for Southerly Wastewater Pollution Control Center, Cleveland, Ohio.
- Coordination of field and office work for the construction of a water pollution control center for Aliso Water Management Agency (AWMA).
- Preparation of plans, specifications, and cost estimations for five vehicle wash facilities, including treatment and recycle of wash-water at Fort Irwin, California, under contract with the Corps of Engineers, Sacramento District.
- Engineering report on the treatment of photographic process wastewater at Beale Air Force Base, California. Report studied treatment alternatives and prepared conceptual layout and cost estimates, including annual operation and maintenance costs.
- Preparation of plans and specifications and cost estimations for fuel storage and transfer facilities at the U.S. Navy's San Nicolas Island, California.
- Design and preparation of plans and specifications for landfill closure for Golden Eagle Refining Company, Carson, California. Project included final cover system, landfill gas control system, site drainage, and permit applications for various regulatory agencies.

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ROBERT P. STEARNS, PRINCIPAL

Education

B.S. - University of Iowa
Civil Engineering

M.S. - University of California at Los Angeles
Engineering Management

Professional Licenses

Registered Civil Engineer - California
Registered Professional Engineer - Virginia, Oregon, Oklahoma, and Washington

Affiliations

American Society of Civil Engineers (ASCE)
Past Chairman of Solid Waste Management Committee
Past Chairman of Standards of Practice Committee
President-Elect, Los Angeles Section
Southern California Waste Management Forum
Past Chairman
Governmental Refuse Collection and Disposal Association
Past Member, International Board and Corporate Director
American Public Works Association
Member of Institute for Solid Wastes
National Solid Waste Management Association
Member, Professional Services Council

Professional Experience

Mr. Stearns has more than 25 years of experience in the study and design of solid and hazardous waste management systems. He began his professional career with the City of Los Angeles, Bureau of Sanitation, in 1960. For the City, he participated in solid waste collection analyses; sanitary landfill acquisition and design studies; and feasibility studies of resource recovery from solid wastes. He was a major contributor in the design and implementation of a computerized management information system for the collection, equipment maintenance, and waste disposal divisions of the Bureau.

In 1967, Mr. Stearns joined a Los Angeles-area environmental consulting firm for which he managed many solid waste projects for private and governmental clients. Notable projects included preparation of comprehensive solid waste management plans for three California counties; comparative performance and cost evaluations for refuse collection crews; analyses of refuse collection problems in several communities; preparation of landfill operating and development plans for municipal and private clients; and design of refuse collection routes for Washington, D.C.

ROBERT P. STEARNS (continued)

Mr. Stearns was a co-founder of SCS Engineers in 1970, and has directed or served in a review capacity on the firm's solid waste management-related assignments. He currently serves as the firm's President and CEO. Under his leadership, SCS has assisted clients with virtually every aspect of the management of municipal, commercial, and industrial solid wastes. More than a dozen new sanitary landfills have been sited and designed under his direction. Detailed performance and cost evaluations of municipal and private solid waste collection operations have been completed in a number of cities, including Washington, D.C.; Seattle, Washington; and Phoenix, Arizona.

Mr. Stearns has been nationally recognized for his work on refuse collection productivity assessments. He has participated in evaluations of collection systems in virtually every state. This work includes the following types of services:

- Evaluation of refuse collection operations.
- Cost comparisons of alternative collection systems.
- Development and evaluation of collection alternatives, such as:
 - Conversion from backyard to curbside collection.
 - Reduction in collection frequency.
 - Reductions in crew size.
- Evaluation of private versus municipal collection systems.
- Recommendations to increase productivity.

He has led waste collection, storage, transfer, and transportation projects for a variety of municipal, regional, military, and private clients. Based on the experience gained in the course of numerous waste collection projects, he developed computer models (PROCOL and COSTCOL) to aid in the allocation of resources (vehicles, personnel, time) and routing of collection vehicles. These computer models enable SCS to identify the optimal route length (number of stops); balance workloads for collection crews; select the optimal collection vehicle capacity; compare/quantify savings possible by modifying service levels, changing crew size, vehicles, etc.; and estimate resources (crews/equipment) and support costs necessary to service a community or service area. The models form the cornerstone for an analysis technique developed and successfully used at many locations throughout the United States.

ROBERT P. STEARNS, PRINCIPAL

Publications and Presentations

- Stearns, R. P. A Checklist for Refuse Collection Equipment Purchases. Presented at Third Annual Seminar of Governmental Refuse Collection Disposal Association, Oakland, California, 1965.
- Stearns, R. P. Technology and the Professional Engineer. Presented at Pacific Southwest Regional Conference, Anaheim, California, April 1965.
- Stearns, R. P., and J. M. Betz. Discussion on Simulation and Analysis of a Refuse Collection System. Journal of the Sanitary Engineering Division, American Society of Civil Engineers, 147(SA3):4830, June 1966.
- Stearns, R. P., et al. One-Man Collection and the Status Quo. Presented at American Public Works Association, Western Regional Conference and Equipment Show, May 1968.
- Stearns, R. P., et al. Comparing the One-Man Crew with Multi-Man Crew for Refuse Collection. Unpublished Report, July 1968.
- Stearns, R. P. Structure of the Associate Member Forum, Los Angeles Section of ASCE. Presented to 1968 Associate Member Forum Conference, Los Angeles, California, October 1968.
- Stearns, R. P., et al. Our Place in the Community We Serve. Presented at Sixth Annual Seminar of Governmental Refuse Collection and Disposal Association, November 1968.
- Stearns, R. P., et al. Survey of U.S. Refuse Collection Practices. Civil Engineering, April 1969.
- Stearns, R. P., et al. For More Efficient Refuse Collection, Try Analyzing Your System with a Mathematical Model. The American City, May 1969.
- Stearns, R. P., et al. National Data on Cities Using Refuse Bags. Unpublished Survey Report, August 1969.
- Stearns, R. P. The Union and the Professional Engineer. Presented to Seventh Annual Associate Forum Conference, American Society of Civil Engineers, Sacramento, California, November 1969.
- Stearns, R. P. Queueing Analysis at Scales at Waste Disposal Sites. Unpublished Paper Presented as Partial Fulfillment for Master's Degree in Engineering Management at University of California, Los Angeles, February 1970.
- Stearns, R. P. Optimal Routing of Refuse Collection Vehicles Discussion. Journal of the Sanitary Engineering Division, American Society of Civil Engineers, 96(SA6):1469-1470, December 1970.

ROBERT P. STEARNS (continued)

- Stearns, R. P. Plant Engineer's Role in Solid Waste Management. Presented at Western Plant Engineers Conference, Anaheim, California, 1971.
- Stearns, R. P., et al. A Mathematical Model for the Analysis of Refuse Collection Systems. Unpublished Report.
- Stearns, R. P., et al. Solid Waste Management in Wholesale Food Distribution Centers. Refuse Removal Journal, 1971.
- Stearns, R. P., D. E. Ross, and H. M. Freeman. Analysis of Federal Programs Affecting Solid Waste Generation and Recycling: A Summation. Waste Age, 3(5):12-13, September/October 1972.
- Stearns, R. P., et al. Improved Refuse Collection - A Comparative Study of One-Man Operation. Presented at Engineering Foundation Research Conference on Solid Waste Research and Development II, 1972.
- Stearns, R. P. Environmental Protection Through Sanitary Landfill Design and Operation. Presented to National Safety Congress, Chicago, Illinois, October 1973.
- Stearns, R. P., and D. E. Ross. Environmental Impact Statements for Sanitary Landfills. Public works, 104(11):63-66, November 1973.
- Stearns, R. P. Management Information Systems for Solid Waste Management Operations. Presented at Governmental Refuse Collection Disposal Association Conference, Ventura, California, 1974.
- Stearns, R. P., et al. The Economics of Separate Refuse Collection. Waste Age, 5(3):6-14, May/June 1974.
- Stearns, R. P. National Science Foundation-Sponsored Study of Refuse Collection Equipment. Presented at Governmental Refuse Collection Disposal Association Conference, Fresno, California, October 1974.
- Stearns, R. P. Is Source Separation Practical? The Experiences of 22 Nationwide Case Study Locations. Presented at Fourth National Congress of National Solid Waste Management Association, New Orleans, Louisiana, November 1974.
- Stearns, R. P. The SCS Engineers/GRCDA National Foundation Equipment Grant: A Status Report. Presented to Seventh Annual Western Regional Solid Waste Symposium, Governmental Refuse Collection and Disposal Association, San Jose, California, April 1975.
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ROBERT P. STEARNS (continued)

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**SUMMARY OF QUALIFICATIONS
HAZARDOUS WASTE AND SUPERFUND SERVICES**

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**SUMMARY OF QUALIFICATIONS
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CONTENTS

INTRODUCTION	1
SCS Representatives	1
Corporate Overview	1
Other Corporate Highlights	2
Unique Qualifications	2
Subsurface Gas.....	2
In-Situ Stripping of Volatile Organic Compounds	2
Remedial Actions at Sanitary Landfill Facilities	2
Tank and Container Storage	3
PCB Management	3
Oil and Solvent Waste Management	3
CORPORATE EXPERIENCE	4
Uncontrolled Hazardous Waste Site (Superfund) Experience	4
Preliminary Assessment	4
Remedial Investigation	4
Remedial Action Selection	4
Facility Design, Cost Estimating, and Construction.....	5
Hazardous Waste (RCRA) Experience	6
Regulatory Compliance and Permitting	6
Waste Minimization Plans	6
Comprehensive Hazardous Waste Management Plans	6
Design of Hazardous Waste Treatment Facilities.....	7
Design of Hazardous Material/Waste Storage and Disposal Facilities.....	7
Closure and Corrective Action Plans	8
Underground Storage Tanks	8
Real Estate Contamination Assessments.....	9
Asbestos Services	9
PERSONNEL.....	10
LABORATORY.....	14
CORPORATE FACILITIES.....	15
Information and Data Management	15
Library Facilities	15
Drafting and Graphics	15

INTRODUCTION

SCS Representatives

SCS Engineers is pleased to have this opportunity to present this summary of its qualifications to provide Hazardous Waste and Superfund Services. The reader may contact any of the following SCS representatives regarding our professional practice:

- Michael W. McLaughlin, a Project Director and Attorney based in SCS's Reston, Virginia office, and a Director and Vice President of the firm.
- Kenneth V. LaConde, a Project Director in SCS's Long Beach, California office, a Director of the firm, and the firm's Vice President for Laboratory Services.
- David E. Roberson, a Project Manager in SCS's Bellevue, Washington office.
- James J. Walsh, PE, a Project Director in SCS's Covington, Kentucky office, and a Vice President of the firm.
- John Cummings; Project Director and Attorney in SCS's Dublin, California office;
- John D. Wright, a Project Director in SCS's Kansas City, Missouri office, and a Director and Vice President of the firm.
- A.J. (Chuck) Gordon, a Senior Project Geologist in SCS's Phoenix, Arizona, office.
- Bruce B. Clark, a Senior Project Geologist in SCS's Tampa, Florida office.

Corporate Overview

SCS Engineers is an environmental and civil engineering consulting firm with offices nationwide. The firm specializes in solving hazardous and solid waste management problems; since 1970, more than 80% of the firm's work has been in these areas. SCS's professional practice is organized in the following eight practice groups:

- Hazardous Waste Engineering
- Underground Storage Tanks
- Hazardous Waste Studies
- Landfill Engineering
- Landfill Gas Control and Recovery
- Public Works Engineering
- Solid Waste Management and Resource Recovery
- Laboratory and Data Processing Support Services

SCS provides engineering and consulting services to private industry, military installations, and government agencies. Services provided by SCS range from investigations, problem assessments and conceptual designs to final engineering design, construction or construction management, and long term monitoring. The firm is proud of its innovative design capability; an SCS Engineers-designed landfill gas recovery system at the City of Industry, California received the American Society of Civil Engineers' Outstanding Civil Engineering Achievement Award.

The firm designs all types of hazardous waste treatment, storage, and disposal facilities, including landfills, incinerators, drum storage areas, bulk storage tanks, land treatment facilities, and waste treatment works. In addition, SCS provides Superfund-related consulting services, including conduct of remedial investigation and feasibility studies, design of remedial measures, and construction or construction management.

Other Corporate Highlights

- Professional staff include environmental, civil, mechanical, electrical, and chemical engineers; geologists and hydrogeologists; public health specialists; chemists, biologists and other natural scientists; planners; systems analysts; computer scientists; and management analysts.
- Fully-equipped analytical laboratory
- Underground tank precision test equipment
- State-of-the-art computer data processing equipment
- Proven record of on-time and on-budget project performance
- Professional Corporation licensed to provide professional engineering services in most states
- Wholly-owned subsidiary provides construction services and design-build capabilities for subsurface gas control and remedial actions.

Unique Qualifications

Subsurface Gas. SCS Engineers is one of a small handful of national consulting firms qualified to assist in the assessment and control of air emissions and subsurface gas migration from land disposal facilities. The firm has performed more than 800 projects in this highly specialized area, including a number at listed Superfund sites.

In-Situ Stripping of Volatile Organic Compounds. As a natural extension of the firm's work in subsurface gas control and recovery, SCS has designed vadose (unsaturated) zone monitoring and treatment facilities at contaminated sites. Owners often find such soil vapor extraction systems to be a cost-effective way to monitor and clean up a site.

Remedial Actions at Sanitary Landfill Facilities. A growing number of sanitary (municipal) waste facilities are being identified as hazardous waste sites under the Superfund program. SCS's broad background in sanitary landfill engineering provides the firm with an understanding of the usual kinds of contamination found at such landfills, as compared with hazardous substances from industrial sources. In addition, the firm is experienced in the design of control facilities which reflect the special conditions (e.g. differential settlement) found at most landfills.

Tank and Container Storage. Senior professionals at SCS have unparalleled knowledge and experience in tank storage of hazardous materials. This experience is broad, ranging from preparation of spill prevention, control and countermeasure (SPCC) plans to design of tank farm storage facilities. The firm is nationally recognized for its work with respect to underground storage of hazardous materials, and for development and implementation of leak detection and cleanup programs for leaking underground storage tanks.

PCB Management. SCS is one of a few national consulting firms with extensive expertise in management of PCB materials and related chemicals (e.g. pentachlorophenols, dibenzofurans, and dioxins). SCS's PCB experience includes preparation of spill cleanup plans and specifications, manuals for the proper handling and disposal of PCB materials, and research into the fate and chemistry of degradation products (such as dioxins) formed upon combustion of PCBs.

Oil and Solvent Waste Management. SCS has conducted oil and solvent waste management projects at more than 100 locations in the last 10 years. Services provided in this area include preparation of plans and specifications for oil and solvent waste collection, storage, and disposal facilities (including land treatment facilities), development of used oil and solvent management programs, design of secondary containment and spill cleanup facilities, and preparation of permit applications.

CORPORATE EXPERIENCE

Uncontrolled Hazardous Waste Site (Superfund) Experience

Proper management of an uncontrolled hazardous waste site requires that the problem be identified, its implications assessed, alternatives considered, and appropriate action selected. SCS Engineers is one of a few national consulting firms which is qualified to assist in all phases of managing uncontrolled sites, including: Preliminary Assessment, Remedial Investigation, Remedial Action Selection, Facility Design, Cost Estimating, and Construction Management

Preliminary Assessment. During the last four years, SCS has conducted preliminary assessments to identify past hazardous waste management practices and possible environmental contamination at a number of military installations, including ten Naval installations in the western United States.

In addition, SCS has performed preliminary assessment and subsequent Hazard Ranking System analysis for a variety of private sector clients in a dozen states. Where the scope of a preliminary assessment justifies their use, SCS has available computer facilities to assist in analyzing site data. In addition, on-line data bases covering toxic material management can be used to broaden investigations of potentially responsible parties. Such information can be useful to officials in government and industry alike who are seeking to apportion financial responsibility for remedial measures at a Superfund site.

Remedial Investigation. SCS geologists and hydrogeologists have been used on projects throughout the country to identify likely subsurface conditions, sometimes based on minimal amounts of data. The firm's geologists are often used to specify locations for groundwater wells and subsequently to interpret results to determine the extent of contaminant movement.

The firm has installed most of the groundwater fate and transport models accepted by EPA on SCS's in-house computer systems. These include USGS2d, USGS3d, USGSMOC, FE3dGW, FEMWASTE, Random Walk, and PATHS (groundwater transport); USGS2d and FEMWASTE WATEQF and PHREEQE (chemical equilibrium); PAL, TSDf, ISCST, and ISCLT (air emission release rates); HWD (dike stability); and HEC-1 and HEC-2 (surface water hydrology). In addition, professionals at SCS are familiar with and routinely use other standard computer models to evaluate remedial alternatives (e.g., EPA's HELP model to evaluate alternative site cover designs).

SCS has collected surface water, groundwater, soil, plant, and air samples for more than 400 projects. These activities have been performed for industrial and military clients in more than 35 states. Typically, quality assurance plans are developed in advance of sample collection to ensure that collection and analysis are performed in accordance with standard methods approved by regulatory officials.

Following sampling and laboratory analysis, SCS scientists apply risk assessment techniques to determine whether site contamination warrants remedial action. SCS is experienced in estimating exposure via ground water, surface water, air, soil (ingestion and inhalation), and food chain pathways.

Remedial Action Selection. Based upon results of the preliminary assessment and investigation, SCS assists clients in the selection of a cost-effective approach to site remediation. In many cases, selection of a remedial action must consider not only the technical aspects of the site problem, but legal and other institutional aspects as well. SCS has worked on several widely-publicized Superfund sites, including:

- Fulbright and Sac River Landfills, Springfield, Missouri (remedial investigation and feasibility study and remedial design performed for potentially responsible parties)

- Del Norte Pesticide Site, Crescent City, California (remedial investigation; design of pilot treatment; preparation of plans and specifications for groundwater pump and treat; assistance during construction)
- Riverfront Park Landfill, Kansas City, Missouri (field investigation and endangerment assessment performed for municipal site owner)
- Odessa Chromium I Site, Odessa, Texas (review of EPA remedial design, evaluation of alternative technologies and expert testimony)
- Krysowaty Farm, New Jersey (preparation of plans and specifications for excavation and disposal; assistance during construction)
- Lee's Lane Landfill, Kentucky (design of emission control facilities, assistance during construction)
- United Chrome Products, Corvallis, Oregon (evaluation of alternative groundwater pump-and-treat technologies)
- Kin-Buc Site, New Jersey (expert testimony and consulting regarding alternative designs for capping the landfill, surface water protection, and post-closure care)
- Port Washington Landfill, New York (regulatory support; design and construction supervision for emission control system (fume incinerator); system start-up; monitoring)
- Jamaica Bay Landfills, New York (operation and closure plans for Fountain Avenue, Edgemere, and Pennsylvania Avenue Landfills; leachate evaluation; emission controls)
- Matousek Landfill, Garfield Heights, Ohio (design and construction of explosive gas control treatment system)
- BKK Landfill, West Covina, California (offsite health and safety monitoring for airborne toxics)
- Industrial Excess Landfill, Uniontown, Ohio (investigation, design and construction of landfill gas collection and treatment system)

SCS clients at these and other sites benefitted from the firm's credibility regarding selection of cost-effective remedial actions. SCS's approach to these problems is based on finding practical solutions. SCS professionals appreciate the sensitive nature of remedial action selection given intense citizen involvement and legal considerations, and are experienced in identifying options which are practical in both a technical and institutional sense.

Facility Design, Cost Estimating, and Construction. SCS has designed formal remedial actions at dozens of waste disposal sites over the last 18 years. At least five of the projects (Del Norte Pesticide Site in California, Industrial Excess Landfill in Ohio, Krysowaty Farm in New Jersey, Lee's Lane Landfill in Kentucky and Port Washington Landfill in New York) involved sites listed on EPA's National Priorities List.

SCS has prepared plans and specifications for remedial measures at several military installations including Naval Air Station, Miramar, California; Casco Bay Naval Fuel Annex, Brunswick Naval Air Station, Maine; Fort Belvoir, Virginia; Naval Surface Warfare Center, Dahlgren, Virginia; Pine Bluff Arsenal, Pine Bluff, Arkansas; and Lone Star Army Ammunition Depot, Texarkana, Texas.

At several sites, SCS designs for remedial actions have enabled the sites to be beneficially used for non-waste management activities. For example, a developer retained SCS to design measures for an arsenic-contaminated site formerly used for cleaning railroad tank cars. After careful evaluation of the nature and extent of contamination, SCS designed a seal and drainage system which isolated the arsenic. Local and state

regulatory officials permitted construction of a townhouse development at the site based on SCS's design. A similar project performed for a hotel developer enabled a former dump site to be used for a major hotel development.

Hazardous Waste (RCRA) Experience

SCS Engineers was performing hazardous waste management projects before the Federal and most state hazardous waste programs were developed. As a consequence, the firm has participated in the evolution of these programs over the years. SCS staff have an intimate knowledge of both the purpose and substance of the Federal and many state hazardous waste programs. In all, SCS has conducted more than 1,000 projects relating to solid and hazardous waste management, both pre- and post-RCRA.

Services provided by the firm have ranged from assistance with regulatory compliance and permitting (waste characterization, security plans, training plans, contingency plans, etc.), to preparation of plans and specifications for hazardous waste treatment, storage and disposal facilities and facility closure.

Regulatory Compliance and Permitting. SCS has assisted a variety of clients in complying with Federal and state hazardous waste management regulations, and in applying for the necessary permits. SCS has developed partial or complete RCRA and equivalent permit applications for a long list of clients, including military ordnance facilities, iron and steel manufacturers, fertilizer production facilities, commercial waste disposal firms, and manufacturers. SCS has prepared hazardous waste permit applications for facilities located in California, Georgia, Iowa, Maryland, New York, North Carolina, Ohio, Pennsylvania, Virginia, and Washington. In addition, the firm has provided regulatory compliance assistance (such as environmental audits) to clients in more than 20 states.

For the American Petroleum Institute, SCS prepared two training packages for use in training hazardous waste landfill and hazardous waste land treatment operators, as required by hazardous waste management regulations. For the Chemical Manufacturers Association, the firm conducted two nationwide surveys of hazardous waste underground injection well facilities with particular attention to regulatory compliance issues.

Waste Minimization Plans. The reauthorization of RCRA in 1984 included a requirement for generators to minimize their generation of hazardous wastes. SCS assists generators in complying with waste minimization requirements. In many cases, generators find that relatively simple changes in their operations can result in significant cost savings for hazardous waste management; in some cases the generator is able to remove itself from the hazardous waste regulatory program altogether.

SCS performs a detailed inventory of hazardous wastes being generated at the facility; identifies recycling (onsite and offsite) and other reduction alternatives; prepares cost estimates and performs payback analysis; and prepares a written implementation plan. The firm has prepared such waste minimization plans for clients in Alabama, California, Illinois, Maine, Maryland, Ohio, Pennsylvania, Virginia, and Washington.

Comprehensive Hazardous Waste Management Plans. SCS Engineers has prepared a number of hazardous waste management plans, including those for Western Canada; the Province of Alberta, Canada; the state of Hawaii; Vandenberg Air Force Base, California (including the Space Shuttle project); small quantity generators in North Hollywood, California; Yolo County, California; southeastern Virginia; and King County, Washington. Such plans typically include:

- Identifying sources, quantities, types, and frequencies of hazardous wastes generated, including wastes from contaminated site cleanup.
- Preparing an inventory of existing hazardous waste treatment, storage, and disposal facilities, analyzing their capacity, and performing TSD facility needs assessment.

- Siting hazardous waste TSD facilities.
- Identifying alternative waste management strategies source minimization, including good housekeeping practices, waste segregation, process modification, product substitution, on-site recycling, and on-site treatment.
- Recommending plan for management of hazardous waste generated by commercial small quantity generators and households.
- Developing conceptual designs, schedules, and financing alternatives.
- Preparing and conducting public information programs.

Design of Hazardous Waste Treatment Facilities. SCS has conducted several dozen projects relating to hazardous waste treatment. These include preparation of engineering of design plans and specifications for treatment facilities, and development of computer-based models to predict the cost and performance of characteristics of different treatment technologies.

SCS has designed incineration facilities for infectious (hospital) wastes, toxic gases collected at Superfund sites, and small solid waste management facilities. Other types of treatment systems designed by the firm include solvent distillation and recovery, oil-water separation, carbon adsorption, lead battery acid neutralization and lead recovery, and physical/chemical treatment for photographic wastes. Clients served in these projects include military installations, private companies, and municipal governments.

SCS clients for engineering feasibility study services include military branches and private companies. For example, SCS reviewed engineering designs for a hazardous waste incinerator and a PCB incinerator for two private developers considering construction of such facilities. Financing the facilities was contingent upon SCS's engineering review. SCS performed a series of projects for the Navy's Civil Engineering Laboratory to examine the feasibility of modular incineration for solid wastes.

Design of Hazardous Material/Waste Storage and Disposal Facilities. SCS has conducted scores of hazardous material and hazardous waste storage projects stretching literally from coast to coast. These have included Spill Prevention, Control and Countermeasure (SPCC) plan preparation, design of modifications to storage facilities, and design of new storage facilities. Over the last two years, SCS has designed new hazardous material/hazardous waste storage facilities totalling several millions of gallons in capacity, including:

- Hazardous materials storage facilities, Mare Island Naval Shipyard, Vallejo, California
- Transformer and circuit breaker oil storage facility, Vancouver, Washington
- JP-4 and liquid oxygen storage facilities, Glenn L. Martin Air National Guard Base, Baltimore, Maryland
- JP-4, JP-5, diesel, fuel oil, leaded gasoline, unleaded gasoline and kerosene storage facility, Marine Corps Development and Education Command, Quantico, Virginia
- JP-4 storage facility, West Virginia Air National Guard Base, Charleston, West Virginia
- Hazardous waste storage and transfer facilities (underground tanks and containers), Bureau of Engraving and Printing, Washington, DC
- Hazardous materials storage and dispensing facilities (containers, and aboveground and underground tanks), Bureau of Engraving and Printing, Washington, DC

- Chemical storage and transfer facility, Great Lakes Chemical Company, Irvine, California
- Diesel and unleaded gasoline storage facility, Fort Lee, Petersburg, Virginia

SCS has provided land disposal consulting services to a variety of Federal, state and local government agencies, military branches, and private companies. More than 250 projects relating to land disposal of wastes have been performed by the firm, including both hazardous and solid waste. SCS has provided full-scale siting and design services at more than a dozen municipal and industrial landfills, and has provided limited design services at scores of others. In addition to landfill facilities, the firm has prepared designs for land treatment and surface impoundment facilities.

Closure and Corrective Action Plans. SCS has prepared several dozen closure plans for hazardous waste facilities in Arizona, Arkansas, California, Georgia, Iowa, Maryland, North Carolina, Ohio, Oregon, Pennsylvania, Texas, Virginia, and Washington. Facilities covered by these plans range from simple storage and treatment facilities to complex combinations of treatment and land disposal. Where possible, SCS assists facility owners in achieving "clean closure", thus eliminating the need for continuing post-closure care.

Where clean closure is not possible, SCS prepares closure and post-closure care plans leaving some contamination in place, with caps and groundwater monitoring designed in accordance with regulatory guidance. The firm assists in developing risk-based closure standards and groundwater monitoring standards ("Alternate Concentration Limits") to help determine whether further corrective action is needed at a facility.

When a release of hazardous waste constituents is identified at a RCRA-regulated facility, even where the release is from a non-regulated solid waste management unit, then new Federal regulations require the development and implementation of a corrective action plan to address the release. SCS has been involved in preparing and negotiating some of the nation's first RCRA corrective actions conducted under these new requirements.

One example includes the firm's work in response to an apparent release of trichloroethylene from a southern manufacturing plant. SCS assisted the manufacturer in assuming control of its response to the situation, rather than awaiting regulatory direction. As a result, carbon filters were installed on wells serving nearby homes and combination air stripper and carbon filter was installed on the plant's water supply within a matter of weeks of discovery of the release. The formal corrective action plan required more than 18 months for agency approval, but in the meantime, the problem was largely solved. Testing indicates that the technologies reduced trichloroethylene concentrations below detection limits.

Underground Storage Tanks

Federal regulations require owners of underground tanks to perform precision tank testing on a regular basis. If leaks are detected, a corrective action program must be developed and implemented. SCS has assisted underground tank owners in developing tank management programs, including identifying underground tanks, assigning priorities for testing, conducting precision tank tests, installing monitoring wells, and designing and implementing corrective measures where necessary.

In the last year, SCS has conducted underground tank testing programs for chemical companies, manufacturers, trucking companies, oil companies, and private developers. SCS conducts the most appropriate tank integrity test method using certified technicians. If necessary, SCS installs groundwater or unsaturated zone monitoring well systems, and collects and interprets analytical results.

In the course of performing underground tank projects for some of the nation's prominent owners of underground tanks, SCS has gained a reputation for practical, effective solutions to underground tank problems. In one case, the firm designed and constructed a groundwater interceptor trench and hydrocarbon recovery system which was far more effective than required by the client's specifications, and which cost roughly one-

third of what the client expected to pay. In another example, the firm was retained to determine the source of migrating gasoline in the groundwater beneath one California site, and to design remedial measures to permit development to continue. Such projects typically are conducted under intense time constraints to assure continuation of the developer's financing; SCS is accustomed to performance under pressure.

Construction of remedial measures can be facilitated through the use of SCS's construction subsidiary, SCS Field Services. Through Field Services, SCS offers "full service" investigation, design, construction and monitoring for remedial measures. Many clients have found this arrangement meets their requirements for responsiveness and accountability when facing an environmental emergency.

Real Estate Contamination Assessments

With the authorization of Superfund in 1986, and a series of similar laws at the state level, sellers and purchasers of real estate (and their lenders) have been placed in an uncomfortable position. Environmental contamination resulting from hazardous material mismanagement can impose substantial liabilities on a purchaser of real estate; in some cases, the expense may be so large as to make the property worthless. If the lender forecloses under these circumstances, it may become the owner of the Superfund site with a net negative value. From the seller's perspective, liability for future contamination of the property could be imposed upon it, unless it can prove that the property was "clean" at the time of transfer.

SCS helps sellers, purchasers, and lenders estimate the extent, if any, of their exposure by performing an environmental contamination assessment prior to conveyance. The purpose of the assessment is to estimate the extent of environmental contamination which may exist at the site. SCS has provided environmental contamination assessments to private developers, lenders, and clients. Each has benefitted from SCS's pragmatic approach to these assignments, which includes conducting the work in phases to minimize the expense of the survey effort. Under this approach, the scope of each phase depends upon the results of the preceding phases.

The SCS approach to contamination assessments includes compiling the site history, reviewing regulatory agency files, and performing site reconnaissance. If contamination is suspected, SCS recommends a specific sampling program to further characterize the nature of the problem. Where hazardous substance contamination is confirmed, SCS has assisted clients in presenting a plan of action to the appropriate regulatory agencies. The firm has provided these services to clients in Alabama, Arizona, British Columbia, California, the District of Columbia, Florida, Georgia, Illinois, Indiana, Kansas, Kentucky, Maryland, Mississippi, Missouri, Nevada, New Jersey, New Mexico, New York, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Texas, Virginia, and Washington.

Asbestos Services

Asbestos-containing materials (ACM) were used for a wide range of building components until the mid-1970s, when concern over airborne asbestos fibers and their health effects became widespread. SCS assists real estate developers and financial institutions in identifying and managing abatement of ACM. Normally, SCS services begin with a comprehensive inspection and sampling of possible ACM, followed by recommendations regarding appropriate abatement measures. Depending upon the condition and location of ACM within a building, it may be possible to isolate ACM (rather than removing it) at considerable savings to the client. Subsequent phases of SCS services include monitoring abatement activities and certification of conditions. SCS has provided asbestos services for scores of projects in Arizona, California, Indiana, Kansas, Maine, Maryland, Missouri, Ohio, Pennsylvania, Virginia, and Washington.

PERSONNEL

Exhibit A summarizes the backgrounds of some 95 key SCS professionals with experience in waste matters. Together, this core staff has more than 750 years of experience solving a wide range of hazardous waste problems, and more than 1,100 total years of professional experience. Two-thirds of the personnel shown hold professional licenses in fields relevant to the firm's practice in hazardous waste and Superfund services. Many are licensed in more than one state; taken together, they provide the firm with the ability to practice professional engineering in most states.

Full resumes and references for any professional shown are available on request.

EXHIBIT A: KEY SCS PERSONNEL WITH WASTE MANAGEMENT EXPERIENCE

Key Personnel	SCS Classification	Education			Degree	Years Experience			Professional Registration*
		BS	MS	PhD		With SCS	In Waste Management	Total Prof.	
M.D. Alpers	Sr. Project Analyst	•	•		Planning	1	8	10	EIT
R.C. Alvord	Sr. Project Scientist	•			Geology	3	11	12	CPG
V.S. Apte	Project Engineer	•	•		Civil/Environmental Engineering	3	6	7	EIT
D.A. Austin	Project Director	•	•		Mechanical Engineering/Business	2	10	20	PE
K.L. Beattie	Staff Analyst	•	•		Sociology/Political Economy	1	2	8	
M.B. Belzer	Project Director	•			Civil Engineering	8	8	18	PE
S.C. Benitez	Sr. Project Scientist	•			Environmental Science	10	10	11	CHMM
C.M. Boone	Project Scientist	•			Environmental Science	11	10	11	
J.L. Briggs	Project Manager	•	•	•	Ecology	5	5	21	
J.E. Buckley	Staff Engineer	•			Geological Engineering	1	3	3	
A.C. Caldwell	Staff Engineer	•			Engineering	1	1	7	
P.J. Carrico	Project Manager	•			Environmental Science	4	4	4	
T.J. Chang	Project Director	•	•		Mechanical Engineering	9	10	15	PE
A.S. Childress	Project Scientist	•	•		Geology	3	3	5	CPG
B.B. Clark	Sr. Project Engineer	•			Civil Engineering	2	12	13	PE/CHMM
E.B. Clement	Staff Engineer	•	•		Civil/Environmental Engineer	1	4	14	PE
T..R. Collings	Staff Scientist	•			Microbiology	1	9	9	
G.L. Colner	Staff Engineer	•			Agricultural Engineering	4	4	8	EIT
E.T. Conrad	Principal	•			Civil Engineering	20	23	31	PE
J.P. Cummings	Project Director	•	•	•	Chemistry/Environmental Eng./Law	2	20	30	RE/ASB
A.J. DiPuccio	Project Director	•			Civil Engineering	11	12	17	PE
C.D. Forbes	Assoc. Staff Scientist	•				1	2	12	
G.A. Farrer	Sr. Project Engineer	•			Civil Engineering	1	5	10	PE
P.K. Foxwell	Staff Engineer	•			Geological Engineering	3	3	3	
R.B. Gardner	Project Director	•	•		Civil Engineering	10	10	10	PE
D.P. Gillespie	Project Scientist	•	•		Geology	11	11	13	CPG
M.D. Geyer	Project Engineer	•			Soil Science/Agricultural Eng.	3	3	3	EIT/AHERA
T.D. Dong	Project Manager	•	•		Environmental Engineering	12	12	12	REA
A.J. Gordon	Project Manager	•	•		Geology	2	9	9	CPG
K.W. Green	Project Scientist	•			Geology	3	3	8	
R.L. Grier	Project Manager	•			Civil Engineering	3	26	27	PE

* Professional Registration

AHERD = Asbestos Hazard Emergency Response Act
 CPG = Certified Professional Geologist/Registered Geologist
 CEG = Certified Engineering Geologist
 CHMM = Certified Hazardous Materials Manager

EIT = Engineer in Training
 PE = Professional Engineer
 PLS = Professional Land Surveyor
 REA = Registered Environmental Assessor
 SB = State Bar

EXHIBIT A: KEY SCS PERSONNEL WITH WASTE MANAGEMENT EXPERIENCE, Continued

Key Personnel	SCS Classification	Education			Degree	Years Experience			Professional Registration*
		BS	MS	PhD		With SCS	In Waste Management	Total Prof.	
M.J. Griffin	Project Scientist	•	•		Chemistry/Environmental Science	3	9	9	
S.M. Hamilton	Project Manager	•			Biology	1	9	10	
M.J. Haven	Project Director	•	•		Biology/Computer Science	10	10	21	
W.M. Held	Sr. Project Engineer	•	•		Civil/Environmental Engineering	7	9	9	EIT
G.D. Helland	Project Scientist	•			Geology	3	3	5	
J.O. Hendricks	Staff Geologist	•			Geology	1	1	13	
J.W. Hughes	Sr. Project Engineer	•			Civil Engineering	2	12	12	PE
C.B. Jenkins	Project Director	•			Chemistry	3	17	24	
B.F. Johnson	Project Scientist	•			Geology	1	7	7	CPG/AHERA
R.W. Jones	Project Engineer	•			Civil Engineering	1	3	14	PE/PLS
K.O. Kagy	Project Engineer	•			Civil Engineering	1	3	10	EIT
M.M. Katzman	Project Manager	•			Geology	3	10	19	CPG
B.P. Knoll	Project Engineer	•			Civil Engineering	1	15	20	PE
S.R. Kothary	Project Engineer	•			Civil Engineering	3	17	19	PE
M. Krieski	Sr. Project Engineer	•			Geological Engineering	1	6	8	PE
K.V. LaConde	Project Director	•			Chemistry	15	15	25	REA
S.A. Levin	Project Engineer	•			Civil Engineering	1	2	6	EIT
K.H. Lister	Sr. Project Scientist	•	•	•	Geology	3	3	13	CPG/REA
R.W. Luce	Project Manager	•	•	•	Geochemistry	5	5	21	CPG
K.A. Madenwald	Project Manager	•	•		Geology/Geotechnical Engineering	3	16	32	PE
P.A. Mandeville	Sr. Project Engineer	•	•		Civil Engineering	2	3	8	PE
J.R. Marsh	Project Manager	•	•		Environmental Engineering	11	11	14	REA
J.D. Marshall	Sr. Project Engineer	•			Chemical Engineering	5	7	8	PE
J.D. McClenagan	Staff Scientist	•			Geology	1	3	4	
M.J. McGuigan	Project Engineer	•			Mechanical Engineering	2	4	10	EIT
J.R. McKie	Staff Engineer	•	•		Meteorology/Civil Engineering	3	3	12	PE
M.W. McLaughlin	Project Director	•		•	Civil Engineering/Law	11	11	12	EIT/SB
J.H. Miller	Aspsc. Staff Scientist	•	•		Geology/Forest Hydrology	1	1	5	
J.J. Miller	Sr. Project Engineer	•			Environmental Engineering	6	6	9	PE
P.G. Newton	Project Manager	•			Civil Engineering	4	11	11	PE/PLS
J.A. Nuno	Sr. Project Engineer	•	•		Environmental Engineering	7	7	7	REA
L.R. Patel	Assoc. Staff Engineer	•			Civil Engineering	1	3	14	

12

* Professional Registration

AHERA = Asbestos Hazard Emergency Response Act
 CPG = Certified Professional Geologist/Registered Geologist
 CEG = Certified Engineering Geologist
 CHMM = Certified Hazardous Materials Manager

EIT = Engineer in Training
 PE = Professional Engineer
 PLS = Professional Land Surveyor
 REA = Registered Environmental Assessor
 SB = State Bar

EXHIBIT A: KEY SCS PERSONNEL WITH WASTE MANAGEMENT EXPERIENCE, Continued

Key Personnel	SCS Classification	Education			Degree	Years Experience			Professional Registration*
		BS	MS	PhD		With SCS	In Waste Management	Total Prof.	
E.R. Peterson	Sr. Project Engineer	•	•		Civil Engineering	4	6	7	PE
G.A. Petoyan	Project Director	•	•		Environmental Engineering	9	9	9	
L.A. Polos	Project Scientist	•			Biology	4	9	9	
T.W. Quane	Staff Scientist	•			Biology	2	2	14	
R.S. Reis	Project Manager	•			Civil Engineering	1	4	12	EIT
K.L. Richardson	Staff Scientist	•			Environmental Studies	4	4	4	AHERA
D.E. Roberson	Project Manager	•	•		Environmental Science	11	11	14	CHMM
D.E. Ross	Project Director	•	•		Civil Engineering	19	22	22	PE/REA
K.K. Saigal	Project Manager	•			Civil Engineering	8	8	28	PE
D.C. Sincerbeaux	Staff Scientist	•			Chemistry	5	5	5	
J.W. Stamm	Staff Engineer	•	•		Chemical Engineering	4	5	5	EIT
R.P. Stearns	Principal	•	•		Civil Engineering	20	29	29	PE
J. Steffan	Project Analyst	•			Business/Marketing	2	12	20	
U.G. Steinberger	Staff Engineer	•	•		Chemical/Environmental Engineering	5	5	5	EIT/AHERA
D.E. Stinson	Project Manager	•			Civil Engineering	3	6	13	PE
K.M. Stremiau	Staff Engineer	•			Civil Engineering	3	4	4	EIT
P.S. Strickland	Staff Engineer	•			Civil Engineering	1	3	4	EIT
L.T. Tagawa	Project Scientist	•	•		Geology	4	5	5	
J.S. Van Volkenburgh	Project Analyst	•			Economics	1	5	10	
W.G. Vogt	Project Manager	•	•		Biology/Environmental Science	9	9	11	
C.A. Votaw	Project Scientist	•			Planning	3	4	5	
J.J. Walsh	Project Director	•			Civil Engineering	15	15	15	PE
C.G. Ward	Project Manager	•			Geologist	2	7	7	
S.J. Watterson	Project Engineer	•			Civil Engineering	2	4	8	PE
T.D. Wetherill	Sr. Project Engineer	•			Mathematics	2	9	10	
J.H. Wheeler	Project Manager	•	•		Environmental Planning	2	15	15	
S.S. Whiting	Project Scientist	•			Mechanical Engineering	1	10	12	
N.E. Wietting	Project Manager	•			Civil Engineering	2	15	15	
J.D. Wright	Project Director	•	•		Civil Engineering	7	7	20	PE
J.A. Young	Project Director	•	•		Chemical Engineering/Business	2	16	24	
N.G. Zolten	Project Engineer	•			Civil Engineering	1	2	6	PE

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 PLS = Professional Land Surveyor
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LABORATORY

The SCS laboratory is located in Signal Hill, California, near the Long Beach office. This facility includes two Hewlett-Packard 5970B GC/MS, a total of eight Varian Gas Chromatographs, Thermo-Jarrell Ash Inductively Coupled Argon Plasma Spectrometer, a Perkin-Elmer Atomic Absorption Spectrometer and various other spectrophotometric equipment. A separate area houses a full wet chemistry laboratory and peripheral equipment. The laboratory performs analyses on water, wastewater, sludges, soils, plants, leachates, gases and groundwater.

The SCS laboratory is widely regarded for its work in analyzing subsurface gases for trace compounds, and for its work in support of SCS's underground tank investigations (e.g., analyses for Benzene, Toluene and Xylene, or BTX; total recoverable petroleum hydrocarbons; and organo-lead in soil and water). In addition, the laboratory has a large bench-scale testing area in which to conduct treatability and leachability studies on a variety of waste materials.

In addition to providing laboratory analyses in support of SCS projects, the laboratory also provides analytical services to a wide range of commercial and military clients. The laboratory is certified by the State of California.

Each SCS office maintains a full complement of field sampling equipment for water, groundwater, soil, air and waste sampling and site assessment. Included are photo-ionization, flame ionization, and electrochemical direct reading instruments for vapor analysis, non-contaminating sample pumps, water level indicators, a portable drill rig, and a variety of supporting field equipment. In addition, each SCS office maintains necessary safety equipment and supplies to enable the firm to respond quickly to field investigation assignments.

CORPORATE FACILITIES

Information and Data Management

SCS Engineers maintains sophisticated data management capabilities within its Data Processing Group. The firm has a large HP 3000 mini-computer system with associated terminals, printers and plotters configured in a time-sharing environment. In addition, the firm has a variety of IBM, Compaq, and Hewlett-Packard micro-computers.

These in-house systems, when coupled with the firm's data processing staff, provide state-of-the-art data manipulation and analysis capabilities for SCS assignments. The firm has developed several specialized applications for hazardous waste and toxic materials analysis at the national or regional level. For example, SCS offers a modified version of EPA's Hazardous Waste Data Management System (HWDMS) to hazardous waste companies performing market research.

The SCS service is called AEGIS, for Automated Environmental Geographic Information Service. Included within AEGIS are the RCRA 3010 notifications (more than 50,000 records); RCRA Part A applicants (some 7,500 records); CERCLA 103c notifications (some 7,000 records); the Open Dumps Inventory; Surface Impoundment Assessment files; wastewater discharge data from 40,000 sites; and state information collected from 10 of the largest states. In addition, the firm has computerized EPA's Comprehensive Environmental Response Compensation and Liability Information System (CERCLIS) to enable SCS staff to quickly identify potential Superfund sites located near any property of interest throughout the United States.

Library Facilities

Each SCS office maintains a working library of solid and hazardous waste research materials, product catalogs, and military guide specifications. The firm's main library is located in the Long Beach office, and contains roughly 25,000 volumes. All of the firm's library holdings are fully automated, with search and circulations assisted using SCS-AUTOLIB (TM), an automated library management system developed by the firm and available commercially. Due to the specialized nature of SCS's work, the library contains solid and hazardous waste reference materials which are not available elsewhere. In addition, the library maintains subscriptions to most of the available solid and hazardous waste research services.

Drafting and Graphics

SCS offices are equipped with a wide range of drafting and graphics equipment. From traditional engineering drafting (plans, details, etc.) to sophisticated computer aided design, drafting, graphics and desktop publishing, SCS has the in-house capabilities to meet client requirements.

Over its history, SCS has amassed a considerable number of proven engineering details and construction techniques which can be used for efficient production of construction drawings. The firm prepares all types of illustrations, including black and white, full color, and line art from photography. Many solid and hazardous waste projects include public participation; use of SCS-produced illustration materials in various media has proven valuable for a number of these projects.