Flynn Learner Warehouses

DEPARTMENT OF LAND UTILIZATION
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET, 7TH FLOOR • HONOLULU, HAWAII 96813
PHONE: (808) 523-4414 • FAX: (808) 527-6743

JEREMY HARRIS
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PATRICK T. ONISHI
DIRECTOR

LORETTA K.C. CHEE
DEPUTY DIRECTOR

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OFC. OF ENVIRONMENTAL QUALITY CONTROL

96/SMA-014(DT)
96-04178

July 5, 1996

The Honorable Gary Gill, Director
Office of Environmental Quality Control
220 South King Street, 4th Floor
State of Hawaii
Honolulu, Hawaii 96813

Dear Mr. Gill:

SPECIAL MANAGEMENT AREA ORDINANCE
CHAPTER 25, ROH
Environmental Assessment/Determination
Finding of No Significant Impact

Recorded Owner	:	Samuel M. Damon Trust Estate
Applicant	:	Flynn Learner Company
Agent	:	Analytical Planning Consultants, Inc.
Location	:	120 Sand Island Access Road, Honolulu, Oahu
Tax Map Key	:	1-2-23: 09
Request	:	Special Management Area Use Permit
Proposal	:	Construct four prefabricated metal warehouse buildings and other improvements
Determination	:	A Finding of No Significant Impact is issued

Attached and incorporated by reference is the Final Environmental Assessment (FEA) prepared by the applicant for the project. Based on the significance criteria outlined in Chapter 200, State Administrative Rules, we have determined that preparation of an Environmental Impact Statement is not required.

We have enclosed a completed OEQC Bulletin Publication Form and four copies of the FEA. If you have any questions, please contact Dana Teramoto of our staff at 523-4648.

Very truly yours,

Loretta Chee
for PATRICK T. ONISHI
Director of Land Utilization

PTO:am
Enclosures
g:negsma14.djt

1996-07-23-OA-FEA- FLYNN LEARNER WAREHOUSES

JUL 23 1996

FILE COPY

FINAL *ENVIRONMENTAL ASSESSMENT*

FLYNN LEARNER WAREHOUSES
120 Sand Island Access Road
Honolulu, Oahu, Hawaii

Tax Map Key 1-2-23: Parcel 9,
Lots 10A, 11A, 12A, and 13A

July 1, 1996

Prepared for:

Sueda & Associates, Inc.
905 Makahiki Way - Mauka Suite
Honolulu, Hawaii 96826

Prepared by:

Wil Chee - Planning, Inc.
1585 Kapiolani Boulevard, Suite 818
Honolulu, Hawaii 96814

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DEPT. OF LAND UTILIZATION
CITY & COUNTY OF HONOLULU

ENVIRONMENTAL ASSESSMENT

FLYNN LEARNER WAREHOUSES
120 Sand Island Access Road
Honolulu, Oahu, Hawaii

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ENVIRONMENTAL ASSESSMENT

1.0 GENERAL INFORMATION

1.1 Applicant

Flynn Learner Company
c/o The Learner Company
2711 Navy Drive
Stockton, California 95206
Phone: (209) 948-3498

1.2 Recorded Fee Owner

Samuel M. Damon Trust Estate
1132 Bishop Street, Suite 1507
Honolulu, Hawaii 96813
Phone: 536-3717

1.3 Agent

Sueda & Associates, Inc.
905 Makahiki Way - Mauka Suite
Honolulu, Hawaii 96826
Phone: 949-6644

1.4 Tax Map Key

TMK 1-2-23: Parcels 9.
The Site contains four lots numbered 10A, 11A, 12A, and 13A

1.5 Lot Area

130,568 SF

1.6 Agencies Consulted

In compliance with §11-200-9, Hawaii Administrative Rules, Department of Health, Title 11, Chapter 200, *Environmental Impact Statement Rules*, early consultation was sought from agencies and groups having jurisdiction or interest in the proposed action. On November 21, 1995, a form letter was sent requesting comments and concerns. The letter included a brief synopsis of the project with maps and illustrations.

It should be noted that in the November 21 letter, the total floor area of the warehouses was given as 70,828 SF (ground floor area). Subsequently, the applicant decided to provide a mezzanine floor in each building. The total gross floor area presented in the Environmental Assessment, (EA) including ground floor and mezzanine is 112,500 SF. The addition of mezzanine floor area will not affect the height and building envelope of the proposed warehouses. Also, as requested by the Department of Land Utilization, the four lots contained on the site have been shown on the site/building plan (Figure 4).

The agencies and groups contacted for early consultation are listed below. Comments and responses can be found in Appendix A. Items are presented chronologically in the order received.

State

Department of Business, Economic Development & Tourism
State of Hawaii
P.O. Box 2359
Honolulu, HI 96804
Tel. (808) 586-2355
Director, Dr. Seiji F. Naya

Department of Health
State of Hawaii
P.O. Box 3378
Honolulu, HI 96801
Tel. (808) 586-4410
Director, Lawrence Miike

Department of Land and Natural Resources
State of Hawaii
P.O. Box 621
Honolulu, HI 96809
Tel. (808) 587-0404
Chairman, Board of Land and Natural Resources, Michael D. Wilson

Department of Transportation
State of Hawaii
869 Punchbowl Street
Honolulu, Hawaii 96813
Tel. (808) 587-2150
Director, Kazu Hayashida

Office of Environmental Quality Control
State of Hawaii
220 South King Street
Central Pacific Plaza, Suite 400
Honolulu, HI 96813
Tel. (808) 586-4185
Director, Gary Gill

Office of State Planning
State of Hawaii
P.O. Box 3540
Honolulu, HI 96811-3540
Tel. (808) 587-2833
Director, Gregory Pai, Ph.D

UH Environmental Center
University of Hawaii at Manoa
2550 Campus Road
Honolulu, HI 96822
Tel. (808) 956-7361
Environmental Coordinator, Dr. John Harrison

County

Board of Water Supply
City & County of Honolulu
630 South Beretania Street
Honolulu, HI 96843
Tel. (808) 527-6180
Manager and Chief of Engineer, Raymond H. Sato

Building Department
City & County of Honolulu
650 South King Street
Honolulu, HI 96813
Tel. (808) 523-4564
Director and Building Superintendent, Randall K. Fujiki

Fire Department of Honolulu
City & County of Honolulu
3375 Koapaka Street, Suite H425
Honolulu, HI 96819
Tel: (808) 831-7771
Fire Chief, Anthony J. Lopez

Department of Land Utilization
City & County of Honolulu
650 South King Street
Honolulu, HI 96813
Tel: (808) 523-4432
Director, Patrick T. Onishi

Department of Parks & Recreation
City & County of Honolulu\
650 South King Street
Honolulu, HI 96813
Tel: (808) 527-6343
Director, Dona L. Hanaike

Department of Public Works
City & County of Honolulu
650 South King Street, 11th Floor
Honolulu, HI 96813
Tel. (808) 523-4341
Director and Chief Engineer, Kenneth E. Sprague

Department of Transportation Services
City & County of Honolulu
711 Kapiolani Blvd., Suite 1200
Honolulu, HI 96813
Tel. (808) 523-4529
Director, Charles O. Swanson

Department of Wastewater Management
City & County of Honolulu
650 South King Street, 3rd Floor
Honolulu, HI 96813
Tel. (808) 527-6663
Director, Felix B. Limtiaco

Others

Hawaiian Electric Company
P.O. Box 2750
Honolulu, Hi 96840
Tel. (808) 543-7771
President and CEO, T. Michael May

Sand Island Business Association
P.O. Box 17603
Honolulu, HI 96817
Tel. (808) 842-1359
Executive Director, Rodney Kim

Kalihi-Palama Neighborhood Board No. 15
1260 Richard Lane B607
Honolulu, HI 96819
Tel. (H)(808) 848-2126
(O)(808) 587-1254
Chairperson, Victor Mon
cc.
Neighborhood Commission
City and County of Hawaii
City Hall
Honolulu, HI 96813
Attn.: Vic Guillermo, Mayor's Representative
Tel. 523-4841

Samuel M. Damon Trust Estate
1132 Bishop Street, Suite 1507
Honolulu, HI 96813
Property Owner/Adjacent Property Owner
Tel. 536-3717

2.0 DESCRIPTION OF THE PROPOSED ACTION

2.1 General Description

2.1.1 Description of Proposed Project

The applicant operated a metal recycling facility on the project site from 1951 until it was closed in 1991. Flynn Learner proposes to convert the now unused site to a warehousing facility with the intention of subleasing space to individual small industrial companies. The proposed project will be composed of four prefabricated metal buildings providing 112,500 SF of warehouse space on the 130,568 SF site. The four buildings can be subdivided into 51 individual warehouse spaces. The remainder of the site includes paved parking stalls, lanes, street access and a 10 feet-wide landscaped border along Sand Island Access Road and a 5-feet wide border along Pahounui Drive.

Contaminants are known to exist on the site from previous industrial use. Several environmental site and soils studies have been completed by consultants. In developing the proposed project, the applicant is prepared to provide recommended remedial action in accordance with State of Hawaii Department of Health regulations.

2.1.2 Relation of the Parcel to the SMA

The project site is situated entirely within the Special Management Area (SMA). See Figure 3. The SMA boundary runs along the opposite side of Sand Island Access Road from the project site.

2.1.3 Location

The project site is located on the southern coast of the island of Oahu on a small peninsula of reclaimed land. It is situated in an area known as Kalihi-Kai on the northwest corner of Sand Island Access Road and Pahounui Drive. Keehi Lagoon at its closest proximity lies 620 feet west of the site's southwestern corner, and Sand Island is approximately 4,000 feet to the southeast of the site. Chinatown, the "Downtown" central business district, and Honolulu Harbor are located within two miles of the project site. See Figures 1, 2 and 3.

2.1.4 Land Use Approvals Required

(a) Special Management Permit - Department of Land Utilization, City & County of Honolulu.

(b) A Conditional Use Permit (CUP), Type 1, for joint development of two or more adjacent lots or a Consolidation application must be obtained if the warehouses encompass two or more of the lots. The determination will be made by the Department of Land Utilization.

(c) Building Permit and related permits required by various government agencies - Building Department, City & County of Honolulu.

(d) Environmental Permits - Department of Health, State of Hawaii. Since hazardous lead contaminated soil will be left in place on the site, the Hazard Evaluation and Emergency Response Office (HEER) of the Department of Health is investigating the need for a deed restriction to be placed on the property identifying the presence of hazardous lead contaminated soil and the requirement to have a properly maintained cap over the contaminated site.

2.2 Technical Characteristics

2.2.1 Use Characteristics

The applicant, Flynn Learner, has operated a metal recycling facility at the site from October 1951 to October 1991, under a lease from the Samuel M. Damon Trust. Since the facility was closed, the property has been intermittently used for parking trucks and equipment. As of this writing, all vehicles have been removed.

The applicant would like to convert the unused site to a new warehousing facility with the intention of sub-leasing individual bays to small industrial companies who require warehouse space in the industrial district. The applicant has a lease with the Samuel M. Damon Trust Estate for the next 31 years. Marketing studies conducted for the applicant indicate that there is a shortage of warehouse space in the industrial district, and that the new use of the property would be welcome by the local business community.

The applicant is prepared to initiate the project as soon as all necessary permits have been obtained, and to undertake all of the remedial actions recommended by its environmental consultant and the Department of Health of the State of Hawaii, .

2.2.2 Physical Characteristics. See Figures 4 and 5.

(a) Building Design:

The warehousing facility will consist of four prefabricated metal buildings. The floor area of these buildings consists of approximately 75,000 SF ground floor area and 37,500 SF mezzanine floor area, totalling approximately 112,500 SF. Warehouse I will contain nine bays totalling 10,946 SF ground floor area and 5,473 SF mezzanine floor area. Warehouse II will have 11 bays totalling 13,606 SF ground floor area and 6,803 SF mezzanine floor area. Warehouse III will have 11 bays with ground floor area of 13,926 SF and 6,963 SF mezzanine floor area, and Warehouse IV has 20 bays totalling 26,864 SF ground floor area and 13,432 SF mezzanine floor area.

The buildings will be composed of galvanized rolled steel structural members which are capable of withstanding the corrosive salt air, while roofing and wall sheeting will be of high tensile steel that is coated with an oven-cured paint system resistant to chipping, peeling, corrosion and fading. Building exteriors will be in neutral colors in keeping with the surrounding neighborhood. Signage will be in accordance with Land Use Ordinance regulations.

Maximum building height will be approximately 36 feet. The height limit for I-2 zoning in this area is 60 feet.

(b) Mechanical:

Sewer laterals and domestic water laterals will be available for each warehouse. Each tenant space will have available a 4-inch sewer and 1-inch domestic water stubout.

Each warehouse shall have the option of being protected by an automatic fire sprinkler system.

There will be no provisions made for central air conditioning in the buildings, however, tenants may add air conditioning to their own spaces at their own expense.

(c) Electrical:

Each building will have a single "house" meter for common area electrical loads such as exterior lighting. Each tenant will have a single Hawaiian Electric Company meter. A main disconnect switch (fused switch) will be located at service equipment for each building. Exterior mounted HECO meters will be located at one end of each building to provide electrical service to each tenant space.

An empty 1-inch conduit will be provided from the main telephone cabinet (MDF) on the exterior of each building to the tenant demising wall. Each tenant will be responsible for arranging and paying for their own telephone service from the MDF to their space.

Illuminance levels for common areas will be in accordance with the recommended practices of the Illuminating Engineering Society and the energy conservation ordinances of the City & County of Honolulu. In general, the parking/common areas will be provided with an average, maintained illuminance level of approximately 2.0 footcandles.

High pressure sodium, building mounted luminaires will be used to meet the illuminance levels and aesthetic requirements of the project. Tenants will be responsible for designing and providing illumination within their own spaces.

Fire alarm systems and security systems will be provided individually by tenants.

(d) Landscaping:

Canopy trees and palms will be selected to enhance the drive along Sand Island Access Road and Pahounui Drive for aesthetic and functional purposes. The use of medium canopy trees will be selected to provide shade and enhancement of the facility within the parking areas. Groundcover and flowering/accent shrubs will be provided in areas under trees, palms and in open landscaped areas.

Landscaping will be provided for aesthetic as well as shade and buffering purposes. The Land Use Ordinance will be used as a guide for spacing of canopy trees along the street frontage and parking area. A permanent below-grade automatic irrigation system will be provided for the establishment and growth of plant materials. Plant material will be selected for their growth habits and adaptability to the salt air environment with consideration to their low maintenance characteristics.

(f) Site:

The existing site is presently unused and consists of a steel paneled shed, a building of CMU construction, and a truck scale located on the western end of the property. These facilities are programmed to be removed. See Figure 6. All other major components of the metal recycling plant have been removed from the site. Former structures at the site included an incinerator, a metal shear, a battery casing storage pit, and an engine block storage pit. The incinerator was located to the west of the shed and the metal shear was located in the southeast corner of the property. A single underground storage tank was located, and since removed, next to the shed. The remainder of the site is vacant and covered by sparse vegetation. Scrap metal, plastic, and glass fragments are mixed into the surface soils. An 8-feet high CMU wall separates the project site from the property bordering on the northeast. The remainder of the site is enclosed by a chain link fence.

Asphaltic concrete will be used for parking and driveway areas. Paving design will follow recommendations by the environmental consultants and will be reviewed and approved by the Department of Health. In the proposed project,approximately 140 on-site parking stalls will be provided (68 required per Land Use Ordinance), as well as five loading stalls (five required per Land Use Ordinance).

The existing site is depressed with elevations ranging from 1 to 2 feet below the adjacent roadways. Mass earth balancing will be required to encapsulate contaminated soil conditions with an increased finish grade throughout the site of approximately three feet above roadway finish elevation. This grade height increase will require the incorporation of retaining walls around the perimeter of the property.

2.2.3 Construction Characteristics

Construction activities will include demolition and removal of existing structures, clearing grubbing, grading, filling, and building construction.

2.2.4 Utilities

There is an existing 12-inch water main along Sand Island Access Road and an 8-inch water main in Pahounui Drive. There is an existing 1" watermeter with 1-1/4" lateral at the front of the site along Sand Island Access Road. The new facility requires a 2" meter with a 2-1/2" lateral, and a 6" fire line with 6" D.C. meter. Fire hydrants exist at the street frontage on each side of the property. Board of Water Supply flow data indicates that flow and water pressure appear to be adequate.

Electrical service will be provided by Hawaiian Electric Company (HECO). System voltage will be 208/120 volts, three phase, four wire, supplied by a HECO pad mounted transformer. The transformer will be located within the planting area along Pahounui Drive. Underground 208/120 volt distribution system will provide HECO service to service equipment (metering equipment) located on the exterior of each building. Underground distribution will consist of concrete pullboxes and concrete encased raceways located in parking/driving areas. Concrete pullboxes will be located near buildings and protected by stanchion to prevent damage from vehicular traffic.

Hawaiian Telephone Company (HTCO) will provide telephone service to the buildings. Empty conduits will be run underground from an HTCO service point on Pahounui Drive to a main telephone cabinet (Main Distribution Frame, MDF) located on the exterior of each building.

2.2.5 Liquid Waste Disposal

There is an 8-inch sewer line in Pahounui Drive and in Sand Island Access road. There is also an existing catch basin at the northwest side of the property along Pahounui Drive. The Department of Wastewater Management of the City & County of Honolulu has indicated that at the present time the sewer collection is inadequate to accommodate the proposed new facility. However, after completion of the Nimitz Highway Relief Sewer Project, tentatively scheduled in April, 1997, the project may be accommodated. A sewer connection application was approved by the Department of Wastewater Management on December 22, 1995. Approximate date of connection is August 1977.

2.2.6 Solid Waste Disposal

Solid waste disposal will be handled by private refuse companies.

2.2.7 Access to Site & Traffic

One new access driveway will be constructed from Sand Island Access Road and from Pahounui Drive. See Figure 4. Pahounui Drive is a City road with curb, gutter and sidewalk. Paving will be designed to handle up to H-20 type vehicles.

Sand Island Access Road is a State roadway with unimproved frontage. The *2020 Oahu Regional Transportation Plan* proposes widening Sand Island Access Road to 6 lanes from Auiki Street to Nimitz Highway between 2001 and 2005. *Bikeplan Hawaii* proposes development of marked bicycle lanes along the road's shoulders. To ensure that planned road widening will not adversely affect the project, the State Department of Transportation (DOT) recommends that buildings be set back ten feet from the existing highway right-of-way.

A traffic assessment was prepared by traffic engineers Phillip Rowell & Associates. The conclusions of the traffic assessment analysis are that the impact of this project is insignificant and no mitigations are required as a result of project generated traffic. The full traffic assessment report can be found in Appendix B of this document.

This final Environmental Assessment includes a revised site plan (since the DEA). These changes are the result of comments received by the Department of Transportation Services (DTS), City & County of Honolulu and the Department of Transportation (DOT), State of Hawaii. DTS recommended that the driveway fronting Pahuounui Drive be eliminated due to its close proximity to the curve in the roadway. This has been done as shown in Figure 4. There is now only one driveway on Pahounui Drive on the mauka end of the property. DOT recommended that buildings be set back ten feet from the highway right-of-way to accomodate future road widening. This change has also been made on the site plan.

2.3 Economic and Social Characteristics

2.3.1 Estimated Cost and Time Phasing of Construction

The estimated cost of the proposed project is approximately $3,000,000, including site work and environmental remediation.

The estimated schedule for the project is sixteen months for Special Management Permit (SMP) processing and approval; six months for building permit processing and approval including Department of Health environmental approvals; six months for site construction; and six months for building construction. This is a total of 34 months from submittal of the SMP application to completion of construction. Construction will be completed in a single phase.

2.4 Environmental Characteristics

2.4.1 Soils

The property soils consist of coralline fill and lagoon sediments at the surface which are underlain by coralline reefal materials (CFC, August 1995). The soils are interspersed with metal, plastic, ash, and glass debris from prior operations.

The property was used from 1951 to 1991 as a metals recycling facility. The operation included an office, a truck scale, a hydraulic metal shear, a battery storage pit, two engine block storage areas, an incinerator, and an underground storage tank. All sources of future contamination have been removed from the property.

Soil and groundwater were investigated for potential contamination from August 1991 to October 1993, the results of which are summarized in a site Risk Assessment Report (CFC, October 1993). Six Contaminants of Concern (COC) were identified by this report prepared by Cotton and Frazier Consultants, Inc. of Honolulu. These were benzo(a)pyrene (BaP), polychlorinated biphenyls (PCB) [as Arochlor 1260], cadmium, copper, lead, and zinc.

Human and other biological receptors may be exposed to these COCs by four potential exposure routes. The first is by the ingestion, inhalation or dermal contact with contaminated surface dirt and dust that is disturbed by wind, vehicular traffic or any of a number of mechanical means. The second is similarly by ingestion, inhalation or dermal contact with disturbed sub-surface soils during property development by construction workers and neighboring properties by the potential fugitive dust created. The third is by consumption or contact with ground water. The forth is by the underground migration of the contaminants in the water table to any nearby surface water body. This exposure route can be further described as those contaminants that are metabolized by the aquatic life and consumed by humans, and the direct exposure of contaminated water to human receptors.

Impact of the contaminants to the closest surface water body, Keehi Lagoon, can be ruled out by calculating the residence time for each COC to migrate the approximate 620 feet. The predicted times ranged from 460,000 years for PCBs to 180,000,000 years for lead (CFC, October 1993). Further, contaminants would be reduced in concentration by bio-degridation, and adsorption while migrating in the soil and ground water before reaching the lagoon. The ground water found under the property is classified by the State of Hawaii, Department of Health (DOH) as being a non-drinking water source.

Copper and zinc were removed from the list of COC due to having a concentration less than the calculated reference dose for absorption, inhalation, and oral exposure to contaminated soils. When the more representative average concentrations for BaP and PCB are used the excess lifetime cancer risk drops to a maximum of 7.5×10^{-6} and 3.0×10^{-6} respectively. This represents 7.5 and 3 additional cancer cases in 1,000,000 exposed persons (CFC, October 1993). These risks are associated with the exposure to the sub-surface soils. Additionally cadmium only had a slightly elevated risk to transient workers if the soil was disturbed. By prohibiting any soil excavation on the property without protective measures to limit direct exposure this threat can be effectively mitigated.

Contamination of the surface soils by lead is of particular concern because of the elevated concentrations averaging 3,990 milligrams per kilogram soil (mg/kg) and its uniform distribution over the site. The threat to permanent and transitory workers can be minimized by removing the exposure of contaminated soils to the workers by remediation or establishing a barrier between the two. Because this property is planned to become a multiple user warehouse, a barrier cap is the most economical of these options so long as measures are taken to guarantee the safety of any future workers who may remove this cap and be exposed subsequently.

Free floating oil was removed by CFC from three exploratory trenches in February and March of 1993 but additional sampling and consultation with DOH revealed the need for further remediation (Miyasaka, November 1995). A layer of free product oil remains in two plumes above the water table at this property. One of lite oil, thought to be from hydraulic oil, and one of heavier motor oil and diesel fuel from the storage of engine blocks. The health risk posed by the oil contamination is considered to be small, but due to the relative ease of removing this contamination by excavation and on island thermal desorption, it was highly recommended by the DOH that the lite oil plume be further remediated (Miyasaka, December 1995). The heavier oil plume posses little or no threat of migration and should be left in place to self remediate. Measures should be taken such that the lead contamination in the surface soils are not dispersed into the surrounding environment while this remedial operation is performed. See 5.0 Mitigation Measures for a detailed description of these measures.

CFC, Risk Assessment Report for 120 Sand Island Access Road, October 22, 1993.
CFC, Free Product Delineation Report for 120 Sand Island Access Road, August 29, 1995.
Ernest K. Hirata & Associates, Inc., Foundation Investigation Flynn Learner Warehouses, 120 Sand Island Access Road, Honolulu, HI, October 4, 1995.
Miyasaka, Michael, DOH-HEER, phone conversation November 29, 1995.
Miyasaka, Michael, DOH-HEER, phone conversation December 14, 1995.

2.4.2 Topography

Site elevation varies between 5 and 7 feet above mean sea level (MSL). The ground surface of the region is nearly flat, but the site has a very slight slope to the west. The site is located on the western flank of the Koolau shield volcano on the Honolulu plain, an elevated coral reef. Much of the land in the vicinity, including the subject site, is composed of built-up land fill. The site itself is underlain by silty sand fill material and lagoon clay sediments, which are in turn underlain by a silty sand, then coralline reefal materials with alluvial soils and then with depth, volcanic rock. Regional groundwater flow direction is from the mountains to the sea. The nearest natural bodies of water are Keehi Lagoon to the west and the Pacific Ocean to the south. There are no other major topographic features in the vicinity.

2.4.3 Surface Runoff, Drainage, and Erosion Hazard

Presently the site is "depressed", being slightly lower than the adjacent grades along both Pahounui Street and Sand Island Access Road frontages. Stormwater runoff is currently contained on site and any overflow is directed to the southeast corner and onto Sand Island Access Road. The proposed project's new condition with impervious paving and paved parking will greatly increase surface runoff. The project civil engineers' understanding is that the City now requires a "no increase in runoff" condition from the project site. This will require collection of stormwater runoff from roofs and pavement to be collected into an underground retention system. The system will be designed to hold the one-hour 10-year rainfall and to dissipate it off-site by surface flow into the perimeter planters and at the driveways.

2.4.4 Hazards

The federal Flood Insurance Rate Map (FIRM) for the area indicates that the site is in Zone X (areas of 500-year flood). According to the current Civil Defense Tsunami Evacuation Map for the vicinity, the project site is not located in a tsunami inundation area.

Surface soils are contaminated with an average lead concentration of 3,990 mg/kg. Lead can affect the gastrointestinal tract, central nervous system, kidneys, gingival tissues, and the eyes (NIOSH, June 1994) from acute or chronic exposure, therefore, best management practices should be used while handling the contaminated soil. The DOH considers the concentrations of lead on the property to be sufficiently high enough to require mitigation measures to limit exposure to human receptors (Miyasaka, November 1995).

National Institute for Occupational Safety and Health, NIOSH Pocket Guide To Chemical Hazards, June 1995.
Miyasaka, Michael, DOH-HEER, phone conversation November 29, 1995.

3.0 AFFECTED ENVIRONMENT

3.1 Surrounding Area

3.1.1 Description of Surrounding Area

Sand Island Access Road is located within the Kalihi industrial district, an area dominated by industrial and commercial properties, with only a small residential population. The closest residence to the site is 1/2 mile up gradient and upwind across Nimitz Highway to the north. The nearest school, Puuhale Elementary, is also 1/2 mile up gradient and upwind across Nimitz Highway.

3.1.2 Description of Subject Site in relation to Surrounding Area

The project site is completely surrounded by industrial and commercial activities. Even though it lies just 600 feet from the water line, it is blocked in both access and view from Keehi Lagoon by the Ameron Cement facility.

3.1.3 Existing Surrounding Land Uses

All adjacent properties are in industrial use. A.L. Kilgo Co., a large building supply adjoins the property to the north. Ameron Cement, a cement storage and transfer facility is located to the west between the site and Keehi Lagoon; McKesson Industrial complex is to the south; and Empire Pacific Industries, an industrial complex is to the east. The US Post Office maintenance facility and Kapalama Military Reservation are located south of the site. Various other retail and industrial businesses occupy the other adjoining properties.

3.1.4 State Land Use Designation

The State land use designation for the property is "Urban."

3.1.5 Development Plan Designation

The City & County of Honolulu Development Plan designation for the site is "Industrial."

3.1.6 Zoning

The City & County of Honolulu's zoning designation for the property is "I-2." According to the Land Use Ordinance, The intent of the I-2 intensive industrial district is to set aside areas for the full range of industrial uses necessary to support the city." Warehousing is one of the principal uses allowed under this zoning category.

3.2 Project Site in Relation to:

3.2.1 Publicly owned or used Beaches, Parks and Recreation Areas

The closest public recreation areas to the project site are Keehi Lagoon Beach Park to the northwest across Keehi Lagoon, and Sand Island State Recreation Area located on the southeastern end of Sand Island. See Figure 2.

3.2.2 Rare, Threatened or Endangered Species and their Habitats

There are no known rare, threatened or endangered species on the project site or in the immediate vicinity. However, the Fish and Wildlife Service of the U.S. Department of the Interior has noted that migrating shorebirds, waterfowl and the endangered Hawaiian stilt (*Himantopus mexicanus knudseni*) use Keehi Lagoon, the closest water body to the proposed project site. For this reason they believe that monitoring of the diesel and motor oil plume is particularly important This comment is also applicable to Section 3.2.3 below.

3.2.3 Wildlife and Wildlife Preserves

There are no wildlife or wildlife preserves on the project site or in the immediate vicinity.

3.2.4 Wetlands, Lagoons, Tidal Lands and Submerged Lands

Keehi Lagoon lies approximately 600 feet from the project site. Several small wetland areas northwest of the site on the State-owned fill area are known to exist and are dominated by stands of red mangrove . These areas provide nursery grounds and protective habitat for fish and shoreline invertebrates. The proposed project is not likely to have an impact on these areas since other industrial properties across Pahounui Drive block access between the site and Keehi lagoon.

3.2.5 Fisheries and Fishing Grounds

Keehi Lagoon has long been used as a fishing ground by casual fishermen, however it is not considered a major fishing ground.

3.3 Historic, Cultural, and Archaeological Resources

There are no known historic, cultural, or archaeological resources on the project site. Due to intensive industrial use of the property over the years, such resources are unlikely to exist. The site is not listed on the State or National Register of Historic Places. However, it is believed that the site is situated proximal, if not on, historic sites documented by Elspeth Sterling and Catherine C. Summers in the Sites of Oahu (Bernice Pauahi Bishop Museum Press, 1978). During site preparation, if any artifacts are encountered, the State Historic Preservation Division of the Department of Land and Natural Resources will be contacted.

3.4 Views

Distance from the site to Keehi Lagoon and location of adjacent existing structures and facilities preclude any significant views to or from the project site. The Coastal View Study prepared for the Department of Land Utilization in 1987 does not indicate significant views to or from the vicinity of the project site.

3.5 Quality of Receiving Waters and Ground Water

First encountered groundwater beneath the site is largely influenced by local tides. It is roughly at the elevation of the nearest body of surface water, Keehi Lagoon. Keehi Lagoon normally fluctuates between 0.5 and 1.5 feet AMSL, making the depth to first encountered water between 3.5 and 6.5 feet beneath the ground surface depending on the location on the site. The State of Hawaii Department of Land and Natural Resources (DLNR) classifies the first encountered groundwater as being used as a non-drinking water source with no ecological importance.

The site lies within the Kalihi hydrogeologic unit on the ocean side of the State of Hawaii Department of Health Underground Injection Control line, indicating that the near surface groundwater of this site is not a potential source of drinking water. However, the moderately salty water of this unit is occasionally used for industrial purposes.

There is only one well recorded with DLNR to be located within 1/2 mile of the site. Well 1953-02 is almost 1/2 mile cross-gradient to the site and is not currently in use. Other than well no. 1953-02 there are no other apparent down gradient receptors which could lead to exposure by humans other than the surface water of Keehi lagoon.

4.0 PROJECT IMPACTS

4.1 Positive Impacts

4.1.1 Business/Economic Benefits

In the short-run, the project will provide employment and contracting opportunities for the construction industry of Oahu. The project will also increase the stock of available warehouse space for small and medium sized businesses who require storage space in the industrial district.

4.1.2 Social Benefits

The project will improve the appearance of the neighborhood by providing an attractive landscaped facility in the industrial district. The new facility will make good use of a large tract of land which has become unsightly due to disuse and lack of maintenance. Through encapsulation, the new warehouses, new paving, and landscaping will remove the potential hazard to public health caused by airborne transport or direct contact with contaminated soil and debris.

4.2 Negative Impacts

4.2.1 Construction Impacts

Negative impacts are expected due to construction activity. These will be short-term in nature and will last only for the duration of the construction period. The likely negative impacts would affect air quality and noise quality. Construction vehicle activity will increase automotive pollutant concentrations in the vicinity of the project site as well as on traffic routes from the vehicles' home base. On-site stationary and mobile construction equipment will contribute to excess exhaust emissions. Fugitive dust emissions are likely to increase during the construction period. Construction related noise will also constitute a negative impact and, in the short-run, construction activity will increase the amount of traffic to and from the site. Short-term soil erosion may become a problem during construction.

4.2.2 Long Term Negative Impacts

There are no long term negative impacts anticipated as the result of the proposed project. The contaminated soils described in forgoing sections of this environmental assessment are an existing condition caused by past use of the site, and will be mitigated by construction of the proposed project and its new use of the property.

4.3 Alternatives

4.3.1 No Action Alternative

The no action alternative (e.g. leaving the site unused in its present condition) is deemed unfeasible and undesirable for the general public, the business community, the applicant and the landowner. No action would mean a continuation of potential hazard to human health due to the unmitigated soil contamination. No action would deprive the business community of a desired use of industrial land, and no action would mean continued loss of revenue for the applicant and land owner.

4.3.2 Other Alternatives

Because of the site's location in Kalihi-Kai which has a long history of industrial and commercial activity, any other use of the property other than industrial would not be feasible. County and state plans call for continued industrial use of the area in the foreseeable future. Other industrial uses were considered, however, market studies indicated that the highest and best use of the property would be warehousing.

5.0 MITIGATION MEASURES

5.1 Existing Soil Contamination - Long Term Mitigation

Three mitigation measures were proposed by Cotton and Frazier Consultants, Inc. (CFC) in their *Remedial Alternatives Analysis* report dated January 25, 1995. They were: 1) a cap applied on the site to modified RCRA specifications, 2) integration of site buildings with a modified cap with out treatment of soils, and 3) in-situ treatment of the soils on site.

The modified cap option would mitigate the lead exposure to permanent workers and neighboring properties by isolating the contaminated soil. It would however limit future development of this property by placing restrictions on the disruption of the sub-grade soils. Additionally, the cap would need to be inspected and repaired as needed on a periodic basis. During construction, mitigation of short term exposure to workers and neighboring properties would need to be addressed .

By integrating the cap with the structures on site, a portion of the cap construction costs can be transferred to the cost of constructing the structures while retaining the benefits of mitigating the lead exposure to permanent workers and neighboring properties. Similarly, the cap would need periodic inspection and short term exposure mitigation measures would need to be implemented during construction.

In-situ treatment of the contaminated soils would effectively mitigate the exposure to lead. The additional benefit to this option over capping would be to allow future development of this property with fewer restrictions. This option would be substantially more costly than the other two, $970K compared to $550K and $185K (CFC, January 1995), but has no annual costs due to the inspection and maintenance. Additionally, The soil volume would be increased by an estimated 20 to 30 percent of its original volume (CFC, January 1995). During treatment operations, additional measures would need to be taken beyond those implemented during capping, to ensure workers on site and neighboring properties are not put at additional risk by contaminated soils being disturbed due to the nature of the solidification processes.

All three options are anticipated to be acceptable by the DOH and the general public. Based on a systematic review of available options and a comparative analysis of remedial action alternatives, Cotton and Frazier Consultants, Inc. recommended pursuing the second option, integration of a permanent site cap into redevelopment of the site. They further recommended that all contaminated soils be impounded on site, including soils disturbed by site improvement construction. To facilitate this, they recommended that a qualified engineering firm design a integrated site cap into redevelopment of the site. See Figure 7 for an illustration of the recommended design basis.

The Hazard Evaluation and Emergency Response Office (HEER) of the Department of Health (DOH), State of Hawaii, reviewed Cotton and Frazier's Remedial Alternatives Analysis of the subject property. In a letter of June 15, 1995, DOH stated that "The HEER Office concurs with the use of the remedial alternative of the integrated structures and modified cap over the site to protect human health and the environment. In general, we concur with your proposal to eliminate the risk caused by the lead by capping the contaminated soil."

In the same letter HEER also requested that the consultants further investigate the areas where free floating oils were found and determine the extent of the free floating oil, to include offsite areas if required, and to remove as much of the oil as possible. In compliance with this request, Cotton and Frazier completed the *Free Product Delineation Report - Location: Flynn-Learner, 120 Sand Island Access Road, Honolulu, HI, August 20, 1995.*

The results of this study led the consultants to make a further remedial action recommendation. "Cotton and Frazier recommends removal of the hydraulic oil impacted soils by excavation. Unimpacted surface soils down to approximately four feet should be excavated and set aside. The discrete zone of product contaminated soils can then be excavated and transported for proper disposal, followed by returning the clean surface soils to the excavation. Such work should consider the previously-identified hazards posed by other contaminants in the surface materials. Further, we recommend regular monitoring of the diesel and motor oil plume to assess its migration and natural attenuation by biologic activity. This can be accomplished by a series of permanent groundwater and soil gas monitoring points to be installed in conjunction with the site cap."

CFC, *Remedial Alternatives Analysis for 120 Sand Island Access Road,* January 25, 1995.
CFC, *Free Product Delineation Report for 120 Sand Island Access Road,* August 29, 1995.

5.2 Construction Mitigation Measures

5.2.1 Air Quality

Measures to control equipment and dust emissions are required according to the Department of Health's Public Health Regulations on Air Pollution Control (State of Hawaii). These measures are particularly important due to the lead contamination in the soils on the property. Equipment emissions can be minimized by proper maintenance of all vehicles and equipment. Dust emissions can be minimized by strict adherence to State air pollution control standards by proper engineering controls.

5.2.2 Noise Quality

Audible construction noise will probably be unavoidable during the entire project construction period. Adverse impacts from construction noise, however, are not expected to be in the "public health and welfare " category due to the temporary nature of work and the administrative controls available for its regulation. The contractor will be required to obtain a noise permit if noise levels are expected to exceed allowable levels as specified in the State Department of Health's Public Health Regulations, Title 11, Chapter 43. The contractor is responsible for properly maintaining construction equipment to minimize noise levels. All internal combustion engines will be required to have mufflers or other noise suppression devices in proper working order. Heavy vehicles required for construction must comply with the State Department of Health's regulations for vehicular noise control.

5.2.3 Soil Contamination - Short-term Risk Abatement

Any construction worker employed at the site runs the greatest risk of impact to their health due to exposure to site soils. In order to mitigate any incidental ingestion and dermal contact, the following precautions should be exercised during construction at the site:

(a) All workers wear respiratory protection (half-face masks).

(b) All workers minimize their exposed skin (boots, long pants, long-sleeved shirts, gloves, safety goggles, and hard hats).

(c) No food be consumed on-site.

(d) Best management practices be employed for the control of dust and erosion (frequent wetting of surface soils, gravel construction entrance and roads, proper erosion control measures).

5.2.4 Erosion

During construction, temporary sediment fences will be constructed around the perimeter of the site. Temporary gravel pads at construction access points will be provided. Erosion and dust control measures will be enforced, and all exposed grade areas will be immediately planted with ground cover.

6.0 DETERMINATION

The proposed action is not expected to cause significantly adverse long-term impacts to the environment. Through the encapsulation of contaminated soil, the project will, in fact, remediate existing site conditions which potentially pose a threat to human health. Therefore, it has been determined that a negative declaration for its construction should be filed.

7.0 FINDING AND REASONS SUPPORTING THE DETERMINATION

7.1 The construction of new warehouse facilities and site work will not involve an irrevocable commitment to loss or destruction of any natural or cultural resources.

7.2 The project does not conflict with any County or State environmental or planning policies.

7.3 The project does not adversely affect the economic and social welfare of the City & County of Honolulu or the State of Hawaii.

7.4 The project will not generate secondary impacts on population or public facilities.

7.5 The project will not cause a substantial degradation of environmental quality.

7.6 The project will not affect any rare, threatened or endangered specie of flora or fauna. No endangered flora or fauna are known to exist on the proposed site.

7.7 The project will not adversely affect air or water quality, or the ambient noise environment of the area except in the short-run during construction.

For the reasons cited above, the proposed project will not have any significant negative environmental effect in the context of Chapter 343, Hawaii Revised Statutes and section 11-200-12 of the State Administrative Rules.

References

Chu, Michael S., and Robert B. Jones. 1987. *Coastal View Study (Prepared for: City & County of Honolulu, Department of Land Utilization).* Honolulu, Hawaii.

Cotton and Frazier Consultants, Inc. October 22, 1993. ***Risk Assessment Report For:** Flynn Learner, Location: 120 Sand Island Access Road, Honolulu, Oahu, Hawaii.* Honolulu, Hawaii.

Cotton and Frazier Consultants, Inc. January 25, 1995. ***Remedial Alternatives Analysis** For: Flynn Learner, Location: 120 Sand Island Access Road, Honolulu, Oahu, Hawaii.* Honolulu, Hawaii.

Cotton and Frazier Consultants, Inc. August 29, 1995. ***Free Product Delineation Report** For: Flynn Learner, Location: 120 Sand Island Access Road, Honolulu, Oahu, Hawaii.* Honolulu, Hawaii.

Hirata, Ernest K. & Associates, Inc. October 4, 1995. ***Foundation Investigation** Flynn Learner Warehouses 120 Sand Island Access Road, Honolulu Hawaii TMK 1-2-23: 9.* Honolulu, Hawaii.

Kusao, Tyrone T., Inc. December 1991. *Environmental Assessment Report for Proposed 24-Lot Industrial Subdivision at 248 Sand Island Access road TMK 1-2-21:13, Applicant: Sen Plex Corporation.* Honolulu, Hawaii.

State of Hawaii, Department of Health, Hazard Evaluation and Emergency Response Office (HEER). June 15, 1995. Letter to James C. Banigan, Flynn Learner, from Steven S. Armann (HEER Office Acting Manager). RE: Remedial Alternatives Analysis for the Flynn Learner site located at 120 Sand Island Access Road. Honolulu, Hawaii.

Project Consultants

The following project consultants contributed technical information in their respective fields of expertise to this environmental assessment:

Architects
Sueda & Associates, Inc.
905 Makahiki Way
Honolulu, Hawaii 96826-2869

Environmental Consultants
Cotton and Frazier Consultants, Inc.
P.O. Box 27126
Honolulu, Hawaii 96827

Civil Engineers
Hida, Okamoto & Associates, Inc.
The Commerce Tower, Suite 915
1440 Kapiolani Boulevard
Honolulu, Hawaii 96814

Soils and Foundation Engineers
Ernest K. Hirata & Associates, Inc.
99-1433 Koaha Place
Aiea, Hawaii 96701-3279

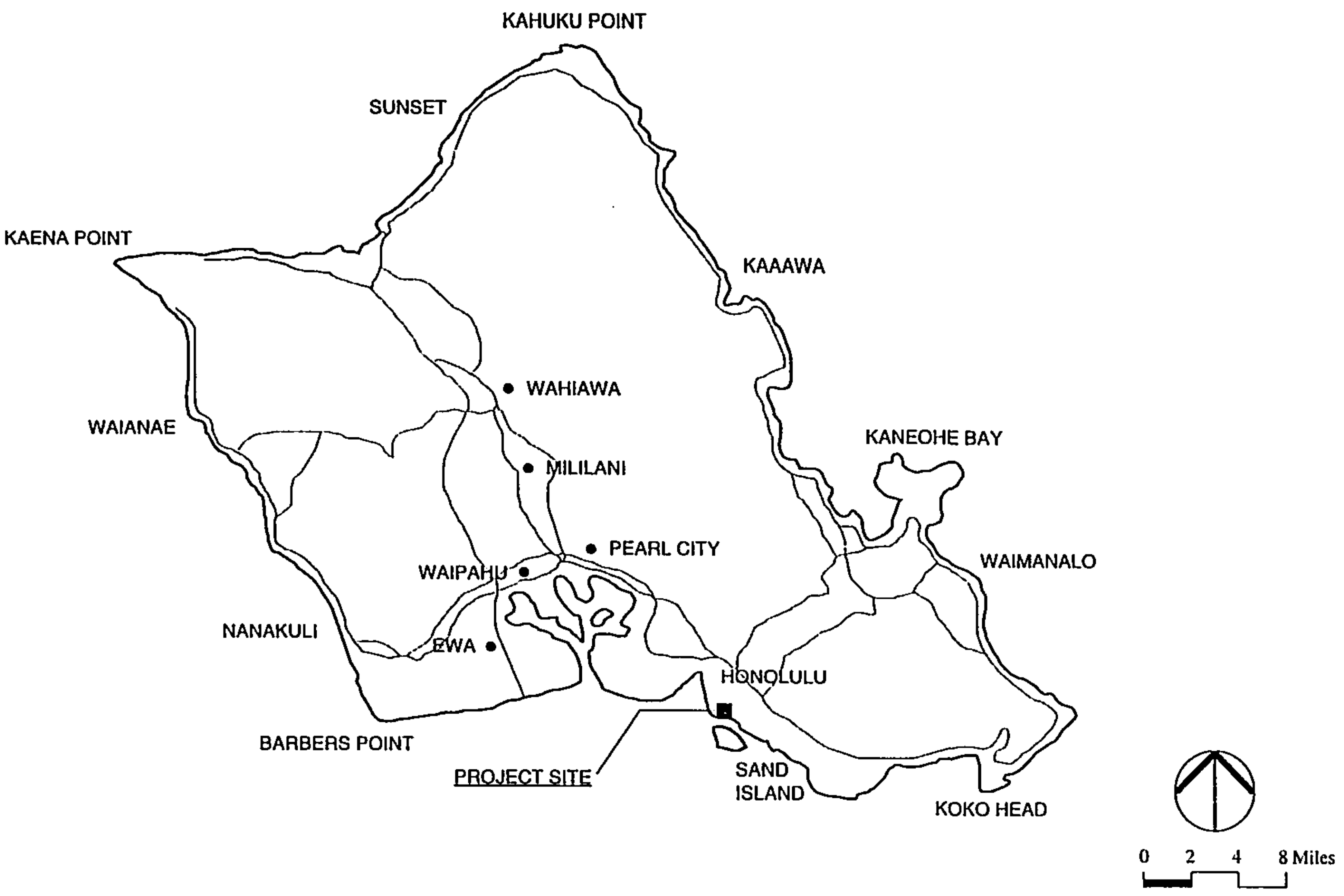
Landscape Architects
Brownlie & Lee
201 Merchant Street, Suite 1920
Honolulu, Hawaii 96813

Mechanical Engineers
Prepose Engineering Systems, Inc.
1314 South King Street, Suite 860
Honolulu, Hawaii 96814

Electrical Engineers
Itano & Associates, Inc.
1505 Dillingham Boulevard, Suite 301
Honolulu, Hawaii 96817

Traffic Engineers
Phillip Rowell and Associates
47-273 'D' Hui Iwa Street
Kaneohe, Hawaii 96744

FIGURES



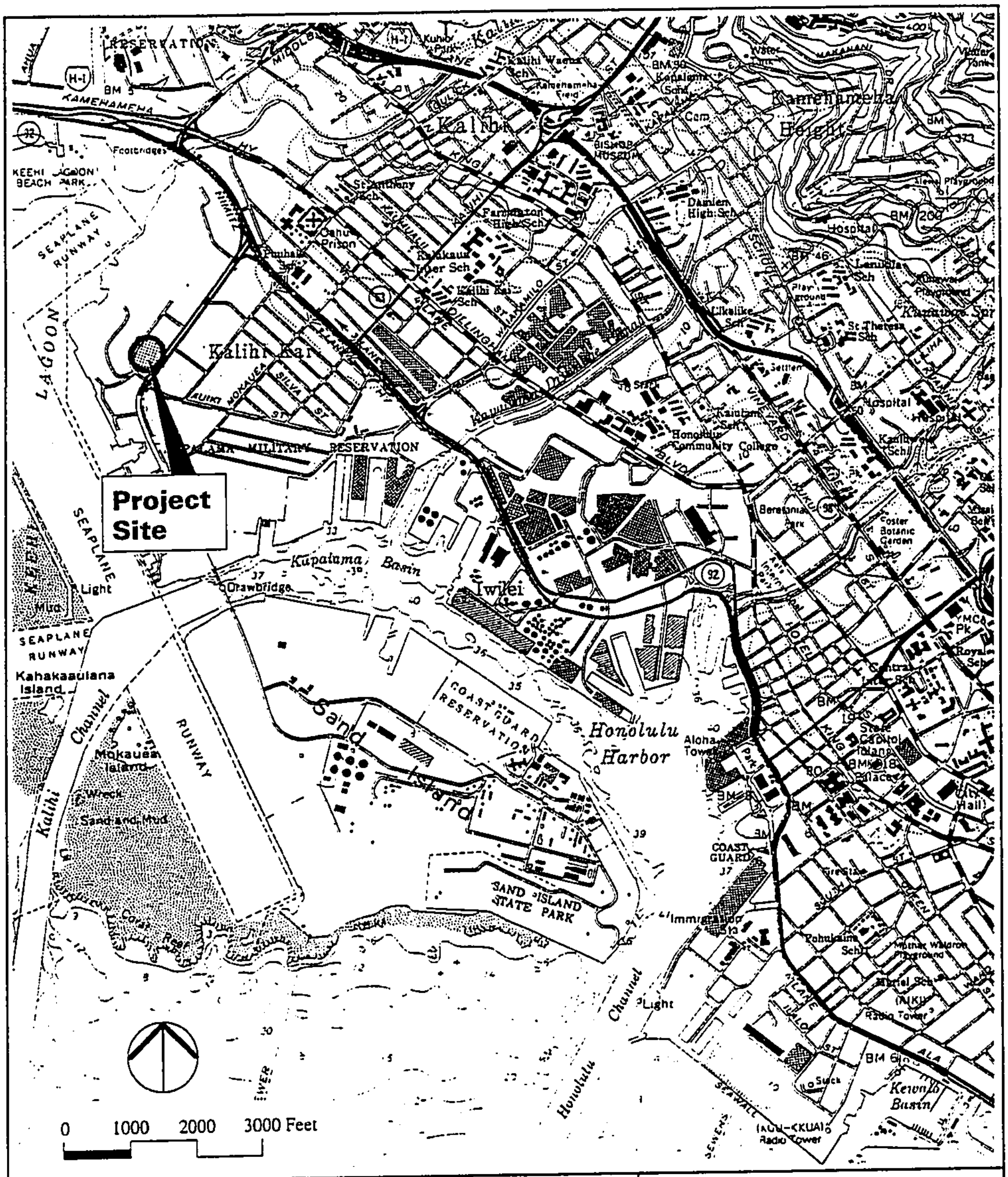
Prepared for:
Sueda & Associates, Inc.

Prepared by:
Wil Chee - Planning, Inc.
Honolulu, Hawaii

Figure 1

ISLAND MAP

ENVIRONMENTAL ASSESSMENT
Flynn Learner Warehouses
120 Sand Island Access Road
TMK 1-2-23:9



Prepared for:
Sueda & Associates, Inc.

Prepared by:
Wil Chee - Planning, Inc.
Honolulu, Hawaii

Figure 2

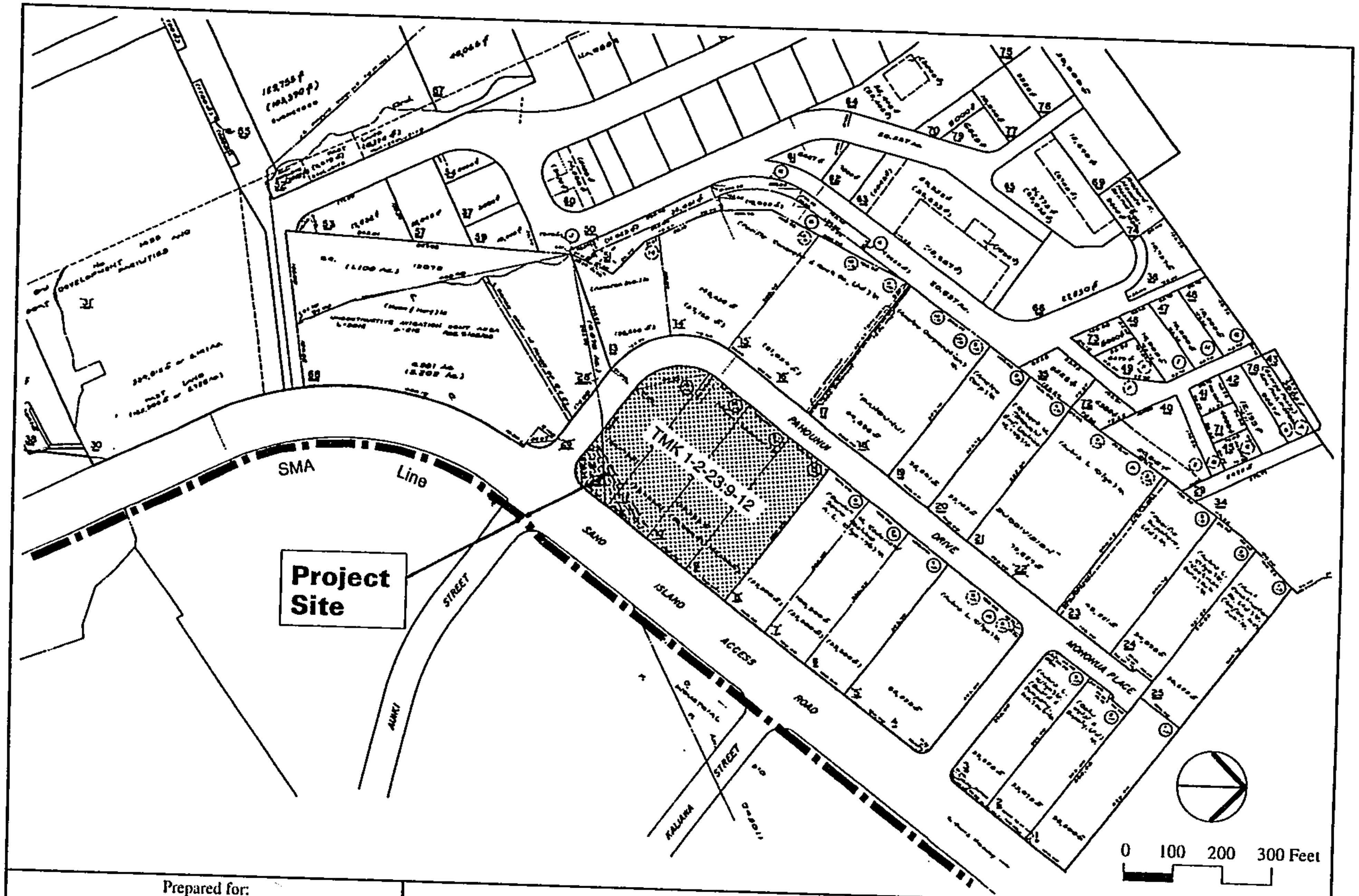
VICINITY MAP

ENVIRONMENTAL ASSESSMENT

Flynn Learner Warehouses

120 Sand Island Access Road

TMK 1-2-23:9



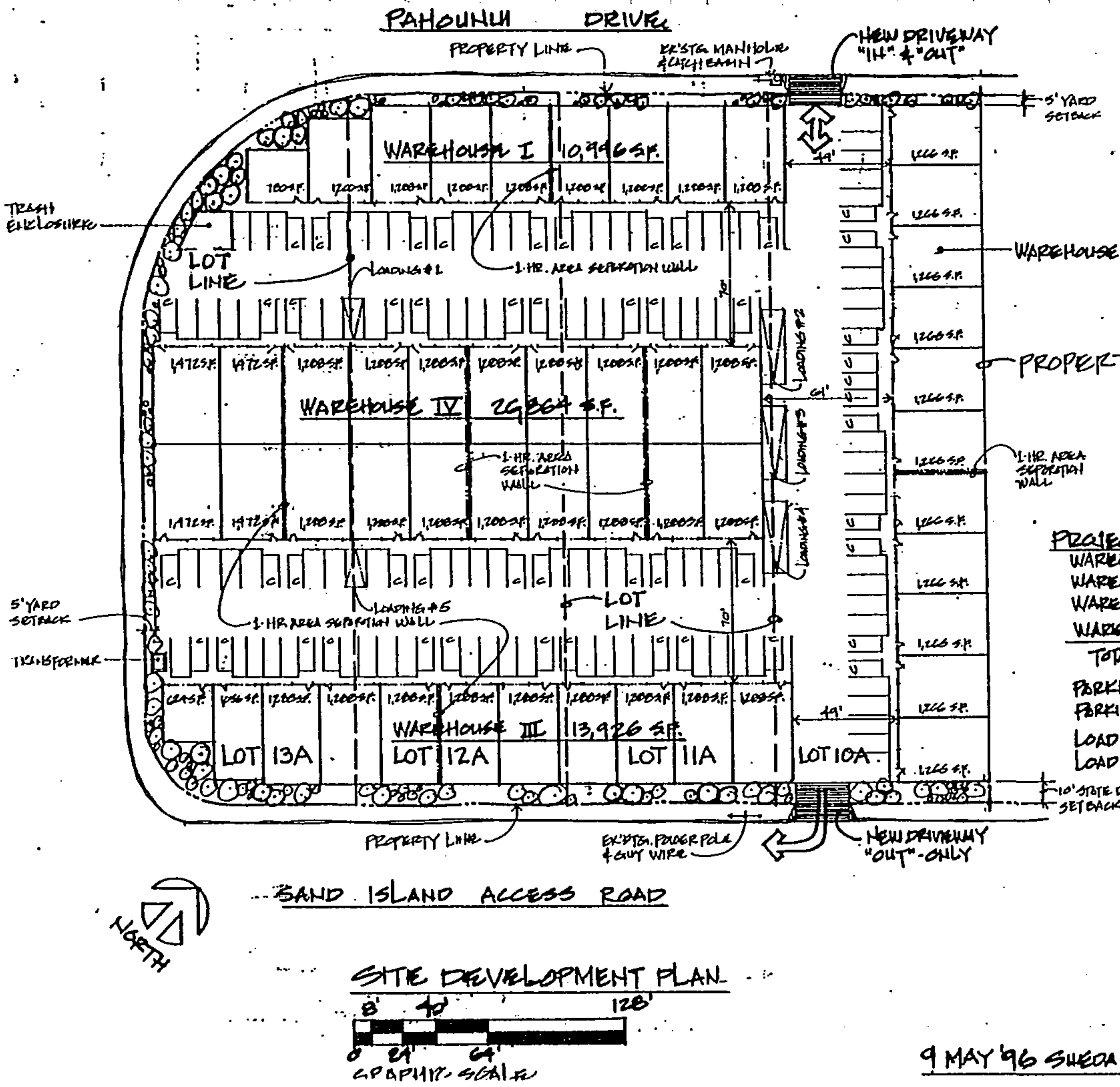
Prepared for:
Sueda & Associates, Inc.

Prepared by:
Wil Chee - Planning, Inc.
Honolulu, Hawaii

Figure 3

LOCATION MAP

ENVIRONMENTAL ASSESSMENT
Flynn Learner Warehouses
120 Sand Island Access Road
TMK 1-2-23:9



SITE DEVELOPMENT PLAN

PROJECT DATA:

WAREHOUSE I	10,946 S.F.
WAREHOUSE II	13,606 S.F.
WAREHOUSE III	13,926 S.F.
WAREHOUSE IV	26,864 S.F.
TOTAL FLOOR AREA	65,342 S.F.

PARKING REQ'D.: 68 STALLS
PARKING PROVIDED: 91 STD. + 49 C = 140 STALLS
LOADING ZONE REQ'D: 5
LOADING ZONE PROVIDED: 5

ENVIRONMENTAL ASSESSMENT

Flynn Learner Warehouses

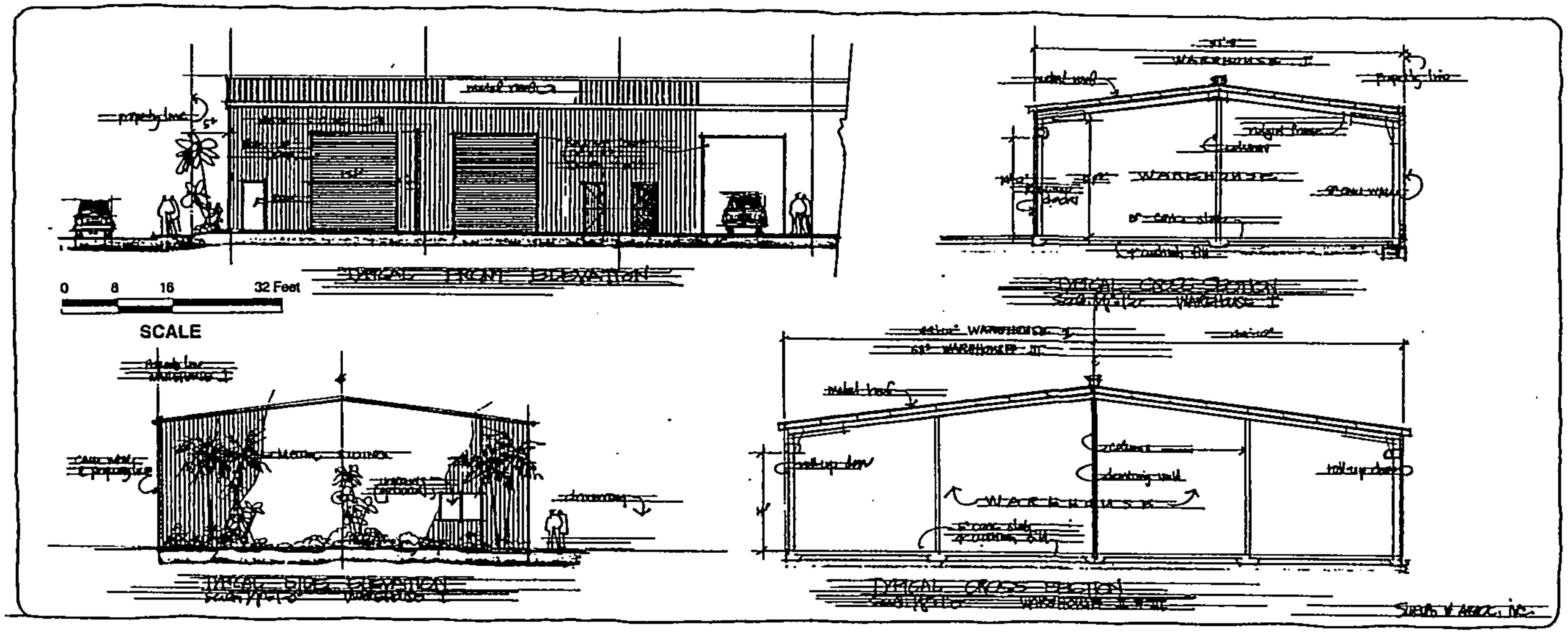
120 Sand Island Access Road

TMK 1-2-23:9

Figure 4

SITE/BUILDING PLAN

9 MAY '96 SUEDA & ASSOCIATES, INC.



ENVIRONMENTAL ASSESSMENT

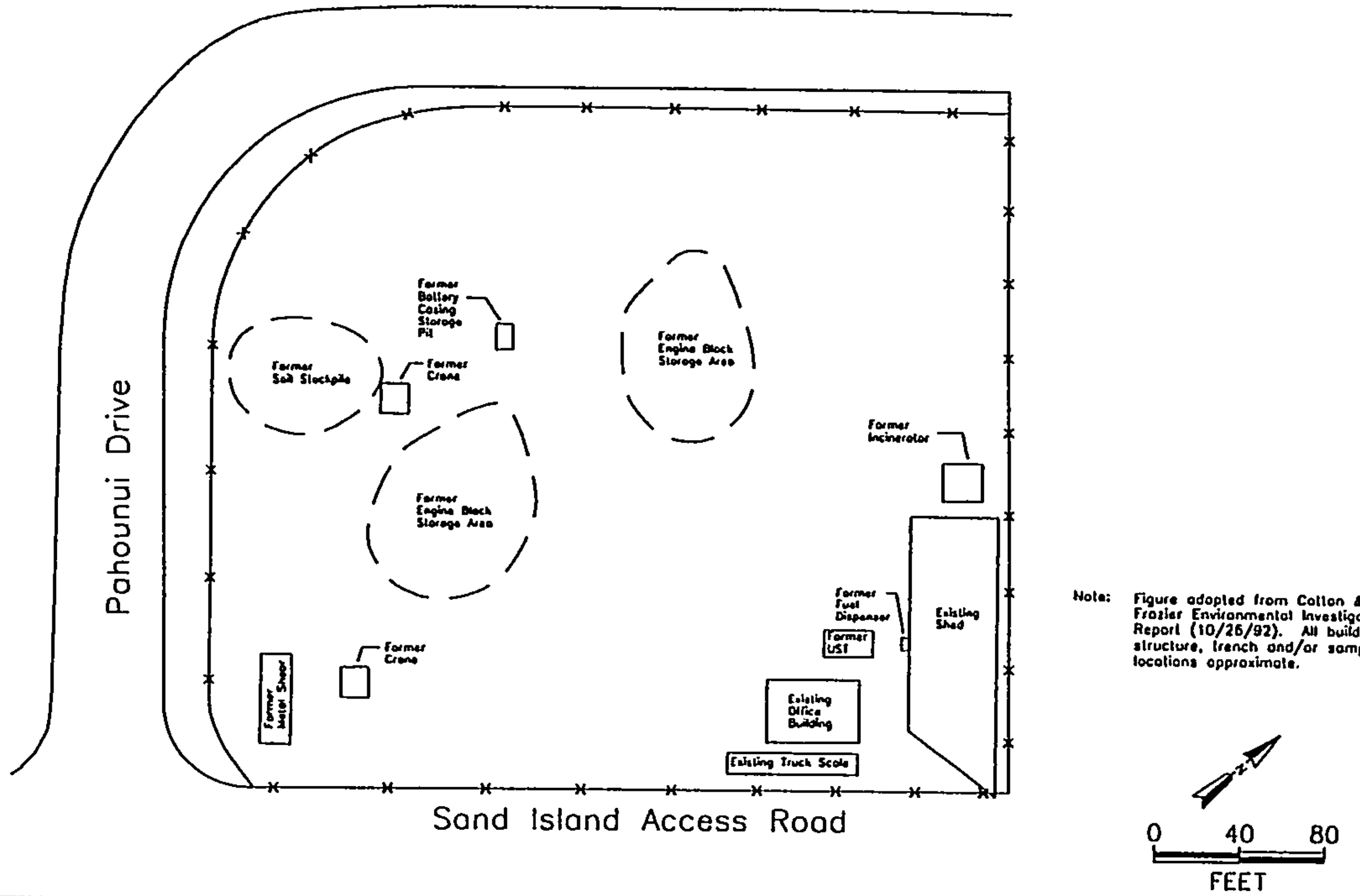
Flynn Learner Warehouses

120 Sand Island Access Road

TMK 1-2-23:9

Figure 5

BUILDING
ELEVATIONS/SECTION



Note: Figure adopted from Cotton & Frazier Environmental Investigation Report (10/26/92). All building, structure, trench and/or sample locations approximate.

Cotton and Frazier Consultants, Inc.
© 1990
Environmental Solutions

TITLE:
SITE LAYOUT
Flynn-Learner Site
Honolulu, Hawaii

DWN: GAM	DES:	PROJECT NO.: 93064
CHKD: LRC	APPD: WMF	FIGURE NO.: 2.1
DATE: 1-20-95	REV: 1	

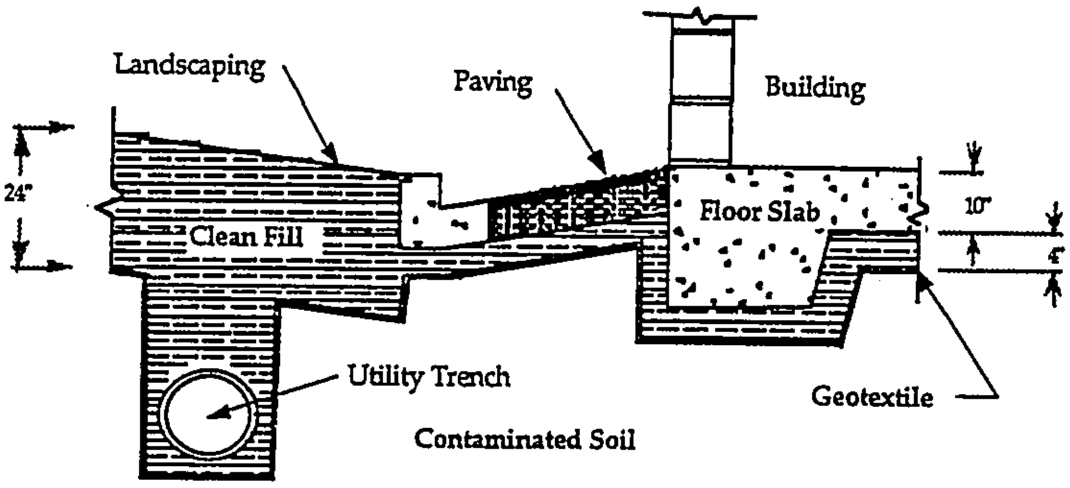
Prepared for:
Sueda & Associates, Inc.

Prepared by:
Wil Chee - Planning, Inc.
Honolulu, Hawaii

Figure 6

EXISTING SITE PLAN

ENVIRONMENTAL ASSESSMENT
Flynn Learner Warehouses
120 Sand Island Access Road
TMK 1-2-23:9



Recommended Integrated Cap Design Basis

Remedial Alternatives Analysis
Flynn-Learner Sand Island Site
CF Job # 93064

COTTON and FRAZIER Consultants, Inc.
Environmental Solutions

Prepared for: Sueda & Associates, Inc. Prepared by: Wil Chee - Planning, Inc. Honolulu, Hawaii	Figure 7 INTEGRATED CAP DESIGN BASIS	ENVIRONMENTAL ASSESSMENT **Flynn Learner Warehouses** 120 Sand Island Access Road TMK 1-2-23:9

APPENDIX - A

Correspondence, Comments & Responses

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O. BOX 3378
HONOLULU, HAWAII 96801

LAWRENCE MIIKE
DIRECTOR OF HEALTH

In reply, please refer to:
HEER OFFICE

June 15, 1995

95-160-MM

Mr. James C. Banigan
Flynn-Learner
91-056 Hanua Street
Eva Beach, Hawaii 96707

Dear Mr. Banigan:

The Department of Health Hazard Evaluation and Emergency Response Office (HEER) has reviewed the Remedial Alternatives Analysis for the Flynn Learner site located at 120 Sand Island Access Road. The HEER Office concurs with the use of the remedial alternative of the integrated structures and modified cap over the site to protect human health and the environment. In general, we concur with your proposal to eliminate the risk caused by the lead by capping the contaminated soil.

We are requesting that you submit to us the design and construction plans for the integrated cap, which shall include the installation of groundwater monitoring wells, along with a management plan for the cap and an operations and maintenance plan for the monitoring wells. A health and safety plan for construction workers installing the cap or any structures built on the site should also be submitted. We are also requesting that a time schedule be submitted on the installation of the integrated cap.

The HEER Office feels that the investigation that was done to locate and remove the free floating oils on the site was not sufficient or fully completed. Before the integrated cap can be installed, we are requesting you to further investigate the areas where free floating oils were found and determine the extent of the free floating oil, to include offsite areas if required, and to remove as much of the oil as possible. We ask that you submit to us for review your plans for the investigation and for the removal of the free floating oil.

We are also requesting that you:

1. Remove all vehicles that are on the site and insure that no lead contaminated soil is tracked off the site on the vehicle tires.
2. Repair the fencing and gates on the site to provide proper security which will prevent people from going onto the site.
3. Post warning signs every 100 feet around the perimeter fencing to inform the public of the hazard posed by the lead contaminated soil on site.
4. Install a temporary cap on the site to prevent the lead contaminated soil from getting airborne and blowing off the site. Also submit the design plans for the temporary cap to to our office for review prior to installation.

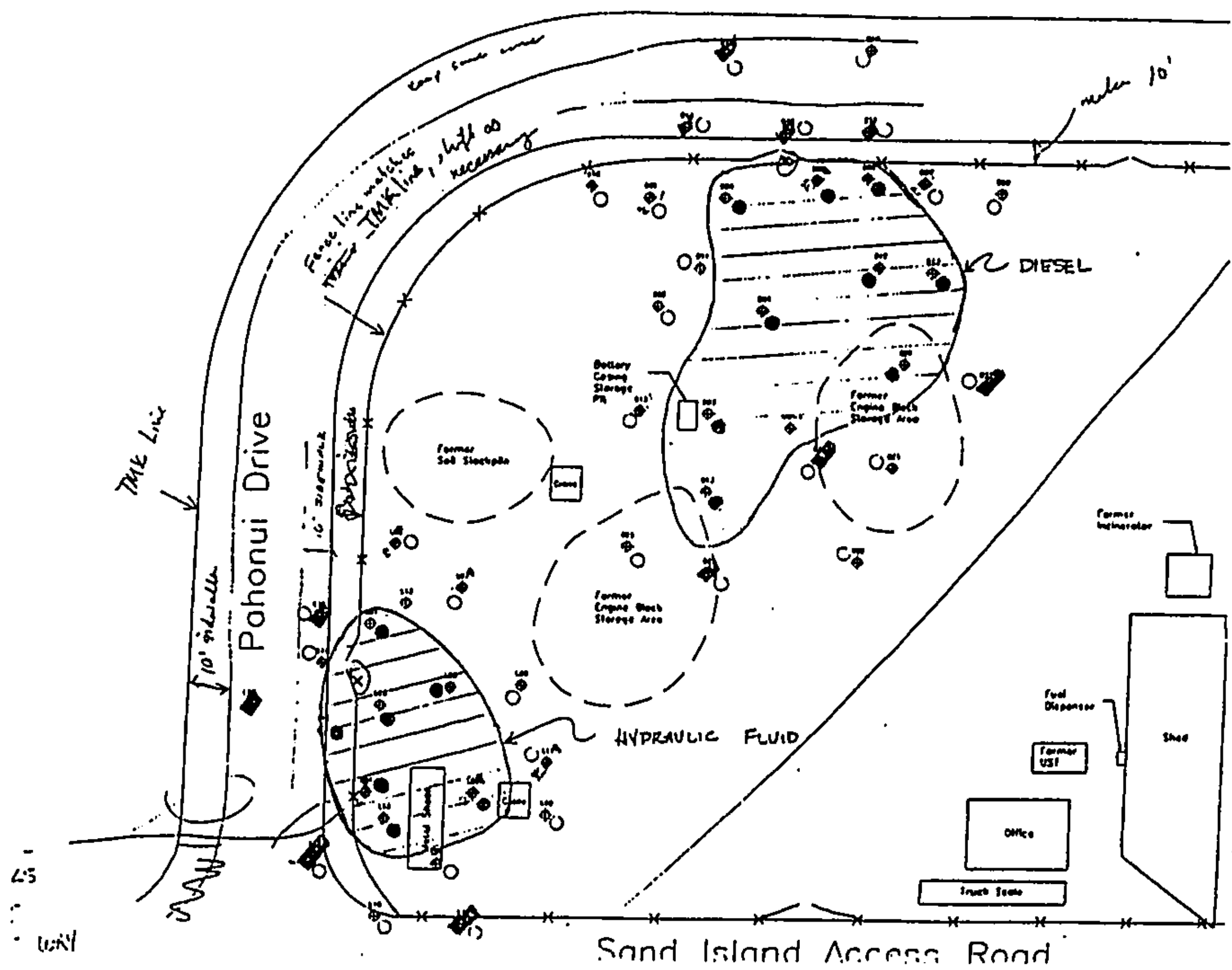
Since hazardous lead contaminated soil will be left in place on the site, we are investigating the need for a deed restriction to be placed on the property identifying the presence of hazardous lead contaminated soil and the requirement to have a properly maintained cap over the contaminated site.

Should you have any questions on the information covered in this letter, please contact Mr. Michael Miyasaka at 586-4698.

Sincerely,

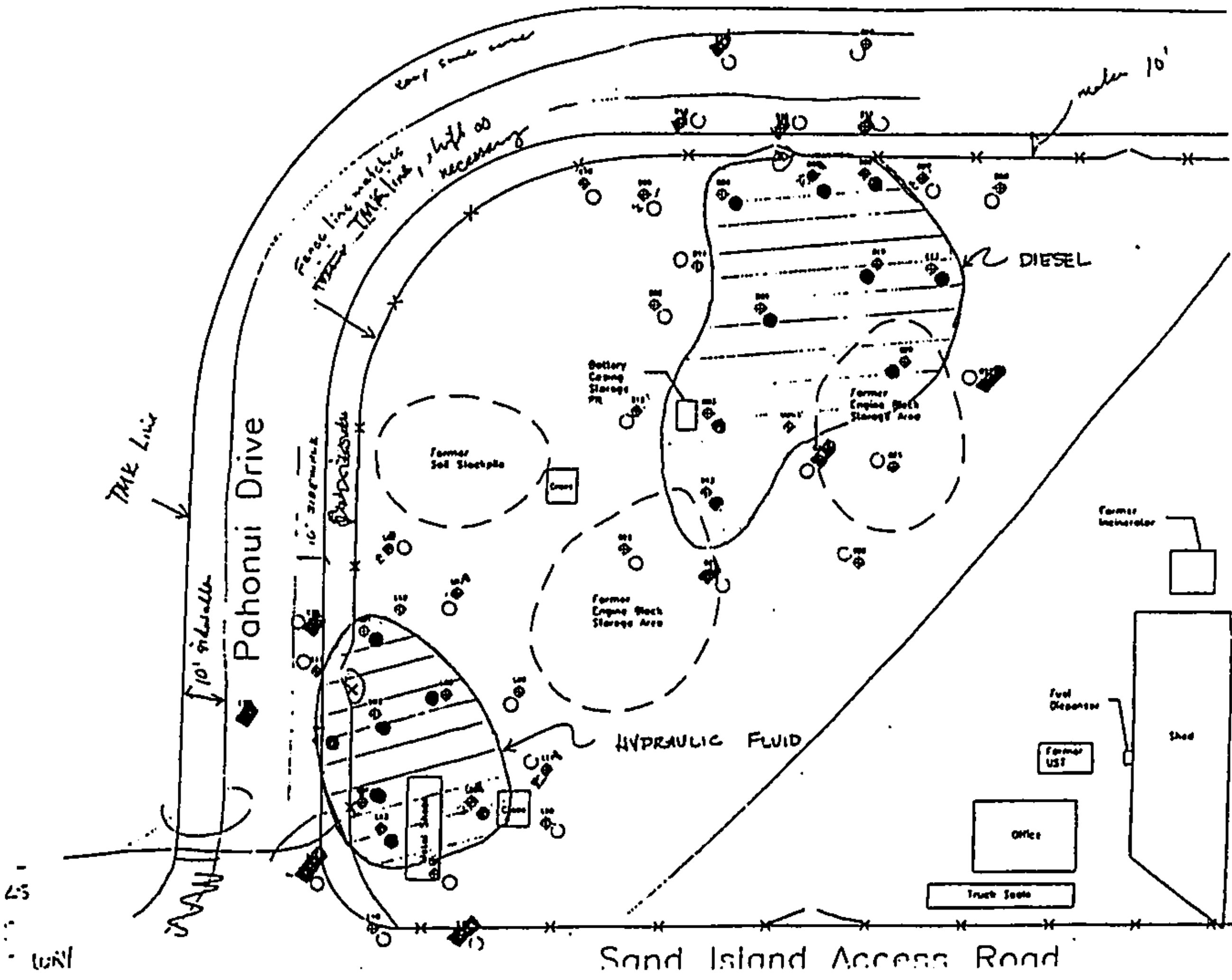
Steven S. Armann, Acting Manager
Hazard Evaluation and Emergency Response Office

c: James Whitman, Damon Estate
Cotton and Frazier Consultants, Inc.


Sand Island Access Road
Pahonui Drive
Truck Scale
Office
Former UST
Fuel Dispenser
Shed
Former Incinerator
Former Engine Block Storage Area
Former Engine Block Storage Area
Former Soil Stockpile
Battery Casing Storage Pit
DIESEL
HYDRAULIC FLUID
TMK Line
10' sidewalk
6' sidewalk
Fence line matches TMK line, shift as necessary
keep same curve
45

CORRECTION

THE PRECEDING DOCUMENT(S) HAS
BEEN REPHOTOGRAPHED TO ASSURE
LEGIBILITY
SEE FRAME(S)
IMMEDIATELY FOLLOWING


Keep same curve
make 10'
Fence line matches ~~TMK~~ TMK line, shift as necessary
TMK Line
10' sidewalk
10' sidewalk
Pahonui Drive
DIESEL
Battery Casing Storage Pit
Former Soil Stockpile
Former Engine Block Storage Area
Former Engine Block Storage Area
Former Incinerator
HYDRAULIC FLUID
Fuel Dispenser
Shed
Former UST
Office
Truck Scale
Sand Island Access Road

November 21, 1995

Form Letter sent to various agencies requesting early consultation.

Director
Agency
Address

Dear Mr./Ms.:

Subject: Flynn Learner Warehouses
120 Sand Island Access Road
Honolulu, Hawaii
TMK 1-2-23: 9, 10, 11, 12
Environmental Assessment (EA) for
Special Mangement Permit (SMP) Application

Wil Chee - Planning, Inc. has been engaged by Sueda & Associates, Inc. to prepare an Environmental Assessment (EA) for the subject project. Sueda & Associates, Inc. is the architect and agent for the applicant, Flynn Learner Company. Flynn Learner holds a along term lease for the site from the Samuel M. Damon Trust Estate, fee owners of the property.

The applicant operated a metal recycling facility on the site from 1951 until it was closed in 1991. They propose to convert the now unused site to a warehousing facility with the intention of sub-leasing space to individual small industrial companies. The proposed project will be composed of four prefabricated metal buildings providing 70,828 SF of warehouse space on the 130,568 SF site. The four buildings can be subdivided into 50 individual warehouse spaces. Parking will be provided in conformance with Land Use Ordinance (LUO) provisions.

Contaminants are known to exist on the site from previous industrial use. The applicant has already had several environmental site and soils studies completed by consultants. In developing the proposed project, they are prepared to provide recommended remedial action in accordance with State of Hawaii Department of Health regulations.

WIL CHEE - PLANNING, INC.
Land Use Planners and
Environmental Consultants
Ala Moana Pacific Center
1585 Kapiolani Boulevard
Suite # 818
Honolulu, Hawaii 96814
Phone 808-955-6088
Fax 808-942-1851

In complianced with §11-200-9, Hawaii Administrative Rules, Department of Health, Title 11, Chapter 200, *Environmental Impact Statement Rules*, this letter is intended to initiate early consultation with agencies or groups having jurisdiction or expertise related to the subject project. We have enclosed maps and preliminary sketches describing the proposed project and would appreciate receiving any comments or concerns which might influence the subject EA. Should you have any questions regarding the EA, please feel free to call me at 955-6088. If you have any technical questions about the project you may address them to Robert Nitta, project manager for Sueda & Associates, Inc., at 949-6644. Thank you very much for your time and interest.

Sincerely,

Richard S. McGerrow
Planner

Attachments

BENJAMIN J. CAYETANO
GOVERNOR

ESTHER UEDA
EXECUTIVE OFFICER

STATE OF HAWAII
DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM
LAND USE COMMISSION
Room 104, Old Federal Building
335 Merchant Street
Honolulu, Hawaii 96813
Telephone: 587-3822

November 27, 1995

SUBJECT: Director's Referral No. 95-198-X
Environmental Assessment (EA) for Special Management
Permit Application, Flynn Learner Warehouses, TMK
1-2-23: 9, 10, 11, 12, Honolulu, Hawaii

We have reviewed the subject EA and note that the subject parcels are located within the State Land Use Urban District.

We have no further comments to offer at this time.

EU:BS:th

Post-it® Fax Note 7671

To GEYI	Date 2/2/96 pages 4/5
Co./Dept.	From Teri
Phone #	Co.
Fax # 62377	Phone # 73822
	Fax #

Telcon Memo

Page 1 of 1

Project: Flynn Learner Warehouses EA
Date/Time: 11/27/95 Monday / 1:45 PM
From: John Nakagawa, Office of State Planning (OSP)
To: R. McGerrow, WCP

Discussion:

OSP has received letter of 11/21/95 re. initial consultation. They have no Comments at this time but may have input at a later stage in the SMP application process

WIL CHEE - PLANNING, INC.
Land Use Planners and
Environmental Consultants
Ala Moana Pacific Center
1585 Kapiolani Boulevard
Suite # 818
Honolulu, Hawaii 96814
Phone 808-955-6088
Fax 808-942-1851

ESTATE OF SAMUEL MILLS DAMON

November 30, 1995

Mr. Richard S. McGerrow, Planner
Wil Chee - Planning, Inc.
Ala Moana Pacific Center
1585 Kapiolani Boulevard Ste 818
Honolulu, Hawaii 96814

Dear Mr. McGerrow:

Re: Flynn Learner Warehouses
120 Sand Island Access Road
Honolulu, Hawaii
TMK: 1-2-23: 9, 10, 11, 12
Environmental Assessment (EA) for
Special Management Permit (SMP) Application

Thank you for your letter of November 21, 1995, which disclosed your intention to prepare an Environmental Assessment for the subject property. Your relationship with Sueda & Associates, Inc. has been noted. Please keep the Damon Estate informed of your progress.

Very truly yours,

ESTATE OF SAMUEL MILLS DAMON

Ms. Kris M. Shimabukuro
Administrative Assistant

KMS:mla

FIRST HAWAIIAN TOWER · 1132 BISHOP STREET, SUITE 1507 · HONOLULU, HAWAII 96813 · (808) 536-3717

DEPARTMENT OF PUBLIC WORKS
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU HAWAII 96813

JEREMY HARRIS
MAYOR

KENNETH E. SPRAGUE
DIRECTOR AND CHIEF ENGINEER

DARWIN J. HAMAMOTO
DEPUTY DIRECTOR

RECEIVED
12/06/95

ENV 95-325

December 5, 1995

Mr. Richard S. McGerrow
Planner
Wil Chee - Planning, Inc.
1585 Kapiolani Boulevard, Ste. 818
Honolulu, Hawaii 96814

Dear Mr. McGerrow:

Subject: Environmental Assessment (EA)
Flynn Learner Warehouses
<u>TMK: 1-2-23: 9, 10, 11 and 12</u>

We have reviewed the subject EA and have the following comments:

1. The EA should describe drainage patterns for existing and proposed conditions.
2. The EA should also discuss water quality, best management practices (BMPs), during construction to minimize storm water runoff and measures to mitigate any permanent increase in runoff from the site after construction has been completed.
3. Frontage improvements which support the project along Pahounui Drive should be constructed in accordance with the City standards. Construction plans should be submitted for review and approval.

Should you have any questions, please contact Mr. Alex Ho, Environmental Engineer, at 523-4150.

Very truly yours,

KENNETH E. SPRAGUE
Director and Chief Engineer

bcc: Eng

---

09 May 1996

RESPONSE TO EARLY CONSULTATION COMMENTS FOR
FLYNN LEARNER WAREHOUSES ENVIRONMENTAL ASSESSMENT

COMMENTS FROM: Department of Public Works
City & County of Honolulu

DATE OF COMMENTS: December 05, 1995

<u>ITEM</u>	<u>RESPONSE</u>
1.	Comply. Drainage is addressed in Section 2.4.3 of the EA document. ✓
2.	Comply. BMPs are addressed in Section 5.2.4 of the EA document. ✓
3.	Will comply.
Note:	See letter from Hida, Okamoto & Associates, Inc., project civil engineers, dated December 7, 1995. This letter responds to all three comments above.

HIDA, OKAMOTO & ASSOCIATES, INC.
CONSULTING ENGINEERS

HARVEY K. HIDA, P.E.
ALAN T. OKAMOTO, P.E.

December 7, 1995

Sueda & Associates, Inc.
905 Makahiki Way
Honolulu, Hawaii 96826

Attention: Mr. Bob Nitta

SUBJECT: FLYNN LEARNER WAREHOUSE
Environmental Assessment
120 Sand Island Access Road
Sand Island, Oahu, Hawaii
HO&A Job No. 95-1133

The following are responses to the Department of Public Works comments dated December 5, 1995.

1. Drainage System:

Currently the existing unpaved site ranges from elevation 5.7 to 9.0. The site is "depressed", being slightly lower than the adjacent grades along the Pahounui Street frontage and along Sand Island Access Road. Stormwater runoff is currently contained on site and any overflow is directed to the southeast corner and onto Sand Island Access Road. The new condition with impervious paving and paved parking will greatly increase surface runoff. Our understanding is that the City now requires a "no increase in runoff" condition from the project site. This will require collection of the stormwater runoff from roofs and pavements to be collected into an underground retention system. The system will be designed to hold the one hour 10 year rainfall and to dissipate it off-site by surface flow into the perimeter planters and at the driveways.

2. Best Management Practices (BMPs):

Excavation into ground water is not anticipated. During construction, temporary sediment fences will be constructed around the perimeter of the site. Temporary gravel pads at construction access points will be provided. Erosion and dust control measures will be enforced. All exposed grades areas will be immediately planted with ground cover.

3. Frontage Improvements:

Pahounui Drive currently has concrete curbs, gutters and sidewalks along the project frontage. Two existing driveways will be removed and two new driveways will be constructed in accordance with City Standards. Construction plans will be submitted to the City for review and approval.

Feel free to contact us at 942-0066 should there be any further questions.

Very truly yours,

HIDA, OKAMOTO & ASSOCIATES, INC.

Alan T Okamoto

Alan T. Okamoto, P.E.
Vice President

95-1133.SA3

DEPARTMENT OF BUSINESS,
ECONOMIC DEVELOPMENT, AND TOURISM

BENJAMIN J. CAYETANO
Governor
SEIJI F. NAYA
Director
RICK EGGED
Deputy Director

ENERGY DIVISION, 335 MERCHANT ST., RM. 110, HONOLULU, HAWAII 96813 PHONE: (808) 587-3800 FAX: (808) 587-3820

December 5, 1995

SUBJECT: Flynn Learner Warehouses
Environmental Assessment (EA) for
Special Management Permit (SMP) Application

The Energy, Resources, and Technology Division has the following comments on subject EA.

The EA is in regard to converting presently unoccupied warehouse space to 50 individual warehouse spaces. The spaces will not be used for human habitation. Hawaii's Model Energy Code exempts "Areas of buildings intended primarily for ... commercial or industrial processing." Warehousing is included in that category. Therefore, the space is exempt from the code.

However, considering that the roofs of the structure are metal, the developer may want to consider minimizing the solar heat transmitted through the roofs by either painting the roof with a reflective coating, or insulating the ceiling with radiant barriers or blow-in insulation. Utilizing a light-colored roof plus insulation would heighten the effectiveness of reducing solar gain.

Studies indicate that insulating the ceilings of residences reduces perceived indoor temperatures by about ten degrees. The benefits of insulation on a highly conductive metal roof should be greater.

The developer might also want to consider other energy efficiency technologies such as metal halide and high pressure sodium lighting and motion sensors.

---

09 May 1996

RESPONSE TO EARLY CONSULTATION COMMENTS FOR
FLYNN LEARNER WAREHOUSES ENVIRONMENTAL ASSESSMENT

COMMENTS FROM: Department of Business, Economic Development, and Tourism
Energy Division
State of Hawaii

DATE OF COMMENTS: December 5, 1995

<u>ITEM</u>	<u>RESPONSE</u>
Paragraphs 3-5	Acknowledged. The project architects will consider methods for minimizing solar heat transmission and other energy efficient technologies.

DEPARTMENT OF WASTEWATER MANAGEMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

JEREMY HARRIS
MAYOR

FELIX B. LIMTIACO, P.E.
DIRECTOR

CHERYL K. OKUMA-SEPE, ESQ.
DEPUTY DIRECTOR

12/15/95

In reply refer to:
WCC 95-43

December 11, 1995

Mr. Richard S. McGerrow
Wil Chee - Planning, Inc.
Ala Moana Pacific Center
1585 Kapiolani Boulevard, Suite #818
Honolulu, Hawaii 96814

Dear Mr. McGerrow:

Subject: **Environmental Assessment for a Special Management Permit Application**
Flynn Learner Warehouses, 120 Sand Island Access Road
TMK: 1-2-023: 009, 010, 011, 012

At the present time the sewer collection system is inadequate to accommodate the conversion of a metal recycling facility to 70,828 square feet of warehouse subdivided into 50 individual spaces. If your anticipated connection date is after the construction of the Nimitz Highway Relief Sewer Project, tentatively scheduled in November, 1996, your project may be accommodated. Please submit a "Sewer Connection Application" form for sewer capacity reservation.

If you have any questions, please contact Ms. Tessa Yuen of the Service Control Branch at 523-4956.

Very truly yours,

FELIX B. LIMTIACO
Director

---

09 May 1996

RESPONSE TO EARLY CONSULTATION COMMENTS FOR
FLYNN LEARNER WAREHOUSES ENVIRONMENTAL ASSESSMENT

COMMENTS FROM:	Department of Wastewater Management City & County of Honolulu
DATE OF COMMENTS:	December 11, 1995

<u>ITEM</u>	<u>RESPONSE</u>
Paragraph 1	Acknowledged. The project is not expected to be completed before November 1996. This comment has been noted in Section 2.2.5 of the EA document.

DEPARTMENT OF TRANSPORTATION SERVICES
CITY AND COUNTY OF HONOLULU
PACIFIC PARK PLAZA
711 KAPIOLANI BOULEVARD SUITE 1200
HONOLULU HAWAII 96813

JEREMY HARRIS
MAYOR

CHARLES O. SWANSON
DIRECTOR

RECEIVED
12/15/95

December 15, 1995

11/95-05533R

Mr. Robert Nitta, Project Manager
Sueda & Associates, Inc.
905 Makahiki Way
Honolulu, Hawaii 96826

Dear Mr. Nitta:

Subject: Environmental Assessment for Special Management <u>Permit Application - Flynn Learner Warehouses</u>

In response to the November 21, 1995 letter from Wil Chee - Planning, Inc., we reviewed the information provided for the subject project and have the following comments:

1. The driveway fronting Pahounui Drive that provides access to TMK: 1-2-23:11 should be eliminated due to its close proximity to the curve in the roadway.
2. Close coordination of the driveway locations with our department at an early stage will minimize the possibility of objections being raised when the building permit plans are submitted.

We look forward to reviewing the environmental assessment. Should you have any questions regarding our comments, please call Faith Miyamoto of the Transportation Systems Planning Division at 527-6976.

Respectfully,

for F. Tamayose
CHARLES O. SWANSON
Director

✓cc: Mr. Richard S. McGerrow,
Wil Chee - Planning, Inc.

---

09 May 1996

RESPONSE TO EARLY CONSULTATION COMMENTS FOR
FLYNN LEARNER WAREHOUSES ENVIRONMENTAL ASSESSMENT

COMMENTS FROM: Department of Transportation Services
City & County of Honolulu

DATE OF COMMENTS: December 15, 1995

<u>ITEM</u>	<u>RESPONSE</u>
1.	Comply. The site plan (Figure 4) will be adjusted accordingly in the final EA document.
2.	Comply.

DEPARTMENT OF LAND UTILIZATION
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813 • (808) 523-4432

JEREMY HARRIS
MAYOR

PATRICK T. ONISHI
DIRECTOR

LORETTA K.C. CHEE
DEPUTY DIRECTOR

RECEIVED
12/19/95

95-08103(DT)

December 18, 1995

Mr. Richard S. McGerrow
Wil Chee - Planning, Inc.
Ala Moana Pacific Center
1585 Kapiolani Boulevard, Suite 818
Honolulu, Hawaii 96814

Dear Mr. McGerrow:

Preliminary Review For Flynn Learner Warehouses
Tax Map Key (TMK): 1-2-23: 09

We have reviewed your proposal to construct four prefabricated metal buildings for warehouse use and have the following comments:

1. The above TMK consists of four lots: Lot 10A, 11A, 12A, and 13A. Your letter states that the TMKs for the proposed warehouses are 1-2-23: 09, 10, 11, and 12. However, according to the Real Property Tax Assessment records, parcels 10 through 12 have been dropped into parcel 9. This discrepancy should be corrected in the Draft Environmental Assessment (EA).

2. A Conditional Use Permit (CUP), Type 1, for joint development of two or more adjacent zoning lots or a Consolidation application must be obtained if the warehouses encompass two or more of the lots. To determine whether a CUP or Consolidation application is required, the proposed development must clearly show how the proposed structures relate to existing lot lines.

3. A Special Management Area Use Permit (SMP) is required as the proposed warehouses are within the Special Management Area. An SMP Application, application instructions, including an outline for preparing an EA, are enclosed.

We would like to review the Draft EA when it becomes available. Should you have any questions regarding this letter, please contact Dana Teramoto of our staff at 523-4648.

Very truly yours,

PATRICK T. ONISHI
Director of Land Utilization

PTO:am
Enclosures

9508103.djt

09 May 1996

RESPONSE TO EARLY CONSULTATION COMMENTS FOR FLYNN LEARNER WAREHOUSES ENVIRONMENTAL ASSESSMENT

COMMENTS FROM: Department of Land Utilization
City & County of Honolulu

DATE OF COMMENTS: December 18, 1995

ITEM	RESPONSE
1.	Acknowledged. This discrepancy has been corrected in the EA document.
2.	Acknowledged. Lot lines are shown on the site plan (Figure 4).
3.	Acknowledged.

ARTMENT OF PARKS AND RECREATIO.
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU HAWAII 96813

JEREMY HARRIS
MAYOR

DONA L. HANAIKE
DIRECTOR

ALVIN K.C. AU
DEPUTY DIRECTOR

RECEIVED
12/21/95

December 19, 1995

Mr. Richard S. McGerrow
Wil Chee - Planning, Inc.
Ala Moana Pacific Center
1585 Kapiolani Boulevard, Suite 818
Honolulu, Hawaii 96814

Dear Mr. McGerrow:

Subject: Comments to the Environmental Assessment for
Special Management Permit Application
Flynn Learner Warehouses
Sand Island, Honolulu, Hawaii
Tax Map Key 1-2-23: 9, 10, 11, and 12

This responds to your environmental assessment preparation notice for the subject project.

Based on our review of the proposed project, we have no comments to offer at this time.

Should you have any further questions on the matter, you may contact Brian Suzuki of our Advance Planning Branch at 527-6316.

Sincerely,

For DONA L. HANAIKE
Director

DLH:ei

cc: Department of Land Utilization

We Add Quality to Life

BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU
630 SOUTH BERETANIA STREET
HONOLULU, HAWAII 96843
PHONE (808) 527-6180
FAX (808) 533-2714

RECEIVED
12/21/95

December 20, 1995

Mr. Richard S. McGerrow
Wil Chee - Planning, Inc.
1585 Kapiolani Boulevard, Suite 818
Honolulu, Hawaii 96814

Dear Mr. McGerrow:

Subject: Your Letter of November 21, 1995 on the Draft Environmental Assessment (DEA) for the Proposed Flynn Learner Warehouses Project, TMK: 1-2-23: 9, 10, 11 and 12, Sand Island Access Road

Thank you for the opportunity to participate in the early consultation on the DEA for the proposed project. We have the following comments:

1. There is an existing water service for TMK: 1-2-23: 12 and a water service, which was ordered off on June 17, 1992, for TMK: 1-2-23: 10.
2. The existing water system is presently adequate to accommodate the proposed warehouse development.
3. The availability of water will be confirmed when the building permit application is submitted for our review and approval. When water is made available, the applicant will be required to pay the prevailing Water System Facilities Charges for resource development, transmission and daily storage.
4. If a three-inch or larger meter is required, the construction drawings showing the installation of the meter should be submitted for our review and approval.
5. The proposed project is subject to Board of Water Supply cross-connection control requirements prior to the issuance of the building permit application.

If you have any questions, please contact Barry Usagawa at 527-5235.

Very truly yours,

FOR RAYMOND H. SATO
Manager and Chief Engineer

---

09 May 1996

RESPONSE TO EARLY CONSULTATION COMMENTS FOR
FLYNN LEARNER WAREHOUSES ENVIRONMENTAL ASSESSMENT

COMMENTS FROM: Board of Water Supply
City & County of Honolulu

DATE OF COMMENTS: December 20, 1995

ITEM	RESPONSE
1.	Acknowledged.
2.	Acknowledged.
3.	Acknowledged.
4.	Will comply.
5.	Acknowledged.

BENJAMIN J. CAYETANO
GOVERNOR

RECEIVED
1/03/95

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

[illegible] - 2 1996

KAZU HAYASHIDA
DIRECTOR

DEPUTY DIRECTORS
JERRY M. MATSUDA
GLENN M. OKIMOTO

IN REPLY REFER TO
HWY-PS
2.8537

Mr. Richard S. McGerrow
Planner
Wil Chee Planning, Inc.
1585 Kapiolani Boulevard, Suite 818
Honolulu, Hawaii 96814

Dear Mr. McGerrow:

Subject: Environmental Assessment (EA) for Flynn Learner Warehouses, Sand Island Access Road, Oahu;
TMK: 1-2-23: 9-12

Thank you for requesting our input for the subject project. We have the following comments.

1. The 2020 Oahu Regional Transportation Plan proposes widening Sand Island Access Road to 6 lanes from Auiki Street to Nimitz Highway between 2001 and 2005. Bikeplan Hawaii proposes development of marked bicycle lanes along the road's shoulders. To ensure that planned road widening will not adversely affect your project, we recommend that buildings be set back ten feet from the existing highway right-of-way.

2. The Draft EA should include a traffic assessment. No left turn movements will be allowed to or from Sand Island Access Road. If right-turns are proposed from Sand Island Access Road to project driveways, then project parking lots must be redesigned to reduce risk of vehicles queuing onto the State highway. For right-turns into project driveways, we require a minimum 50-foot driveway "throat" and recommend a 100 to 150-foot "throat", before vehicles have access to project parking stalls or loading zones.

3. Construction plans for driveways from Sand Island Access Road must be submitted for our review and approval.

Very truly yours,

KAZU HAYASHIDA
Director of Transportation

09 May 1996

RESPONSE TO EARLY CONSULTATION COMMENTS FOR FLYNN LEARNER WAREHOUSES ENVIRONMENTAL ASSESSMENT

COMMENTS FROM: Department of Transportation
State of Hawaii

DATE OF COMMENTS: January 2, 1996

ITEM	RESPONSE
1.	Comply. The site plan (Figure 4) has been changed accordingly.
2.	Comply. A traffic assessment has been completed for the project and is appended to the EA (Appendix B).
3.	Will comply.

Hawaiian Electric Company, Inc. • PO Box 2750 • Honolulu, HI 96840-0001

William A. Bonnet
Manager
Environmental Department

RECEIVED
1/15/96

January 10, 1996

Richard S. McGerrow
Wil Chee - Planning, Inc.
Ala Moana Pacific Center
1585 Kapiolani Blvd. Suite #818
Honolulu, Hawaii 96814

Dear Mr. McGerrow:

Subject: **Environmental Assessment for the Flynn Learner Warehouses**

Thank you for the opportunity to comment on your Environmental Assessment report for the Flynn Learner Warehouses project. We have reviewed the subject document and have no comments at this time on the proposed project. HECO shall reserve further comments pertaining to the protection of existing powerlines bordering the project area until construction plans are finalized. Again, thank you for the opportunity to comment on this Environmental Assessment.

Sincerely,

William A. Bonnet

An HEI Company

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O. BOX 3378
HONOLULU, HAWAII 96801

LAWRENCE MIIKE
DIRECTOR OF HEALTH

In reply, please refer to:

RECEIVED
1/31/96

January 30, 1996

95-233/epo

Mr. Richard S. McGerrow, Planner
Wil Chee - Planning, Inc.
Ala Moana Pacific Center
1585 Kapiolani Boulevard, Suite 818
Honolulu, Hawaii 97814

Dear Mr. McGerrow:

Subject: Early Consultation for Environmental Assessment
120 Sand Island Access Road
Honolulu, Hawaii
TMK: 1-2-23: 9, 10, 11, 12

Thank you for allowing us to review and comment on the subject project. We have the following comments to offer:

Hazard Evaluation and Emergency Response (HEER) Office

Lead contamination has been found in the soil on the subject site. Also, free product hydraulic oil has been found in the groundwater on the site.

The HEER Office has been involved with Flynn Learner and its environmental consultant, Cotton and Frazier Consultants, Inc., in a site environmental investigation and the development of remedial actions. The lead contamination will be mitigated by the installation of an integrated structure and a soil cap. The groundwater contamination will be mitigated by removing the contaminated soil. These corrective actions must be accomplished before any development on the site can take place.

Should you have any questions on this matter, please contact Mr. Michael Miyasaka of the HEER Office at 586-4698.

Sincerely,

Lawrence Miike
Director of Health

c: HEER

---

09 May 1996

RESPONSE TO EARLY CONSULTATION COMMENTS FOR
FLYNN LEARNER WAREHOUSES ENVIRONMENTAL ASSESSMENT

COMMENTS FROM: Department of Health
State of Hawaii

DATE OF COMMENTS: January 30, 1996

ITEM	RESPONSE
paragraph 3	Comply. The applicant will accomplish all of the corrective actions mentioned in the letter.

96-07141

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P.O. BOX 621
HONOLULU, HAWAII 96809

MICHAEL D. WILSON
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTY
GILBERT S. COLOMA-AGARAN

AQUACULTURE DEVELOPMENT
PROGRAM
AQUATIC RESOURCES
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CONSERVATION AND
ENVIRONMENTAL AFFAIRS
CONSERVATION AND
RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT
WATER RESOURCE MANAGEMENT

APR - 8 1996

Ref.:LM-PEM

Honorable Patrick T. Onishi, Director
Department of Land Utilization
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

File No. PM-96-007

Dear Mr. Onishi:

Subject: Review of Draft Environmental Assessment, ROH Projects Within the Special Management Area, Flynn Learner Warehouses, Sand Island, Oahu, Tax Map Key: 1-2-23:09

We have reviewed the subject Draft Environmental Assessment prepared for the above project and would like to offer the following comments:

Division of Aquatic Resources

Our main concern is in the area of contaminants from surface run-off from the existing site and the potential for contaminants from the new industrial businesses. If the new businesses produce hazardous materials, such as paint or automotive repair shops, such businesses should be required to develop and adhere to strict guidelines for proper disposal of such materials. The guidelines may prevent a repeat of the soil contamination that occurred during the operation of the metal recycling facility.

A secondary concern is noted from paragraph 2.2.5 on page 9 of the draft environmental impact assessment. It states that the County Department of Wastewater Management has indicated that the proposed new facility could not be accommodated but that it may be accommodated after November, 1996. There does not appear to be any alternative plan in the event that the facility cannot be accommodated at that time.

Land Division, Oahu District Land Office

No objections to proposed project provided that:

1. As contaminants remain in the soil from previous industrial use, the applicant strictly adhere to conditions placed upon the project by the Department of Health, State of Hawaii. Wherever mitigative measures are called for, the applicant work closely with the Department of Health and strictly comply with any deed restrictions or restrictive covenants to be incorporated into the property's deed which may reveal the presence of lead contaminated soil on the lot and the requirement to have a properly maintained cap over the contaminated site.

2. The project have no adverse effect on the adjacent Keehi Industrial Park lots which are owned by the State of Hawaii and are encumbered by revocable permits to various business entities.

3. The applicant obtain all required Federal, State and County permits prior to construction activities.

Thank you for the opportunity to review the Draft Environmental Assessment. We have no further comments to offer at this time. Should you have any questions, please contact Patti Miyashiro at 587-0430 of our Land Division.

Aloha,

Gilbert S. Coloma-Agaran
for MICHAEL D. WILSON

c: Oahu Land Board Members

09 May 1996

RESPONSE TO REVIEW COMMENTS ON THE DRAFT ENVIRONMENTAL ASSESSMENT FOR FLYNN LEARNER WAREHOUSES

COMMENTS FROM: Department of Land and Natural Resources
State of Hawaii

DATE OF COMMENTS: April 8, 1996

ITEM	RESPONSE
Aquatic Resources 1.	Concur. The applicant will require tenants to adhere to strict guidelines for proper disposal of hazardous materials according to Department of Health regulations.
2.	Concur. The project will not be completed before November, 1996. Completion is not expected until 34 months after submittal of the SMP application.
Land Division 1.	Will comply.
2.	Concur. The project is not expected to cause any long-term negative impacts to the adjacent Keehi Industrial Park lots. Mitigation measures to reduce short-term negative impacts during construction will be taken as described in Section 5.2 of the EA document.
3.	Will comply.

BENJAMIN J. CAYETANO
GOVERNOR

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
235 SOUTH KING STREET
FOURTH FLOOR
HONOLULU, HAWAII 96813
TELEPHONE (808) 586-4185
FACSIMILE (808) 586-4186

GARY GILL
DIRECTOR

May 8, 1996

May 08, 1996

Post-it™ brand fax transmittal memo 7671 # of pages ▸ 10

To Wil Chee Planning Inc	From OEQC
Co.	Co.
Dept.	Phone # 586-4185
Fax # 942-1851	Fax # 586-4186

Mr. Jack Hecht
Flynn Learner Company
2711 Navy Drive
Stockton, California 95206

Dear Mr. Hecht:

We have reviewed a draft environmental assessment (DEA) prepared by Wil Chee - Planning, Inc. for Sueda and Associates, Inc., entitled *Flynn Learner Warehouses, 120 Sand Island Access Road, Honolulu, Oahu, Hawaii, Tax Map Key 1-2-23: Parcel 9, Lots 10A, 11A, 12A, and 13A, February 1996*, and transmitted to the Office of Environmental Quality Control (OEQC) by a March 15, 1996, letter of the Hon. Patrick T. Onishi, Director of Land Utilization, City and County of Honolulu, to Mr. Gary Gill, Director of OEQC. We offer the following comments on the document (page numbers refer to those found in the DEA).

I. Page 16, section 5.1, *Existing Soil Contamination - Long Term Mitigation*

Three long term mitigation options are discussed. These include: on-site cap with modified RCRA specifications; integration of site buildings and modified cap without treatment of soils; and, *in-situ* treatment of soils.

The first two options appear to be mitigating the potential impact of vertical contaminant migration to human and other environmental receptors through such physical processes as run-off, erosion, and wind.

An extensive discussion of the potential impact of horizontal subsurface contaminant migration (via groundwater) to Keehi Lagoon is apparently dismissed in a statement on page 10 (section 2.4.1, paragraph 5) which reads in pertinent part as follows:

"[The] [i]*mpact of the contaminants to the closest surface water body, Keehi Lagoon, can be ruled out by calculating the residence time for each* [contaminant of concern] *to migrate the approximate 620 feet. The predicted times ranged from 460,000 years for* [polychlorinated biphenyls] *to 180,000,000 years for lead (CFC, October 1993). Further, contaminants would be reduced in concentration by bio-degridation* [sic], *and adsorption while migrating in the soil and ground water*

---

before reaching the lagoon. The ground water found under the property is classified by the State of Hawaii, Department of Health ... as being a non-drinking water source."

A. Please indicate whether the calculations of times for 620 foot migration of lead and polychlorinated biphenyls to Keehi Lagoon are for migration through the saturated zone or the vadose (unsaturated) zone. If the calculations are based on the latter, please provide 620 foot migration times through the saturated zone (along with an estimate of propagated error in making the calculation). Please also discuss the effects of tidal flux and other gradients on contaminant migration.

B. Please briefly describe the lateral extent of contamination for free floating oils, lead and polychlorinated biphenyls in the subsurface vadose and saturated zones, and indicate what investigations were conducted to determine the likelihood of contamination beyond the property boundaries.

C. If contamination beyond the facility boundaries is likely as a result of any investigations in B above, please discuss any secondary and cumulative impacts which may arise from the proposed action, especially with respect to mangrove wetland areas in section 3.2.4 which provide protective habitat for fish and shoreline invertebrates.

D. In paragraph 4, *in situ* treatment of contaminated soils to mitigate lead exposure is proposed in the DEA. Please briefly describe what is meant by *in situ* treatment to mitigate lead exposure (i.e., does this mean leaving in place, or using technologies such as concentration dilution by adding soil, encapsulation, glassification, soil washing, extraction, or a combination of technologies, etc.).

II. On page 14, section 3.5, *Quality of Receiving Waters and Ground Water*, paragraph 3 states in part that "... there are no other apparent down gradient receptors which could lead to exposure by humans other than the surface water of Keehi Lagoon."

A. Please ascertain the water quality designation of Keehi Lagoon with the Department of Health and briefly discuss how the proposed action and any proposed mitigation measures will effect such a designation.

III. On page 14, section 3.3, *Historic, Cultural, and Archaeological Resources* correctly states that the site is not listed on the State or National Register of Historic Places. However, we believe that the site is situated proximal, if not on, historic sites documented by Elspeth Sterling and Catherine C. Summers in the *Sites of Oahu* (Bernice Pauahi Bishop Museum Press, 1978). Please find enclosed excerpts from the *Sites of Oahu* (at p. 322) dealing with the Apili, Pahounui, Pahouiki, Auiki and

Mr. Jack Hecht
Flynn Learner Company
May 8, 1996
Page 3 of 3

Ananoho fishponds in the former Kona (now Honolulu) district of Oahu. The enclosures contain historical allusions to the gardens of Captain Alexander Adams, harbormaster for Kamehameha I, salt pans for the harvesting of pa'akai and the historic Kalihi Leprosy Receiving station near Kaliawa Street (see, *Sites of Oahu*, p. 327). If during the course of any excavation during site preparation historical artifacts are encountered, please contact the State Historic Preservation Division of the Department of Land and Natural Resources.

IV. Page 13, section 3.2.1, *Publicly Owned or Used Beaches, Parks and Recreation Areas.*

Please discuss any impacts of the proposed action and mitigation measures on the white sand beach at Keehi Lagoon Park, canoeing and recreational fishing in the Keehi Lagoon area.

If there are any questions, please call Mr. Leslie Segundo, Environmental Health Specialist, at 586-4185. Thank you for the opportunity to comment.

Sincerely,

Gary Gill
GARY GILL
Director of Environmental Quality Control

Enclosures

c: Hon. Patrick Onishi, City & County of Honolulu, Dept. of Land Utilization (via facsimile 527-6743)
Mr. Dana Teramoto, City & County of Honolulu, Dept. of Land Utilization (via facsimile 527-6743)
Samuel M. Damon Trust Estate (via facsimile 536-3729)
Mr. Lloyd Sueda, Sueda & Associates, Inc. (via facsimile 949-6707)
Wil Chee Planning Inc. (via facsimile 942-1851)

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09 May 1996

RESPONSE TO REVIEW COMMENTS ON THE DRAFT ENVIRONMENTAL ASSESSMENT FOR FLYNN LEARNER WAREHOUSES

COMMENTS FROM: Office of Environmental Quality Control
State of Hawaii

DATE OF COMMENTS: May 8, 1996

<u>ITEM</u>	<u>RESPONSE</u>
I.	See letter of May 15, 1996 from Cotton and Frazier Consultants, Inc. in response to this comment.
II.	See letter of May 15, 1996 from Cotton and Frazier Consultants, Inc. in response to this comment.
III.	Acknowledged. The information on historic references has been added to Section 3.3. ✓
IV.	See letter of May 15, 1996 from Cotton and Frazier Consultants, Inc. in response to this comment.

COTTON and FRAZIER Consultants, Inc.
P.O. Box 37136 Honolulu, Hawaii 96837
Phone: (808) 599-1999 Fax: (808) 599-1502

May 15, 1996

Bob Nitta
SUEDA & ASSOCIATES, INC.
905 Makahiki Way - Mauka Suite
Honolulu, Hawaii

RE: Response to DOH May 8, 1996 Letter

Dear Mr. Nitta:

The following is our response to the above letter.

Ia. - Calculation time is for the saturated zone.
- Tidal fluctuation is minimal. A maximum of 0.35 foot change was observed during a two foot tide cycle.
- An assumed conservative gradient of 0.0002 to 0.001 ft/ft was used for the site based on on-site and regional hydrogeological data. These values were used with the solute transport model (saturated) ONE-D with other input values.

Ib. - PCB extent was verified by installation and sampling of four soil borings about the B-9 location, PCB contaminated soils were then removed and disposed of properly.
- Free floating oil extent has been fully defined by further on- and off-site sampling as shown by the attached map.
- Lead extent is shown by the attached map.

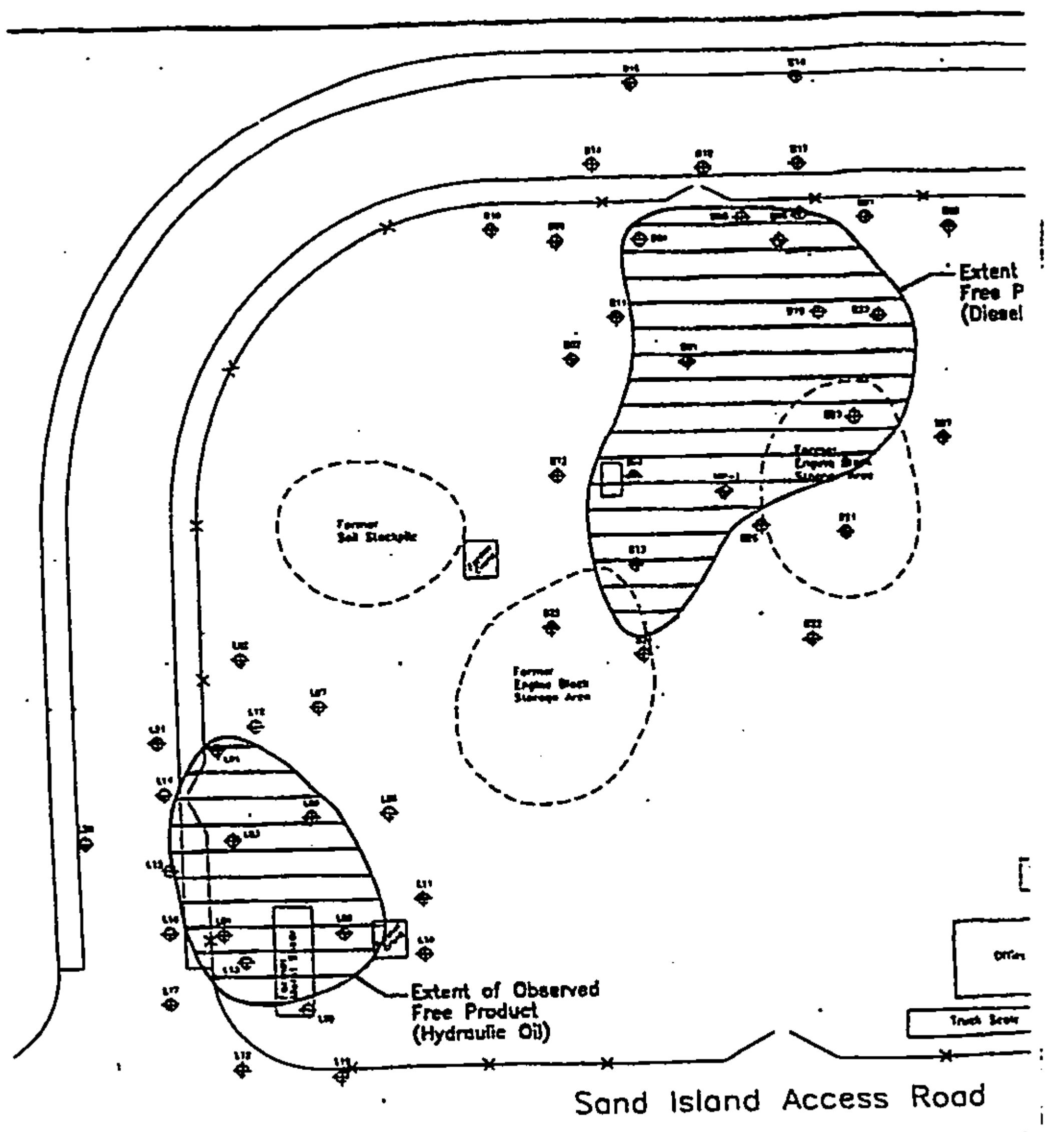
Ic. - As shown in the attached maps free product was found to be off site in a limited area. However, the majority of the free product and associated contaminated soils from this area have been removed and properly disposed. Any residual free product is assumed to be immobile, and is not expected to impact the lagoon, as stated in the risk assessment report.

Id. - Soil flushing, solidification, electrokinetics, and vitrification were the insitu technologies examined and screened.

II - The water quality designation of Keehi Lagoon is marine embayment class A.
- We are not proposing any short term potential migration, only long term migration potential, in thousands of years.

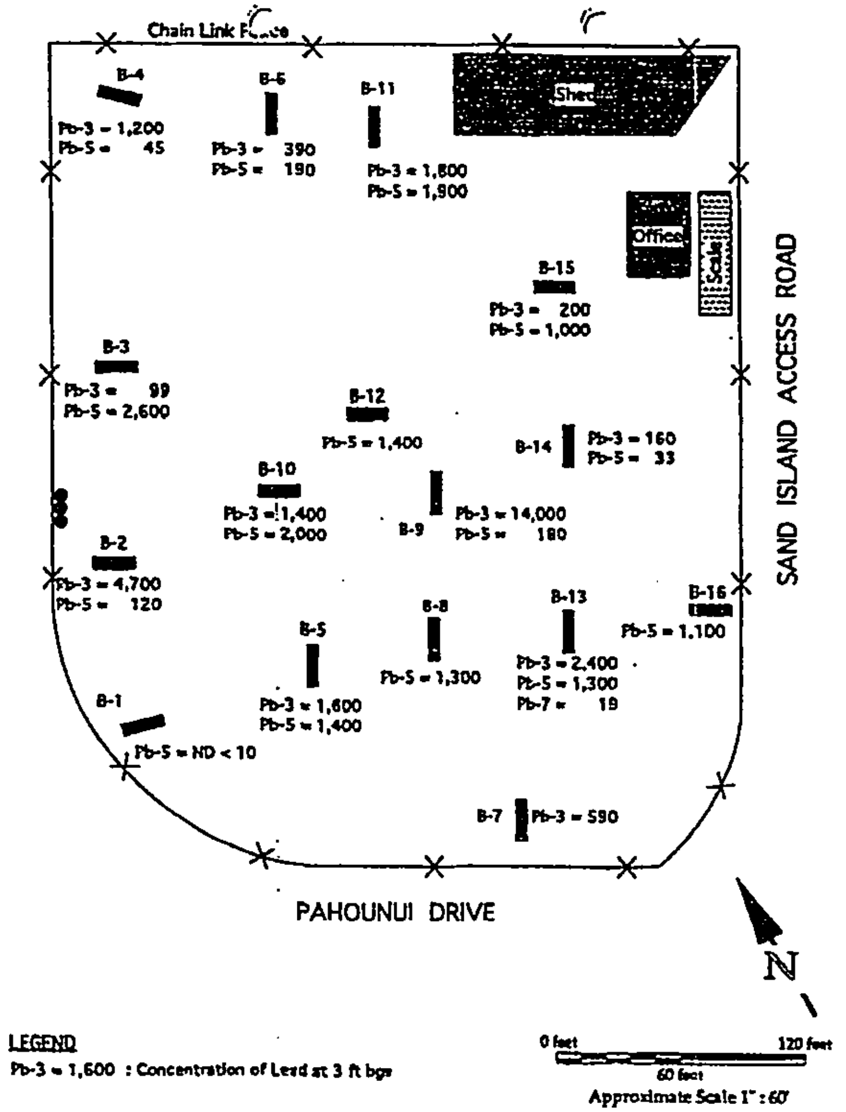
IV - The issue of migration has already been addressed above, and in the risk assessment report.

Sincerely,
W. Mark Frazier
President



Cotton and Frazier Consultants, Inc.
Environmental Solutions

Title:
EXTENTS OF OBSERVED FREE PRODUCT
Flynn-Learner – 120 Sand Island Access Road
Honolulu, Hawaii



LEGEND
Pb-3 = 1,600 : Concentration of Lead at 3 ft bgs

Approximate Scale 1" : 60'

COTTON and FRAZIER Consultants, Inc. March 3, 1994	Aug 12, 1992 SAMPLE LOCATIONS AND LEAD RESULTS Flynn-Learner Sand Island, Oahu, Hawaii	Figure 1

96-03176

DEPARTMENT OF WASTEWATER MANAGEMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

JEREMY HARRIS
MAYOR

FELIX B. LIMTIACO, P.E.
DIRECTOR

CHERYL K. OKUMA-SEPE, ESQ.
DEPUTY DIRECTOR

'96 MAY 30 PM 3 59

In reply refer to:
WCC 96-67

May 29, 1996

MEMORANDUM

TO: MR. PATRICK ONISHI, DIRECTOR
DEPARTMENT OF LAND UTILIZATION

FROM: FELIX B. LIMTIACO, DIRECTOR
DEPARTMENT OF WASTEWATER MANAGEMENT

SUBJECT: ENVIRONMENTAL ASSESSMENT, CHAPTER 25, ROH
PROJECTS WITHIN THE SPECIAL MANAGEMENT AREA
FLYNN LEARNER WAREHOUSES
120 SAND ISLAND ACCESS ROAD
TMK: 1-2-23: 009 (96/SMA-014, DT)

Our response relating to the availability and adequacy of the municipal sewer system for the subject project is as follows:

- [ ] Municipal Sewer System Available and Adequate
(This statement shall not be construed as confirmation of sewage capacity reservation. Sewage capacity reservation is contingent on submittal and approval of a "Sewer Connection Application" form.)
- [ ] Municipal Sewer System Not Available
- [ ] Municipal Sewer System Not Adequate
- [ ] Liable for Payment of a Wastewater System Facility Charge
- [X] Other: We can accommodate the conversion of a metal recycling facility to 112,500 square feet of warehouse subdivided into 51 individual warehouse spaces after the construction of the Nimitz Highway Relief Sewer Project, tentatively scheduled for completion in April 1997.

Contact Person:

Tessa Yuen, Ext. 4956

FELIX B. LIMTIACO
DIRECTOR

6-29-94

---

28 June 1996

RESPONSE TO COMMENTS ON THE
FLYNN LEARNER WAREHOUSES ENVIRONMENTAL ASSESSMENT

COMMENTS FROM: Department of Wastewater Management
City & County of Honolulu

DATE OF COMMENTS: May 29, 1996

ITEM	RESPONSE
Check-off Box "Other"	Acknowledged. The tentative completion date for the Nimitz Highway Relief Sewer Project has been changed from November, 1996, to April, 1997 in Section 2.2.5 of the EA.

96-03493

DEPARTMENT OF PUBLIC WORKS
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET 11TH FLOOR • HONOLULU, HAWAII 96813
PHONE (808) 523-4341 • FAX (808) 527-5857

JEREMY HARRIS
Mayor

KENNETH E. SPRAGUE
DIRECTOR AND CHIEF ENGINEER

DARWIN J. HAMAMOTO
DEPUTY DIRECTOR

ENV 96-119

1996 MAY 31
DEPT. OF LAND UTILIZATION
CITY & COUNTY OF HONOLULU

May 30, 1996

MEMORANDUM:

TO: PATRICK T. ONISHI, DIRECTOR
DEPARTMENT OF LAND UTILIZATION

FROM: for KENNETH E. SPRAGUE
DIRECTOR AND CHIEF ENGINEER

SUBJECT: ENVIRONMENTAL ASSESSMENT (EA)
FLYNN LEARNER WAREHOUSES
TMK: 1-2-23: 09

We have reviewed the subject EA and have no additional comments to offer at this time.

Should you have any questions, please contact Mr. Alex Ho, Environmental Engineer, at Local 4150.

DEPARTMENT OF LAND UTILIZATION
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU HAWAII 96813 • (808) 523-4432

JEREMY HARRIS
MAYOR

PATRICK T. ONISHI
DIRECTOR

LORETTA K.C. CHEE
DEPUTY DIRECTOR

RECEIVED
6/07/96

96-00999(DT)
96/SMA-014

June 6, 1996

Mr. Donald A. Clegg
Analytical Planning Consultants, Inc.
84 North King Street
Honolulu, Hawaii 96817

Dear Mr. Clegg:

Comments to Environmental Assessment (EA)
Flynn Learner Warehouses
<u>Tax Map Key: 1-2-23: 09</u>

It was our understanding that Wil Chee - Planning, Inc. would be distributing the above EA to various government agencies for their review. However, only the project description was distributed to these agencies, not the Draft EA. Thus, the EA submitted to us on May 16, 1996 for the above-referenced project is incomplete as the agencies did not comment on the Draft EA. Therefore, we are sending the EA to various government agencies for their comments. The EA will be complete when all comments from the various government agencies and your responses to these agencies (if any) are included in the EA. We also have the following comments to the above EA:

1. What will be stored within the proposed warehouses?

2. Is there a temporary cap on the site to prevent the lead contaminated soil from getting airborne and blowing off the site? If yes, has the State Department of Health approved this temporary cap?

3. Has the free floating oil (including off-site areas) been removed?

4. The EA mentions the following documents, which should be included in the EA:

    a. "Risk Assessment Report For Flynn Learner," October 22, 1993.

    b. "Remedial Alternatives Analysis For Flynn Learner," January 25, 1995.

    c. "Free Product Delineation Report For Flynn Learner," August 29, 1995.

    d. "Foundation Investigation Flynn Learner Warehouses," October 4, 1995.

5. The Special Management Area Use Permit lists Sueda & Associates, Inc. as the agent for the project. As you are now the current agent, a letter authorizing you to act as the agent should be signed by the applicant (Flynn Learner Company).

If you have any questions regarding this letter, please contact Dana Teramoto of our staff at 523-4648.

Very truly yours,

Patrick Onishi

PATRICK T. ONISHI
Director of Land Utilization

PTO:am

/cc: Wil Chee-Planning, Inc. (Richard McGerrow)

g:sea141tr.djt

COTTON and FRAZIER Consultants, Inc.
P.O. Box 27126 Honolulu, Hawaii 96827
Phone: (808) 599-1993 Fax: (808) 599-1602

June 28, 1996

Mr. Richard McGerrow
Will Chee Planning, Inc.
Ala Moana Pacific Center
1585 Kapiolani Blvd, Suite 818
Honolulu, HI 96814

RE: City and County Letter dated June 6, 1996

Dear Mr. McGerrow:

Per your fax dated June 26, 1996, we present the following comments to the City and County letter dated June 6, 1996. Only items 2 and 3 pertain to us and are commented on.

2) Yes, a temporary cap is present on site to prevent dust migration. Yes, the State Hazard Evaluation and Emergency Response (HEER) division of the Department of Health has reviewed and accepted this temporary cap.

3) All free product has been removed as per the HEER department knowledge and directives.

If there are any questions please call me at 599-1993.

Thank you,

W. Mark Frazier

W. Mark Frazier
President

c: Jim Banigan (HMR)

---

28 June 1996

RESPONSE TO COMMENTS ON THE
FLYNN LEARNER WAREHOUSES ENVIRONMENTAL ASSESSMENT

COMMENTS FROM: Department of Land Utilization
City & County of Honolulu

DATE OF COMMENTS: June 6, 1996

ITEM	RESPONSE
1.	The applicant intends the new warehouses for general use by businesses who require warehousing space in the industrial district. At the present time there are no plans to restrict leasing to any particular type of business.
2.	See letter of June 28, 1996 from Cotton & Frazier Consultants, Inc. in response to this comment.
3.	See letter of June 28, 1996 from Cotton & Frazier Consultants, Inc. in response to this comment.
4.	Comply. Per telephone conversation between Dana Teramoto (DLU) and Richard McGerrow (Wil Chee - Planning, Inc.) only one copy of the four reference documents needs to be submitted to DLU for filing with OEQC. The volume of these documents totaling 325 pages precludes them from being bound together with the main body of the EA. Therefore, they will be bound and submitted as a separate volume titled "Technical Reference Documents".
5.	Sueda & Associates, Inc. and Donald A. Clegg are both agents for the applicant, Flynn Learner Company. An authorization letter for Sueda & Associates, Inc. was submitted to DLU on February 20, 1996 with the Draft EA and DLU master application form. A copy of this authorization letter is attached. An authorization letter for Donald A. Clegg is forthcoming.

FLYNN - LEARNER
C/O THE LEARNER COMPANY
2711 NAVY DRIVE
STOCKTON, CALIFORNIA 95206
PH: (209) 948-3498
FAX: (209) 941-2574

NOV 29 [illegible]

November 28, 1995

SUBJECT: 120 SAND ISLAND ACCESS ROAD PROPERTY

TO WHOM IT MAY CONCERN:

We hereby authorize Lloyd T. Sueda to act as our agent in the submission of applications, permits and construction and/or building plans pertaining to the above referenced project.

Very truly yours,

FLYNN - LEARNER COMPANY

Jack P. Hecht
Vice President

BENJAMIN J. CAYETANO
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

KAZU HAYASHIDA
DIRECTOR

DEPUTY DIRECTORS
JERRY M. MATSUDA
GLENN M. OKIMOTO

96-03771

IN REPLY REFER TO:
HWY-PS
2.0548

JUN 10 1996

Mr. Patrick T. Onishi, Director
Department of Land Utilization
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Onishi:

Subject: Environmental Assessment (EA) for Flynn Learner Warehouses, Honolulu; TMK: 1-2-23: 09

Thank you for consulting us concerning the subject EA. We have the following comments:

1. The revised traffic circulation plan is acceptable.
2. Construction plans for project access to Sand Island Access Road must be submitted for our review and approval.
3. The special management area use permit should require that the development will not increase surface runoff onto Sand Island Access Road. The developer must submit project drainage system plans and supporting studies for our review and approval.

Very truly yours,

KAZU HAYASHIDA
Director of Transportation

---

28 June 1996

RESPONSE TO COMMENTS ON THE
FLYNN LEARNER WAREHOUSES ENVIRONMENTAL ASSESSMENT

COMMENTS FROM: Department of Transportation
State of Hawaii

DATE OF COMMENTS: June 10, 1996

ITEM	RESPONSE
1.	Acknowledged.
2.	Acknowledged.
3.	Acknowledged.

96-03773

BOARD OF WATER SUPPLY

CITY AND COUNTY OF HONOLULU
630 SOUTH BERETANIA STREET
HONOLULU, HAWAII 96843
PHONE (808) 527-6180
FAX (808) 533-2714

June 10, 1996

1996 JUN 10 PM 4: 03
[illegible]

TO: PATRICK T. ONISHI, DIRECTOR
DEPARTMENT OF LAND UTILIZATION

FROM: FOR RAYMOND H. SATO, MANAGER AND CHIEF ENGINEER
BOARD OF WATER SUPPLY

SUBJECT: YOUR MEMORANDUM OF MAY 22, 1996 ON THE ENVIRONMENTAL ASSESSMENT (EA), CHAPTER 25, ROH, FOR THE FLYNN LEARNER WAREHOUSES PROJECT, SAND ISLAND, OAHU, TMK: 1-2-23: 09

Thank you for the opportunity to review and comment on the EA for the proposed Flynn Learner Warehouses project.

Our previous comments of December 20, 1995, which are included in Appendix A are still applicable. However, please note that the water service for the property consists of a 1-inch, not a 3/4-inch water meter.

If you have any questions, please contact Barry Usagawa at 527-5235.

---

28 June 1996

RESPONSE TO COMMENTS ON THE
FLYNN LEARNER WAREHOUSES ENVIRONMENTAL ASSESSMENT

COMMENTS FROM: Board of Water Supply
City & County of Honolulu

DATE OF COMMENTS: June 10, 1995

ITEM	RESPONSE
Paragraph 2	Acknowledged. Size of the existing water meter has been corrected from 3/4" to 1" in Section 2.2.4 of the EA.

96-03772

DEPARTMENT OF TRANSPORTATION SERVICES
CITY AND COUNTY OF HONOLULU
PACIFIC PARK PLAZA
711 KAPIOLANI BOULEVARD, SUITE 1200
HONOLULU, HAWAII 96813

JEREMY HARRIS
MAYOR

CHARLES O. SWANSON
DIRECTOR

June 12, 1996

TSP96-00431

MEMORANDUM

TO: PATRICK T. ONISHI, DIRECTOR
DEPARTMENT OF LAND UTILIZATION

FROM: CHARLES O. SWANSON, DIRECTOR

SUBJECT: CHAPTER 25, ROH, ENVIRONMENTAL ASSESSMENT FOR FLYNN LEARNER WAREHOUSES

In response to your May 22, 1996 memorandum, we reviewed the subject environmental assessment. We have no objections to the issuance of a Negative Declaration for this project.

Construction plans for all work within the City's right-of-way should be submitted to this department for review and approval.

Should you have any questions regarding our comments, please contact Faith Miyamoto of the Transportation System Planning Division at Local 6976.

for F. Samayoshi
CHARLES O. SWANSON

bcc: THD

---

28 June 1996

RESPONSE TO COMMENTS ON THE
FLYNN LEARNER WAREHOUSES ENVIRONMENTAL ASSESSMENT

COMMENTS FROM: Department of Transportation Services
City & County of Honolulu

DATE OF COMMENTS: June 12, 1996

ITEM	RESPONSE
Paragraph 2	Acknowledged.

96-03916

'96 JUN 19 P2:57

United States Department of the Interior
FISH AND WILDLIFE SERVICE
Ecological Services - Pacific Islands Ecoregion
300 Ala Moana Blvd., Room 3108
P.O. Box 50088
Honolulu, Hawaii 96850
Phone: (808) 541-3441
FAX: (808) 541-3470

In Reply Refer To: SMJ

JUN 19 1996

Mr. Patrick T. Onishi
Department of Land Utilization
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Reference: *Environmental Assessment, Chapter 25, ROH Projects Within the Special Management Area, Flynn Learner Warehouses, Sand Island Access Road.*

Dear Mr. Onishi:

The U.S. Fish and Wildlife Service (Service) has reviewed the *Environmental Assessment, Chapter 25, ROH Projects Within the Special Management Area, Flynn Learner Warehouses, Sand Island Access Road* (EA). The EA is dated May 1996 and was delivered to our office on May 23, 1996. The Service offers the following comments for your consideration.

There may be no known rare, threatened, or endangered species on the project site or in the immediate vicinity of the proposed project; however, *Section 3.2.2 Rare, Threatened, or Endangered Species and their Habitats* and *Section 3.2.3 Wildlife and Wildlife Preserves* of the EA should state that migrating shorebirds, waterfowl, and the endangered Hawaiian stilt (*Himantopus mexicanus knudseni*) use Keehi Lagoon, the closest water body to the proposed project site.

We agree with the recommendations contained within *Section 5.1 Existing Soil Contamination - Long Term Mitigation* and concur with "the use of the remedial alternative of the integrated structures and modified cap over the site to protect human health and the environment." We also concur with the removal of hydraulic soils by excavation and the recommendation for regular monitoring of the diesel and motor oil plume. While we don't have any objection to the migration times listed for PCB's and lead (*Section 2.4.1 Soils*), the migration of oil into Keehi Lagoon may be much quicker. We believe that monitoring of the diesel and motor oil plume is particularly important because migrating shorebirds, waterfowl, and the endangered Hawaiian stilt use Keehi Lagoon.

If you have any questions, please contact Fish and Wildlife Biologist Scott Johnston at 808/541-3441.

Sincerely,

for/ Brooks Harper
Field Supervisor
Ecological Services

28 June 1996

RESPONSE TO COMMENTS ON THE FLYNN LEARNER WAREHOUSES ENVIRONMENTAL ASSESSMENT

COMMENTS FROM: U.S. Department of the Interior
Fish and Wildlife Service

DATE OF COMMENTS: June 18, 1996

ITEM	RESPONSE
Paragraph 2	Acknowledged. Your comments have been added to Section 3.2.2 in the EA and referenced to section 3.2.3. The text now reads, "There are no known rare, threatened or endangered species on the project site or in the immediate vicinity. However, the Fish and Wildlife Service of the U.S. Department of the Interior has noted that migrating shorebirds, waterfowl and the endangered Hawaiian stilt (*Himantopus mexicanus knudseni*) use Keehi Lagoon, the closest water body to the proposed project site. For this reason they believe that monitoring of the diesel and motor oil plume is particularly important This comment is also applicable to Section 3.2.3 below."
Paragraph 3	Acknowledged. Changes to the EA same as above.

APPENDIX - B

Traffic Assessment Report

TRAFFIC ASSESSMENT REPORT

FLYNN LEARNER WAREHOUSES

IN HONOLULU, HAWAII

Prepared For

Flynn Learner Company
Stockton, California

Prepared By

Phillip Rowell and Associates
47-273 D Hui Iwa Street
Kaneohe, Hawaii 96744
Phone & Fax: (808) 239-8206

February 12, 1996

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

Phillip Rowell and Associates has been retained to perform a Traffic Assessment for a proposed warehouse project in Kalihi-Kai, Honolulu, Hawaii. These lots are located along the north side of Sand Island Access Road and east of Pahounui Drive.

The proposed development is to consist of four warehouses with a total gross floor area of 112,500 square feet including mezzanine. Also included in the development will be 154 parking spaces and 7 loading zones.

The following report has been prepared to describe the traffic characteristics of the project and likely impacts to the adjacent roadway network. This introductory chapter discusses the location of the project, the proposed development, and the study methodology.

Project Location and Description

The location of the proposed project shown on Figure 1.

As previously noted, the project is to consist of 112,500 gross square feet of floor area. There are four separate buildings planned. The current plan provides two driveways along Sand Island Access Road and two driveways along Pahounui Drive. The driveways along Sand Island Access Road will allow right turns in and out only because of the median being constructed along Sand Island Access Road.

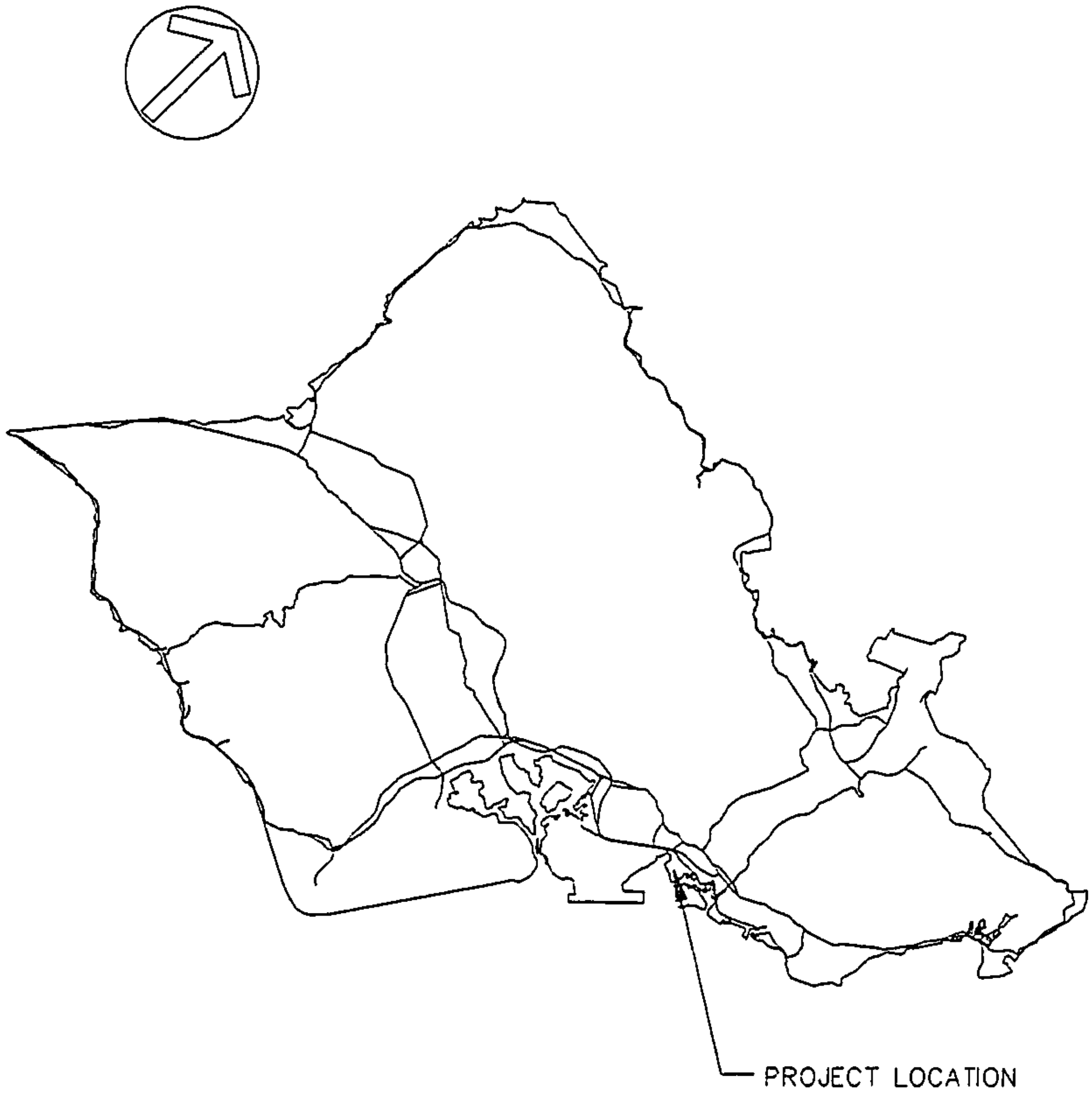


Figure 1

Location Map

Study Methodology

In order to conduct this traffic study, a number of tasks were performed. These tasks are discussed in the following paragraphs.

1. Data Collection

Traffic counts were obtained from Hawaii Department of Transportation and supplemented by traffic counts conducted for this study to verify peak hour turning volumes. These counts were conducted during January 1996.

2. Analysis of Existing Traffic Conditions

Using the data collected, existing traffic conditions in the vicinity of the project were determined. Traffic conditions are described by the level-of-service (LOS) at each study intersection.

The planning method described in the 1994 Highway Capacity Manual (HCM) was used to determine the level-of-service at the intersections. A comparative analysis is presented for each scenario (i.e. existing and future conditions with the project) using this method. A more detailed explanation of the methodology, the level-of-service concept and the results are presented in Chapter 2.

3. Analysis of Project-Related Traffic Characteristics

The next step in the traffic analysis of the project was to estimate the peak-hour traffic that would be generated by the proposed project. This was done using standard trip generation rates published by the Institute of Transportation Engineers. These trips were distributed based on the origin of the visitors and employees and the available approach and departure routes. The project related traffic characteristics is presented in Chapter 3.

4. Determination of Project-Related Traffic Impacts

The HCM method was then used to conduct a level-of-service analysis for future conditions with the project. This condition was compared to 1996 existing conditions to determine the impacts of this project. The results of this analysis is presented in Chapter 4.

2. ANALYSIS OF EXISTING CONDITIONS

This chapter presents the existing traffic conditions and volumes on the roadways adjacent to the proposed project. The level-of-service concept and the results of the level-of-service analysis for existing conditions are also presented. The purpose of this analysis is to establish the base conditions for the determination of the impacts of the project which are described in a subsequent chapter.

Existing Intersection Controls

The intersection of Sand Island Access Road at Pahounui Drive is controlled by a traffic signal. The signal provides separate left turn phases for Sand Island Access Road traffic to Pahounui Drive and to Auiki Street. A schematic of the intersection indicating the lane configuration and signal phasing is shown as Figure 2.

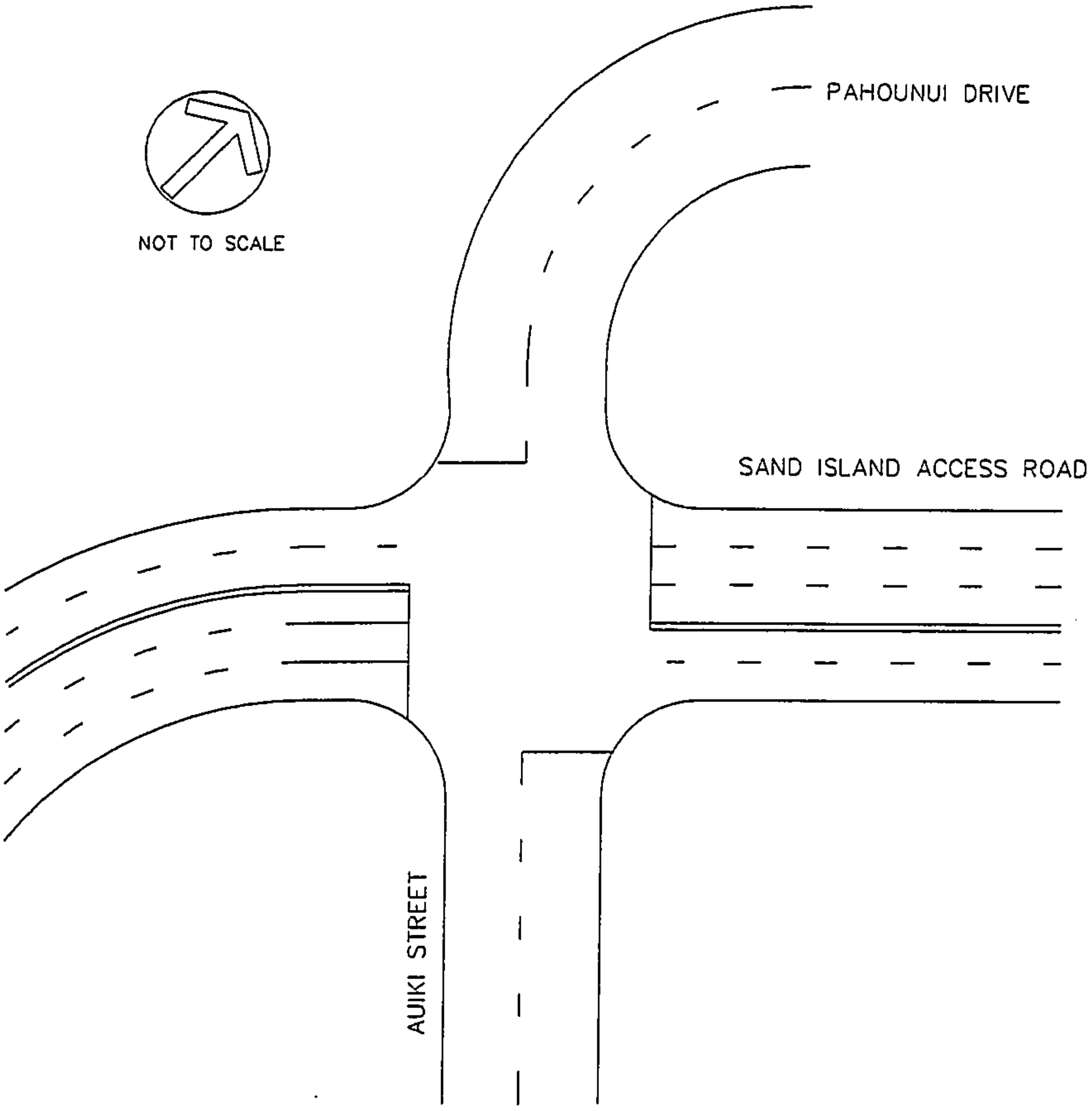


Figure 2

Existing Intersection Configuration

Existing Peak Hour Traffic Volumes

The existing weekday morning and afternoon traffic volumes approaching and departing the intersection of Sand Island Access Road at Pahounui Drive were obtained from Hawaii Department of Transportation (HDOT) data. These counts were performed in 1993 and were adjusted as follows:

1. The traffic counts were increased by three percent (3%) per year to adjust for the ambient increase in traffic from 1993 to 1996. This growth rate was calculated from the total daily traffic volumes provided in the HDOT traffic data from 1984 to 1993. Therefore, the 1993 traffic volumes were increase by approximately 10 percent.

2. Morning and afternoon peak hour counts were conducted to obtain the turning movements at the intersection. The percentage turning movements obtained from the manual counts was then applied to the total approach traffic volumes from HDOT traffic volume.

3. Traffic volumes were factored by 1.20 to account for the high percentage of heavy vehicles using all approaches of the intersection. This factor converts the number of vehicles counted to passenger car equivalent units. HDOT's counts did not provide vehicle classification counts. It was estimated that 20% of the vehicles were heavy trucks. The HCM correction factor for this percentage is 0.833.

The AM and PM peak hour traffic volumes used in the following analyses are shown in Figure 3.

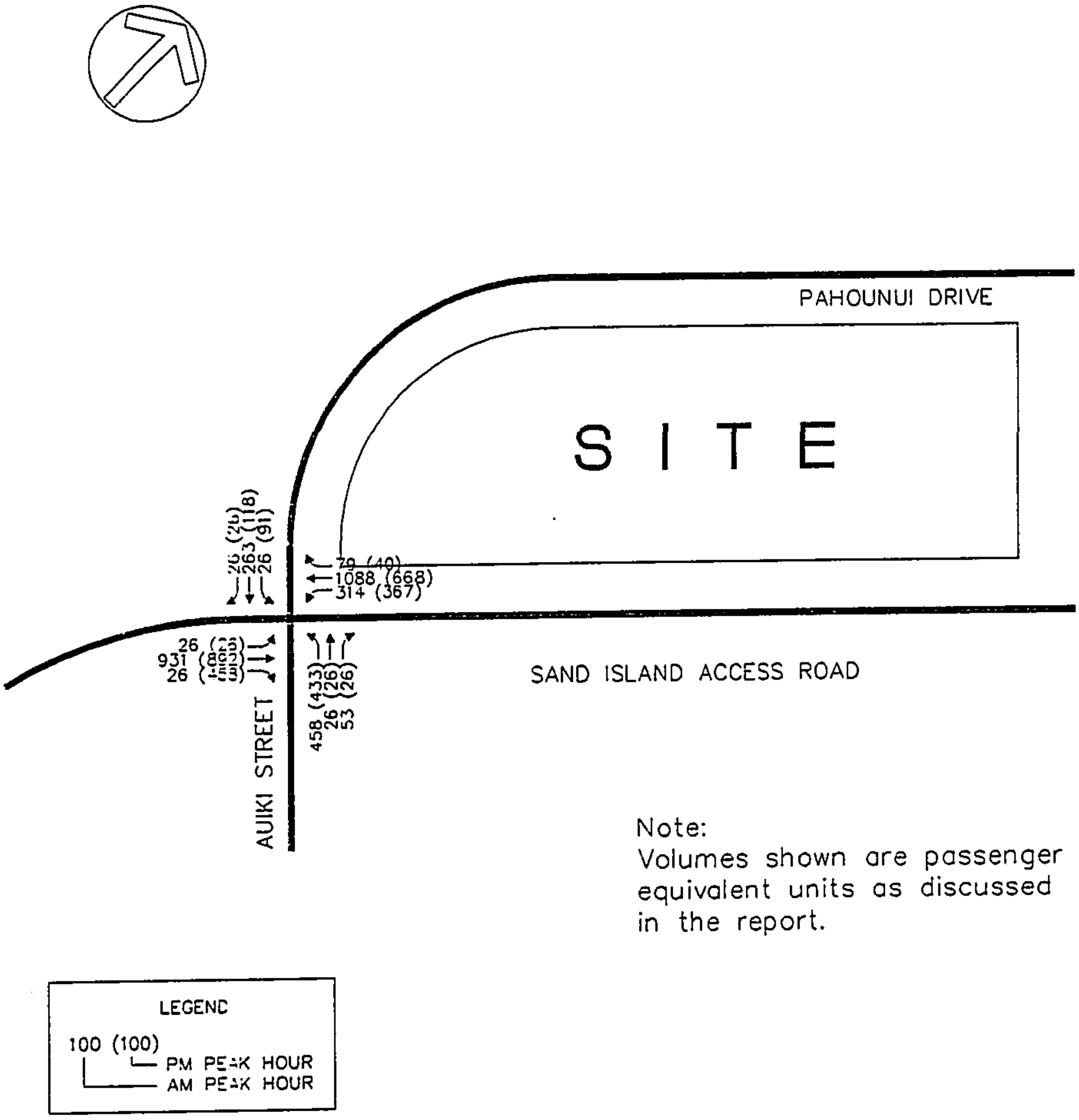
Level-of-Service Concept

Signalized Intersections

The planning method described in Chapter 9 of the 1994 Highway Capacity Manual (HCM) was used to analyze the operating efficiency of the signalized intersections adjacent to the study site. This method involves the calculation of a volume-to-capacity (V/C) ratio which is related to a level-of-service or as "under capacity," "near capacity," "at capacity," or over capacity." A maximum intersection capacity based on the number of phases was used for the V/C calculations.

"Level-of-Service" is a term which denotes any of an infinite number of combinations of traffic operating conditions that may occur on a given lane or roadway when it is subjected to various traffic volumes. Level-of-service (LOS) is a qualitative measure of the effect of a number of factors which include:

- Space,
- Speed,
- Travel Time,
- Traffic Interruptions,
- Freedom to Maneuver,
- Safety
- Driving Comfort, and
- Convenience



Note:
Volumes shown are passenger equivalent units as discussed in the report.

Figure 3

Existing [1996] Peak Hour Traffic Volumes

There are six levels-of-service, A through F, which relate to the driving conditions from best to worst, respectively. The characteristics of traffic operations for each level-of-service are summarized in Table 1. In general, LOS A represents free-flow conditions with no congestion. LOS F, on the other hand, represents severe congestion with stop-and-go conditions. Level-of-service D is typically considered acceptable for peak hour conditions in urban areas.

Table 1 Level-of-Service Definitions for Signalized Intersections (Planning Method)(1)

Level of Service	Interpretation	Volume-to-Capacity Ratio(2)	Stopped Delay (Seconds)
A,B	Uncongested operations; all vehicles clear in a single cycle.	0.000-0.700	<15.0
C	Light congestion; occasional backups on critical approaches	0.701-0.800	15.1-25.0
D	Congestion on critical approaches but intersection functional. Vehicles must wait through more than one cycle during short periods. No long standing lines formed.	0.801-0.900	25.1-40.0
E	Severe congestion with some standing lines on critical approaches. Blockage of intersection may occur if signal does not provide protected turning movements.	0.901-1.000	40.1-60.0
F	Total breakdown with stop-and-go operation	>1.001	>60.0

Notes:
(1) Source: Highway Capacity Manual, 1994.
(2) This is the ratio of the calculated critical volume to Level-of-Service E Capacity.

Corresponding to each level-of-service shown in the table is a volume/capacity ratio. This is the ratio of either existing or projected traffic volumes to the capacity of the intersection. Capacity is defined as the maximum number of vehicles that can be accommodated by the roadway during a specified period of time. The capacity of a particular roadway is dependent upon its physical characteristics such as the number of lanes, the operational characteristics of the roadway (one-way, two-way, turn prohibitions, bus stops, etc.), the type of traffic using the roadway (trucks, buses, etc.) and turning movements.

Existing Level-of-Service Analysis

The signalized intersections were analyzed using the signalized level-of-service (LOS) planning method. Results of these analyses are shown in Table 2 The calculated level-of-service were confirmed by field observations.

The intersection of Sand Island Access Road at Pahounui Drive operate at Level-of-Service (LOS) C during the morning peak hour and LOS E during the afternoon peak hour. The calculations for the morning confirms the field observations. However, the LOS E calculated was not observed; the observed LOS was D. There were no long standing lines of vehicles in queues and all lanes cleared on every traffic signal cycle.

Table 2 Existing Level-of-Service Analysis for Signalized Intersections(3)(4)

Intersection	AM Peak Hour		PM Peak Hour	
	V/C(1)	LoS(2)	V/C(1)	LoS(2)
Sand Island Access Road at Pahounui Drive	0.798	C	0.938	E

NOTES:
(1) V/C = Volume-to-Capacity Ratio
(2) LoS = Level-of-Service
(3) Level-of-Service calculated using planning method described in Highway Capacity Manual.
(4) For calculations, see Appendix C.

3. PROJECT-RELATED TRAFFIC CHARACTERISTICS

This chapter discusses the methodology used to identify the traffic-related impacts of the proposed project. Generally, the process involves the determination of weekday and peak-hour trips that would be generated by the proposed project, distribution and assignment of peak hour trips on the approach and departure routes, and finally, determination of the levels-of-service at affected intersections subsequent to implementation of the project.

Trip Generation

Future traffic volumes generated by the project were determined using trip generation equations contained in Trip Generation, Fifth Edition, prepared by the Institute of Transportation Engineers. The trip generation analysis and the resulting daily and peak hour volumes are summarized in Table 3.

The trip generation rates used are those for mini-warehouses as defined in Trip Generation. This definition most closely describes the proposed development as we understand it. It is our understanding that the warehouse will be leased to individual users and that office space will be limited to administration only.

Table 3

Trip Generation Calculations

Flynn Learner Warehouses Traffic Assessment

Note

Gross Floor Area 112,500 Square Feet

Period	Trips/TGSF	Trips	
Weekday Total	2.61	294	
AM Peak Hour Total	0.26	29	
AM In	90%		26
AM Out	10%		3
PM Peak Hour Total	0.28	32	
PM In	50%		16
PM Out	50%		16
Saturday Total	2.33	262	
Saturday Peak Hour	0.40	45	
Sat In	50%		23
Sat Out	50%		22
Sunday Total	1.78	200	
Sunday Peak Hour	0.30	34	
Sunday In	50%		17
Sunday Out	50%		17

Trip Distribution

The project-related trips were distributed along the anticipated approach and departure routes to the project site. These routes are based approximately on the existing distribution of traffic approaching and departing the intersection of Sand Island Access Road at Pahounui Drive.

The approach and departure distributions are as follow:

a. 25% from the east along Sand Island Access Road
b. 5% from the east along Pahounui Drive
c. 20% from the south along Auiki Street
d. 50% from the west along Sand Island Access Road

Trip Assignment

Using the trip generation and trip distribution previously discussed, project-related traffic was assigned to the various traffic movements at the intersections studied. The assignment is based on the access and egress plan as shown in the Environmental Assessment. The plan provides two driveways along Sand Island Access Road and two along Pahounui Drive.

The traffic assignments are shown on Figure 4.

1996 Plus Project Peak Hour Traffic Volumes

Future traffic volumes with the project were determined by superimposing the project-generated traffic on the 1996 existing traffic volumes presented in Chapter 2. The resulting traffic volumes are shown for the peak hours on Figure 5.

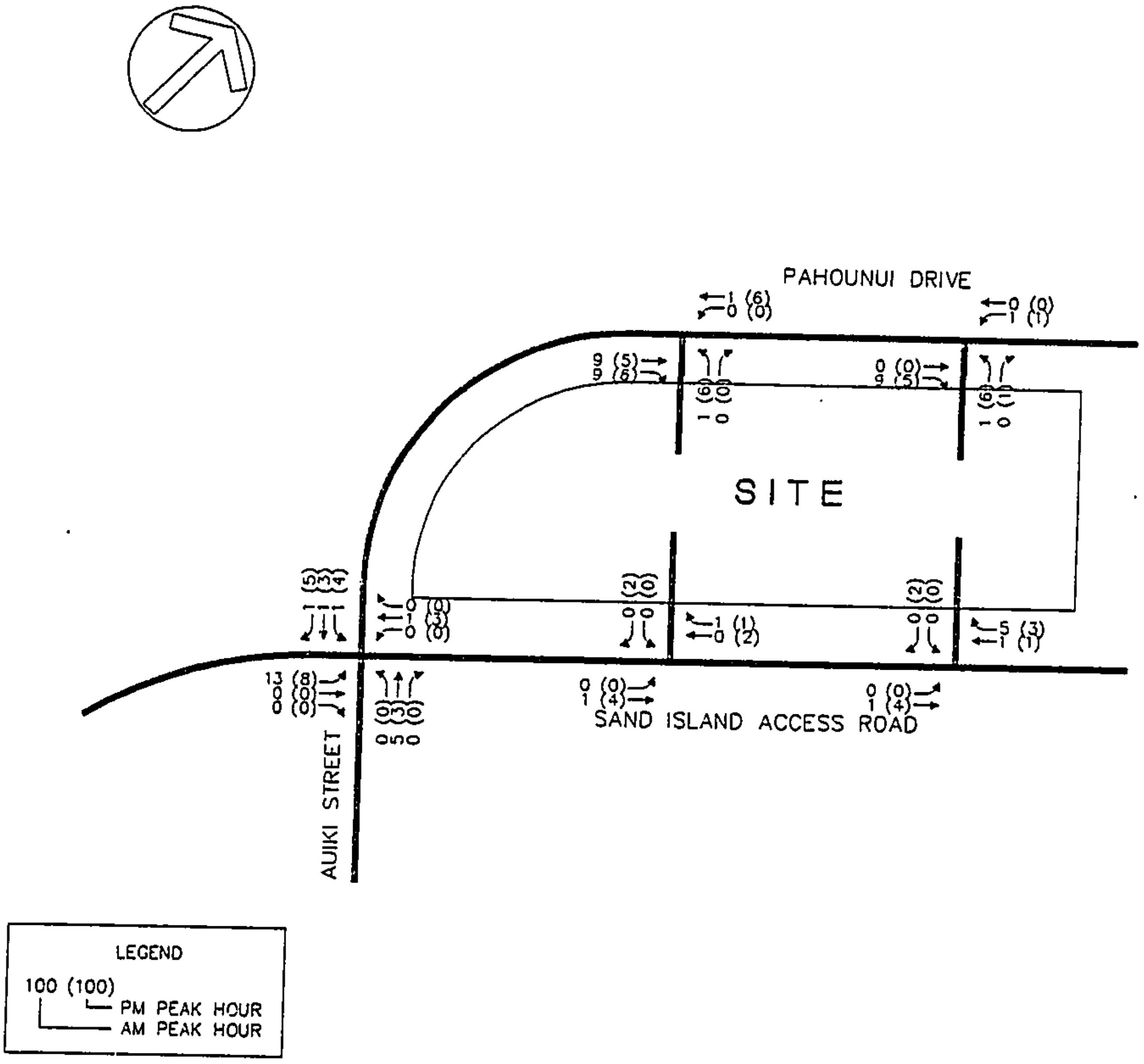


Figure 4

Traffic Assignments

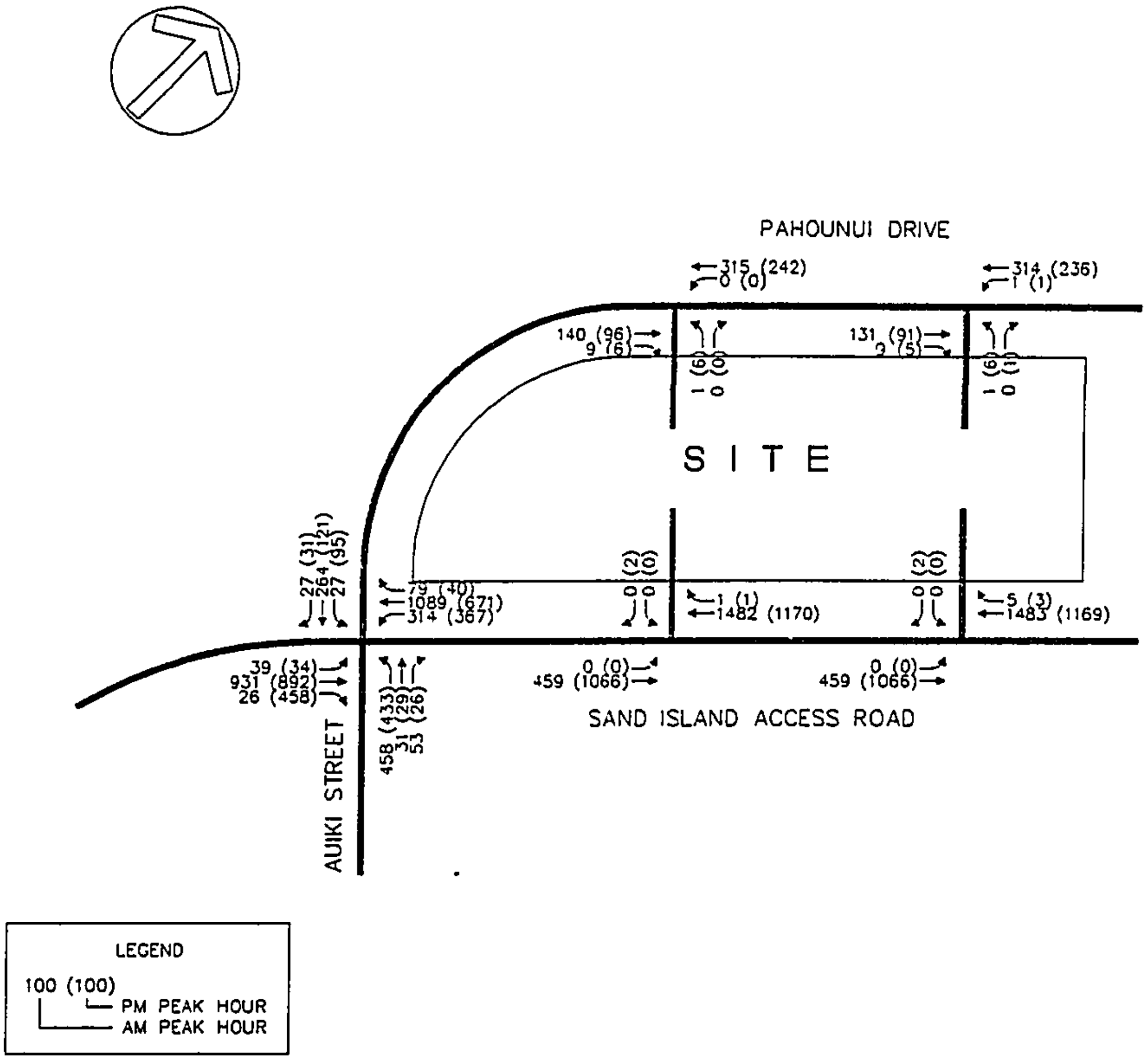


Figure 5

1996 Existing Plus Project Peak Hour Traffic Volumes

4. CONCLUSIONS AND RECOMMENDATIONS

The purpose of this chapter is to present the results of the level-of-service analysis, which identifies the project-related impacts. In addition, any mitigation measures necessary and feasible are identified and other access, egress and circulation issues are discussed.

Definition of Significant Impacts

Criteria for determining if a project has a significant traffic impact for which mitigation measures must be investigated have been established based on traffic impact study guidelines used in various other cities. Generally, the criteria are as follows: if the level-of-service (LOS) without the project is E or F and the volume/capacity (V/C) ratio changes less than 0.020, the project's traffic impacts are considered insignificant. However, if the V/C ratio change is greater than 0.020, then mitigation measures which will reduce the V/C ratio change to less than 0.020 must be identified. If the LOS with the project is D or better, then no mitigation measures need to be identified.

The above criteria was developed in consultation with Office of Environmental Quality Control and the consultant preparing the Oahu Long-Range Regional Transportation Plan and the Waikiki Regional Traffic Impact Study for the City and County of Honolulu and was used for both these studies and the Traffic Impact Analysis Report for the Hawaii Convention Center.

Project Related Traffic Impacts and Mitigation Measures

The results of the LOS are summarized in Tables 4. Shown in the table are the volume-to-capacity ratios for conditions without and with the project. Also shown are the results of the analysis for conditions after Sand Island Access Road has been widened from two to three lanes in each direction as now planned by HDOT.

Table 4 **Results of Level-of-Service Analysis for Sand Island Access Road at Pahounui Drive[3]**

Condition	AM Peak Hour				PM Peak Hour			
	w/o Project		w/ Project		w/o Project		w/ project	
	V/C[1]	LoS[2]	V/C[1]	LoS[2]	V/C[1]	LoS[2]	V/C[1]	LoS[2]
Sand Island Access Road as Four Lanes	0.798	C	0.801	D	0.938	E	0.940	E
Sand Island Access Road as Six Lanes	0.698	B	0.701	C	0.797	C	0.799	C

NOTES:
(1) V/C = Volume-to-Capacity Ratio
(2) LoS = Level-of-Service
(3) Level-of-Service calculated using planning method described in Highway Capacity Manual.

Conclusions and Summary

The conclusions of the traffic assessment analysis is that the impact of this project is insignificant and no mitigations are required as a result of project generated traffic.

Study Methodology

In order to conduct this traffic study, a number of tasks were performed. These tasks are discussed in the following paragraphs.

1. Data Collection

Traffic counts were obtained from Hawaii Department of Transportation and supplemented by traffic counts conducted for this study to verify peak hour turning volumes. These counts were conducted during January 1996.

2. Analysis of Existing Traffic Conditions

Using the data collected, existing traffic conditions in the vicinity of the project were determined. Traffic conditions are described by the level-of-service (LOS) at each study intersection.

The planning method described in the 1994 Highway Capacity Manual (HCM) was used to determine the level-of-service at the intersections. A comparative analysis is presented for each scenario (i.e. existing and future conditions with the project) using this method. A more detailed explanation of the methodology, the level-of-service concept and the results are presented in Chapter 2.

3. Analysis of Project-Related Traffic Characteristics

The next step in the traffic analysis of the project was to estimate the peak-hour traffic that would be generated by the proposed project. This was done using standard trip generation rates published by the Institute of Transportation Engineers. These trips were distributed based on the origin of the visitors and employees and the available approach and departure routes. The project related traffic characteristics is presented in Chapter 3.

4. Determination of Project-Related Traffic Impacts

The HCM method was then used to conduct a level-of-service analysis for future conditions with the project. This condition was compared to 1996 existing conditions to determine the impacts of this project. The results of this analysis is presented in Chapter 4.

2. ANALYSIS OF EXISTING CONDITIONS

This chapter presents the existing traffic conditions and volumes on the roadways adjacent to the proposed project. The level-of-service concept and the results of the level-of-service analysis for existing conditions are also presented. The purpose of this analysis is to establish the base conditions for the determination of the impacts of the project which are described in a subsequent chapter.

Existing Intersection Controls

The intersection of Sand Island Access Road at Pahounui Drive is controlled by a traffic signal. The signal provides separate left turn phases for Sand Island Access Road traffic to Pahounui Drive and to Auiki Street. A schematic of the intersection indicating the lane configuration and signal phasing is shown as Figure 2.

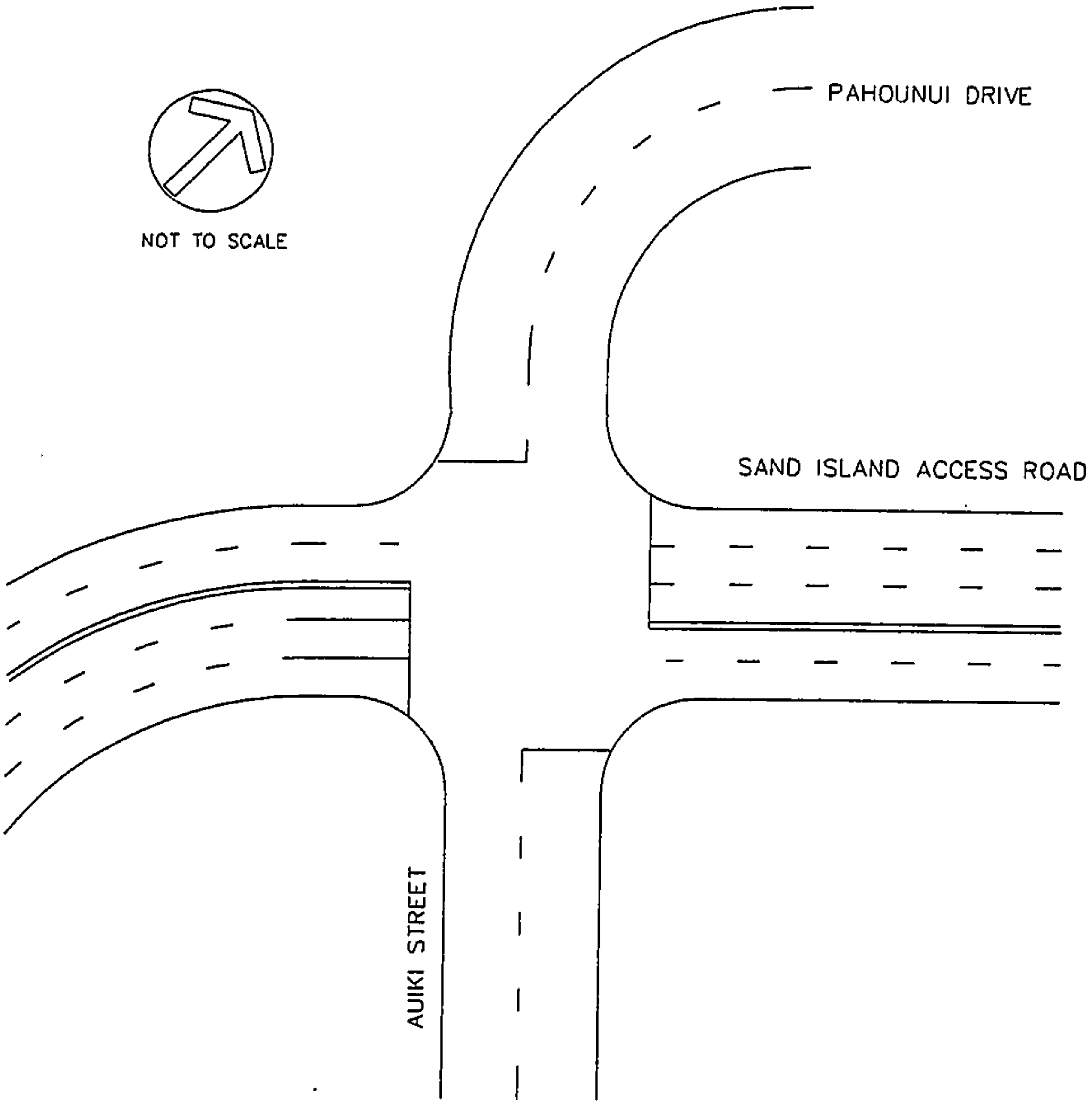


Figure 2
Existing Intersection Configuration

Existing Peak Hour Traffic Volumes

The existing weekday morning and afternoon traffic volumes approaching and departing the intersection of Sand Island Access Road at Pahounui Drive were obtained from Hawaii Department of Transportation (HDOT) data. These counts were performed in 1993 and were adjusted as follows:

1. The traffic counts were increased by three percent (3%) per year to adjust for the ambient increase in traffic from 1993 to 1996. This growth rate was calculated from the total daily traffic volumes provided in the HDOT traffic data from 1984 to 1993. Therefore, the 1993 traffic volumes were increase by approximately 10 percent.

2. Morning and afternoon peak hour counts were conducted to obtain the turning movements at the intersection. The percentage turning movements obtained from the manual counts was then applied to the total approach traffic volumes from HDOT traffic volume.

3. Traffic volumes were factored by 1.20 to account for the high percentage of heavy vehicles using all approaches of the intersection. This factor converts the number of vehicles counted to passenger car equivalent units. HDOT's counts did not provide vehicle classification counts. It was estimated that 20% of the vehicles were heavy trucks. The HCM correction factor for this percentage is 0.833.

The AM and PM peak hour traffic volumes used in the following analyses are shown in Figure 3.

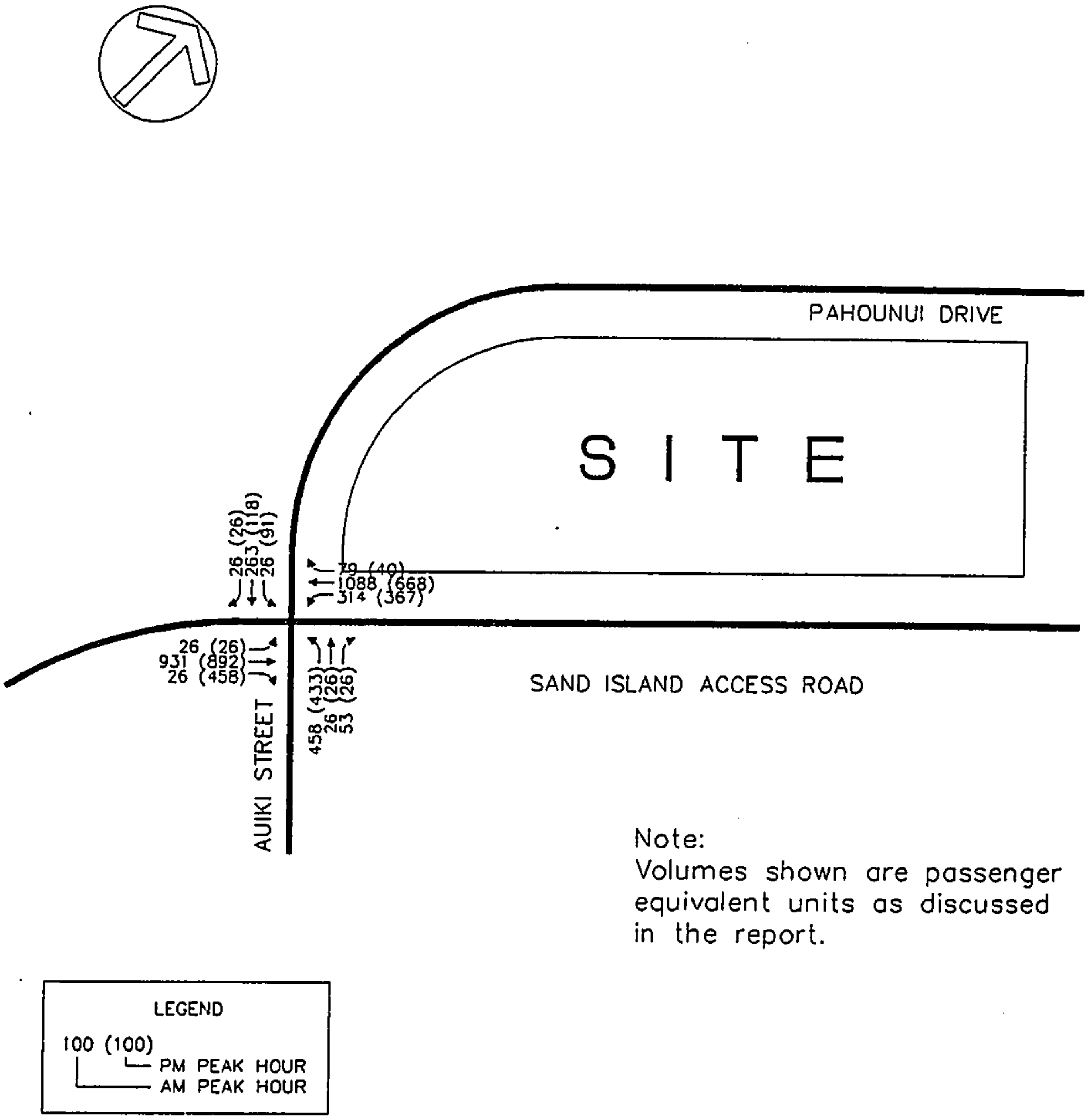
Level-of-Service Concept

Signalized Intersections

The planning method described in Chapter 9 of the 1994 Highway Capacity Manual (HCM) was used to analyze the operating efficiency of the signalized intersections adjacent to the study site. This method involves the calculation of a volume-to-capacity (V/C) ratio which is related to a level-of-service or as "under capacity," "near capacity," "at capacity," or over capacity." A maximum intersection capacity based on the number of phases was used for the V/C calculations.

"Level-of-Service" is a term which denotes any of an infinite number of combinations of traffic operating conditions that may occur on a given lane or roadway when it is subjected to various traffic volumes. Level-of-service (LOS) is a qualitative measure of the effect of a number of factors which include:

- Space,
- Speed,
- Travel Time,
- Traffic Interruptions,
- Freedom to Maneuver,
- Safety
- Driving Comfort, and
- Convenience



Note:
Volumes shown are passenger equivalent units as discussed in the report.

Figure 3

Existing [1996] Peak Hour Traffic Volumes

JUL 23 1996
FILE COPY

ENVIRONMENTAL ASSESSMENT

FLYNN LEARNER WAREHOUSES
120 Sand Island Access Road
Honolulu, Oahu, Hawaii

Tax Map Key 1-2-23: Parcel 9,
Lots 10A, 11A, 12A, and 13A

July 1, 1996

TECHNICAL REFERENCE DOCUMENTS

Prepared for:

Sueda & Associates, Inc.
905 Makahiki Way - Mauka Suite
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Prepared by:

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ENVIRONMENTAL ASSESSMENT

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TECHNICAL REFERENCE DOCUMENTS

Note: This volume contains technical reference documents pertaining to the EA. The main body of the EA is bound in a separate volume.

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Table of Contents

Risk Assessment Report

For:
Flynn Learner
91-056 Hana Street
Ewa Beach, Hawaii 96707

Location:
120 Sand Island Access Road

October 22, 1993

CFC Job #93064

Cotton and **Frazier**
Consultants, Inc.

"Environmental Solutions"

P.O. BOX 27126
Honolulu, Hawaii 96827

PHONE (808) 599-1993
FAX (808) 599-1502

120 SAND ISLAND ACCESS ROAD
RISK ASSESSMENT REPORT

PREFACE

COTTON and FRAZIER Consultants Inc. (CFC) has been involved with 120 Sand Island Access Road since engaged in June 1992 to perform an environmental investigation of the site. Mark W. Frazier, Senior Hydrogeologist and Vice President, managed all aspects of field investigation and reporting until project management for this risk assessment was passed to Lee R. Cranmer, Licensed Professional Civil Engineer and Project Manager, in July 1993.

Cooperating with CFC on the modeling of fate and transport was Donn L. Marrin, Doctor of Water Resources and President of InterPhase, a San Diego, California based firm specializing in vadose zone migration and environmental chemistry.

Exposure assessment predictions, toxicological effects, and assessment of human-health based risks were conducted under the supervision of G. Joseph Stewart, Environmental Toxicologist, a Redmond, Washington based consultant specializing in toxicology and environmental chemistry.

RISK ASSESSMENT REPORT
120 SAND ISLAND ACCESS ROAD

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120 SAND ISLAND ACCESS ROAD
RISK ASSESSMENT REPORT

1.0 EXECUTIVE SUMMARY

COTTON and FRAZIER Consultants Inc. (CFC) was engaged by Jim Bannigan, General Manager of Flynn Learner, to perform a risk assessment of the environmental conditions known to exist on their leased property at 120 Sand Island Access Road. The 130,000 sq. ft. site has been used by Flynn-Learner for metals recycling from 1951 to 1991 and the presence of several compounds of concern have been confirmed on the site: benzo(a)pyrene, polychlorinated biphenyls, cadmium, copper, lead, and zinc.

Modeling of the vadose zone and groundwater transport mechanisms indicated that: 1.) only polychlorinated biphenyl vapors would diffuse up through the ground surface and 2.) it would take a minimum of 460,000 years for any of the compounds to reach Keehi Lagoon via the groundwater.

The only exposure scenarios predicted to lead to human contact with contaminants were found to be: 1.) dermal contact with, 2.) inhalation of, and 3.) incidental ingestion of site soil particles by employees and construction workers who might be employed directly on site.

Based upon a review of information obtained by site investigations and an assessment of potential exposures to compounds of concern and their toxic effects, we concluded that certain human health-based risks exist from the known environmental conditions of the site. However, these risks can be mitigated by taking some specific actions.

Based upon our investigation and the findings of Dr. Don Marrin and Mr. Joe Stewart, COTTON and FRAZIER Consultants, Inc. recommends the following actions be taken to mitigate site risks:

- Abating long-term exposure risks by "capping" the site with a traffic grade asphalt pavement in areas not redeveloped with structures.
- Mitigating any incidental ingestion and dermal contact during construction through the use of appropriate respiratory protection, minimizing exposed skin, and consuming no food on-site. Also, best management practices should be employed to control dust and erosion.
- To reduce any risks occasioned by exposure of soils to wind, we recommend constructing a temporary site "cap" as soon as is practical.
- Interim to any site improvements, anyone remaining on site more than 3 hours should follow all recommendations provided for construction exposure mitigation.

2.0 INTRODUCTION

2.1 Overview

COTTON and FRAZIER Consultants Inc. (CFC) was engaged by Flynn-Learner to perform a risk assessment of the environmental conditions known to exist on their leased property at 120 Sand Island Access Road. The 130,000 sq. ft. site was used by Flynn-Learner for metals recycling from 1951 until 1991. Releases of several compounds of concern were confirmed by environmental investigations of the site commencing in 1991. Our assessment includes identifying compounds of concern, assessing exposure and toxicity, comparing risk abatement options, and recommending a course of action for closure of the property.

2.2 Site Description

a. Site Location - The site is located on the island of Oahu, to the west of Honolulu, on a small peninsula of reclaimed land, on the northwest corner of Sand Island Access Road and Pahounui Drive [Figure 2-1]. The site address is: 120 Sand Island Access Road, Honolulu, Hawaii 96819 (TMK 1-2-23, parcel 9).

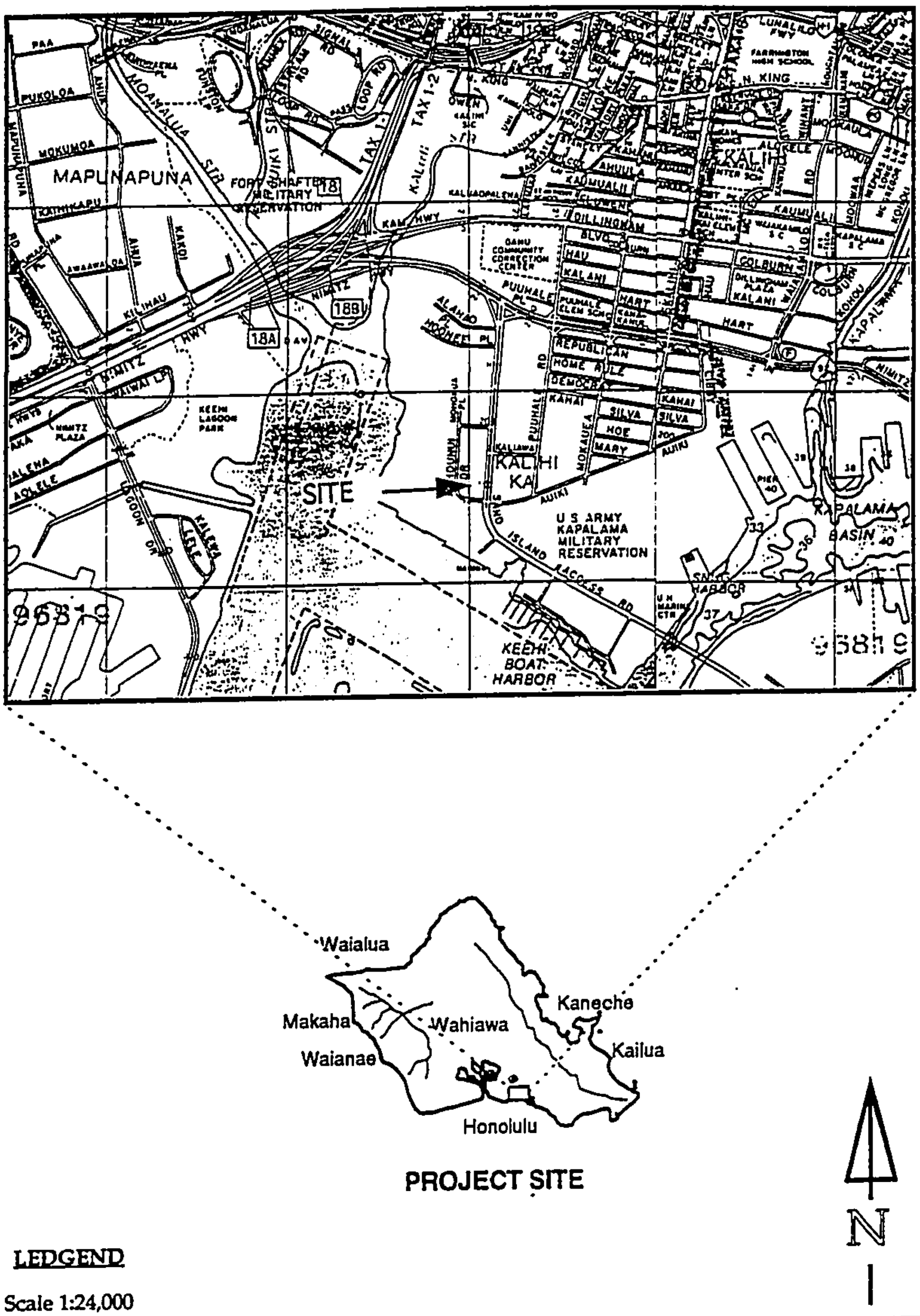
b. Present Site Conditions - At present (September 1993), the property lies unused, except for a few truck trailers and a crane stored on site. Only two vacant structures occupy the 330 by 400 foot property; a single-story 30 by 45 foot office building and a 40 by 135 foot shed, both located adjacent to the Sand Island Access Road [Figure 2-2]. The only other improvements remaining on site are truck scales located between the office building and Sand Island Access Road. The remainder of the site consists of fairly level and barren soil, a silty sand mixed with metal, glass, and plastic debris.

c. Site History -

1. Ownership - Records at the State of Hawaii Real Property Assessment Division only date back to 1951 for this property. On October 2, 1951, the site owners, the Samuel M. Damon Trust Estate, signed a 40-year lease with Flynn Learner commencing on October 2, 1951.

2. Operations - Flynn-Learner operated a permitted metal recycling facility on the site from 1951 to 1991. Aerial photos indicate that automobile recycling took place on-site since at least 1955. The site has been idle since 1991 [CFC, October 1992].

   Former structures at the site included an incinerator, a metal shear, a battery casing storage pit, and an engine block storage pit. The incinerator was located to the west of the shed and the metal shear was located in the southeast corner of the property. A single underground storage tank was located, and since removed, next to the shed [CFC, October 1992].



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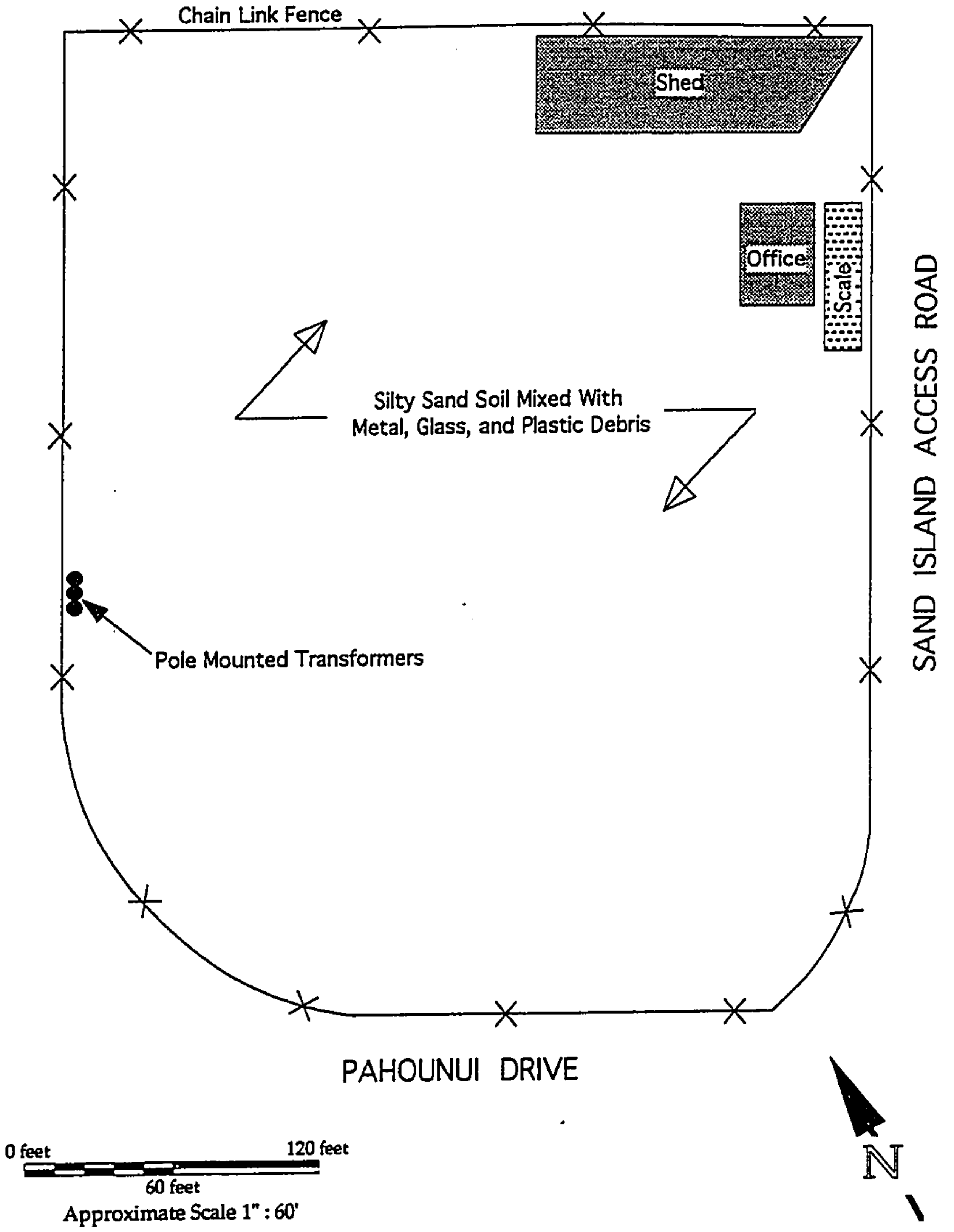
COTTON and FRAZIER Consultants, Inc. October 22, 1993	SITE LOCATION FLYNN-LEARNER Sand Island, Oahu, Hawaii	Figure 2-1



COTTON and FRAZIER
Consultants, Inc.
October 22, 1993

PRESENT SITE CONDITIONS
Sand Island Access Road Facility
Oahu, Hawaii

Figure 2-2

3. Site Investigation - Petroleum hydrocarbons and elevated levels of cadmium and lead were confirmed by Weiss Associates during their preliminary investigation of the site in August 1991 [Weiss, October 1991]. CFC personnel further delineated the extents of the petroleum hydrocarbon and metals during our August 1992 investigation of the site. Two free product plumes on the groundwater, three areas of gross petroleum hydrocarbon contamination, and cadmium and lead contamination within site surface soils were documented. The apparent sources of the petroleum hydrocarbon releases were hydraulic oil from the metal shear equipment and crane, and motor oils from the engine block storage area. The apparent sources of cadmium and lead were from car batteries dismantled on site [CFC, October 1992].

2.3 Scope

This risk assessment was performed in accordance with U.S. Environmental Protection Agency (EPA) guidance [EPA, December 1989]. The following activities were conducted:

a. Identification of Compounds of Potential Concern - All available reports on the site were reviewed to determine compounds detected on site. Previous analytical results were reviewed alongside the results of additional analysis to determine which compounds were detected, which compounds exceeded applicable or relevant and appropriate requirements (ARARs) and if any trends were demonstrated by the available data. The result of this activity was the selection of compounds of concern for use in exposure and risk assessment.

b. Exposure Assessment - By characterizing the physical setting and determining beneficial uses of the vicinity, potential exposure pathways were identified. This activity resulted in an estimate of the magnitude, frequency, and duration of exposure to potential receptors of the compounds of concern.

c. Toxicity Assessment - Next, the adverse health effects of each compound of concern were examined, enabling a quantitative and qualitative characterization of the risk associated with such exposures. Any uncertainties associated with the first three activities were also considered at this point.

d. Risk Abatement - Finally, we analyzed methods for abating identified risks. By comparing available technologies we were able to recommend specific corrective actions and develop a plan for their implementation.

2.4 Report Organization

This report is organized into the following sections:

1.0 Executive Summary
2.0 Introduction
3.0 Identification of Compounds of Concern
4.0 Exposure Assessment
5.0 Toxicity Assessment
6.0 Risk Abatement
7.0 Summary and Conclusions
8.0 References
Appendices

3.0 IDENTIFICATION OF COMPOUNDS OF POTENTIAL CONCERN

3.1 Analytical Investigation

Contamination of site soil was investigated and reported on by Weiss Associates in August 1991 [Weiss, October 1991] and by CFC in August 1992 [CFC, October 1992]. CFC personnel conducted six additional investigative events between October 1992 and August 1993 to further quantify site soils and groundwater. Table 3.1 summarizes analytical results.

Key to Table 3-1 - Compounds Detected vs. ARARs

DOH SOIL	State of Hawaii, Department of Health, published guidelines.
DOH WATER	State of Hawaii, Department of Health, published guidelines.
ND<1	Not detected at a minimum detection limit of 1 ppm.
NS	No published standard.
PPM	Part per million.
Soil BG	Background analysis results of soil samples.
Soil High	Highest detected value for that round of sampling.
Soil Low	Lowest detected value for that round of sampling.
Water High	Highest detected value for that round of sampling.
Water Low	Lowest detected value for that round of sampling.
--	Not sampled that round.
*	Samples collected on July 21, 1993.
**	Results are from one discrete sample, all others samples resulted in ND.

Table 3-1 Compounds Detected vs. Applicable or Relevant and Appropriate Requirements (ARARs)

Compound	8/21/91 Soil High mg/kg	8/21/91 Soil Low mg/kg	8/21/91 Soil BG mg/kg	8/12/92 Soil High mg/kg	8/12/92 Soil Low mg/kg	10/15/92 Soil BG mg/kg	8/12/92 Water High mg/L	3/3/93 Filter Water mg/L	7/26/93 Water High mg/L	2/17/93 Soil mg/kg	DOH SOIL mg/kg	DOH WATER mg/L
METALS												
Sb, Antimony	182	ND<3.25	ND<3.25	64	ND<10	- -	ND<0.06	ND<0.1	- -	- -	NS	15
As, Arsenic	- -	-	- -	25	ND<5	ND<5	25	0.02	- -	- -	NS	0.036
Ba, Barium	670	195	95			110	- -	- -	- -	- -	NS	NS
Cd, Cadmium	124	2	3	46	1.2	ND<1	0.17	ND<0.05	- -	- -	3	0.043
Cr, Chromium	170	19	14	170	4.7	3.6	0.73	ND<0.05	- -	- -	NS	0.05
Co, Cobalt	32	16	5	61	5	- -	0.24	ND<0.1	- -	- -	NS	NS
Cu, Copper	31,700	60	175	9,900	38	- -	17	ND<0.1	0.00034	- -	NS	0.0029
Pb, Lead Avg Soil 3,990	9,570	110	240	14,000	ND<10	ND<10	22	ND<0.1	- -	- -	400	0.14
Ni, Nickel	225	ND<1.5	6	-	- -	- -	- -	- -	- -	- -	NS	0.033
V, Vanadium	110	42	14	180	5.7	- -	0.66	ND<0.1	- -	- -	NS	NS
Zn, Zinc	48,925	240	500	14,000	48	- -	54	0.1	0.00069	- -	NS	0.086
PETROLEUM PRODUCTS												
PCB, Total	20	3	- -	94	1.4	- -	ND<0.002	- -	- -	12	1	0.01
TRPH	42,000	900	- -	2,800	190	- -	ND<5	- -	- -	- -	NS	NS
TPH-D	7,900	66	- -	370	17	- -	5.4	- -	- -	- -	NS	NS
Benzene	ND<0.005	ND<0.005	- -	*0.0005	ND<0.0005	- -		- -	ND<0.0005	- -	1.7	1.7
Ethylbenzene	0.180	ND<0.015	- -	*0.0084	ND<0.0005	- -		- -	ND<0.0005	- -	1.4	0.14
Toluene	0.029	ND<0.015	- -	*0.0005	ND<0.0005	- -		- -	ND<0.0005	- -	21	2.1
Xylene	0.290	ND<0.015	- -	*0.0021	ND<0.0005	- -		- -	ND<0.0005	- -	NS	NS
Acenaphthene	2.2	ND<0.07	- -	ND<0.9	ND<0.9	- -	ND<0.01	- -	ND<0.02	- -	100	0.32
Acenaphthylene	0.8	ND<0.06	- -	ND<0.9	ND<0.9	- -	ND<0.01	- -	ND<0.02	- -	NS	NS
Anthracene	3.6	ND<0.3	- -	ND<0.9	ND<0.9	- -	ND<0.01	- -	ND<0.02	- -	NS	NS
Benzo(a)anthracene	7.0	ND<0.5	- -	**2.1	ND<0.9	- -	ND<0.01	- -	ND<0.02	- -	NS	NS
Benzo(k)flouranthene	8.2	ND<0.7	- -	ND<0.9	ND<0.9	- -	ND<0.01	- -	ND<0.02	- -	NS	NS
Benzo(a)pyrene	6.8	0.21	- -	**2.9	ND<0.9	- -	ND<0.01	- -	ND<0.02	- -	1	0.3
Benzo(g,h,i)perylene	6.6	ND<0.3	- -	**2.6	ND<0.9	- -	ND<0.01	- -	ND<0.02	- -	NS	NS
Chlorobenzene	0.026	ND<0.015	- -	ND<0.005	ND<0.005	- -	ND<0.0005	- -	- -	- -	NS	NS
Chrysene	8.5	ND<0.5	- -	**2.2	ND<0.9	- -	ND<0.01	- -	ND<0.02	- -	NS	NS
Dibenzo(a,h)anthracene	2.6	ND<0.3	- -	ND<0.9	ND<0.9	- -	ND<0.01	- -	ND<0.02	- -	NS	NS
1,3-DCB	0.028	ND<0.015	- -	ND<0.005	ND<0.005	- -	ND<0.0005	- -	- -	- -	NS	0.85
1,2 & 1,4-DCB	0.024	ND<0.015	- -	ND<0.005	ND<0.005	- -	ND<0.0005	- -	- -	- -	NS	0.85
Flouranthene	12.0	ND<0.8	- -	**2.6	ND<0.9	- -	ND<0.01	- -	ND<0.02	- -	500	0.013
Flourene	2.5	ND<0.3	- -	ND<0.9	ND<0.9	- -	ND<0.01	- -	ND<0.02	- -	NS	NS
Indeno(1,2,3-cd)pyrene	5.7	ND<0.3	- -	**2.3	ND<0.9	- -	ND<0.01	- -	ND<0.02	- -	NS	NS
Napthalene	4.6	ND<0.3	- -	**1.6	ND<0.9	- -	ND<0.01	- -	ND<0.02	- -	100	0.78
Phenathrene	20.0	ND<0.2	- -	**4.5	ND<0.9	- -	ND<0.01	- -	ND<0.02	- -	NS	NS
Pyrene	21.0	ND<0.1	- -	5	ND<0.9	- -	ND<0.01	- -	ND<0.02	- -	NS	NS
Tetrachloroethylene	0.120	ND<0.015	- -	ND<0.005	ND<0.005	- -	ND<0.0005	- -	- -	- -	0.145	0.145
1,1,1-TCA	0.023	ND<0.015	- -	ND<0.005	ND<0.005	- -	ND<0.0005	- -	- -	- -	10.4	10.4
1,1,1 Trichloroethylene	- -	- -	- -	ND<0.9	ND<0.9	- -	ND<0.0005	- -	- -	- -	NS	0.026

a. Soil Investigation -

1. Weiss Associates, Remedial Action Letter Report, August 21, 1991 - Between August 26 and September 4, 1991, Weiss Associates collected ninety-six (96) soil samples from shallow depths throughout the property and three (3) samples just off-site. Ninety (90) of these samples were composited into twenty (20) samples for analysis of a total of twenty-nine (29) discrete samples. Weiss Associates had the twenty-nine (29) samples analyzed for ten (10) metals; polychlorinated biphenyls (PCB's); total recoverable petroleum hydrocarbons (TRPH); total petroleum hydrocarbons as diesel (TPH-D); benzene, toluene, ethylbenzene, and xylenes (BTEX); and polynuclear aromatic hydrocarbons (PAH). While discrete maximum concentrations for the analytes cannot be estimated from these composite samples, the results represent "average" contaminant concentrations for the locations contributing to each composite sample.

   Compounds detected in soil samples above state of Hawaii Department of Health (DOH) guidelines were cadmium, lead, polychlorinated biphenyls and benzo(a)pyrene [Table 3-1].

2. CFC, Environmental Investigation Report, October 26, 1992 - CFC undertook an environmental investigation in August 1992 to document the presence of organic and inorganic analytes in soil at specific locations and depths, as well as in groundwater samples collected from trenches. From August 11 to 12, 1992, CFC used a backhoe to excavated soil from sixteen (16) locations on site. During excavation, petroleum free product was observed as two (2) distinct plumes floating on the groundwater. Twenty-eight (28) soil samples were collected from three, five, and seven foot depths and analyzed for nine (9) metals, PCB, TRPH, TPH-D, BTEX, PAH, and solvents.

   Compounds detected in the soil samples above DOH guidelines were: Cadmium, Lead, polychlorinated biphenyls, and benzo(a)pyrene [Table 3-1]. The report recommended further on site and off site soil sampling to fully delineate the extent of contamination.

3. CFC, total metals background sampling, October 15, 1992 - On October 15, 1993, CFC collected three (3) soil samples from the southwest corner of the intersection of Pahounui Drive and Sand Island Access Road [Appendix A, Figure A-1]. This location is 75 feet from the site, across Pahounui Drive. The three (3) samples were collected by a split spoon sampler from 2.5 foot, 4.5 foot, and 6.5 foot depths of a single boring made by an 8 inch hollow stem auger. The samples were analyzed for eight (8) metals: arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver. The results of those analyses [Appendix A, Table A-1] represent the "background" levels of these eight (8) metals at the site [Table 3-1].

4. CFC. PCB investigation and remediation. February 17. 1993 to March 16, 1993 - On February 17, 1993, CFC had four (4) borings drilled around the perimeter of a sample location which indicated elevated levels of PCB. A soil sample collected at a depth of 3 feet from location B-9 during CFC's August 12, 1992 investigation contained 94 mg/kg polychlorinated biphenyls. The four (4) borings were drilled with an 8 inch hollow stem auger at distances of 5 feet, 7 feet, 5 feet, and 6 feet from the original sampling point [Appendix B, Figure B-1]. Soil samples were collected by a split spoon sampler from 3 foot and 5 foot depths in each boring.

   Laboratory analysis of the soil samples indicated a maximum concentration of 12 ppm polychlorinated biphenyls in a 3 foot deep sample [Table 3-1 and Appendix B, Table B-1].

   The maximum concentration detected in any of the 5 foot deep samples or remaining 3 foot deep samples was 0.049 ppm, indicating a limited release of PCBs within the perimeter of the 4 borings and to a depth no greater than 3-5 feet.

   CFC contracted with Industrial Technologies to dispose of the contaminated soils. On March 16, 1993, Industrial Technology excavated approximately 14 cubic yards of soil, placed it in HazMax™ plastic lined cardboard boxes, and removed it from site for eventual shipment to Idaho for land filling.

5. CFC. trenching and free product recovery. February 11 to March 3. 1993 - In order to better characterize and remove free product contamination on the surface of groundwater (discovered during August 12, 1992 investigation), CFC excavated three (3) trenches on February 11 and 12, 1993 [Appendix C, Figure C-1]. Lithology of the three (3) trenches was mapped [Appendix C, Figure C-2] and any free product encountered was recorded. A dark brown product was encountered at the bottom of the trench #1. The trench was segregated into 3 zones and the encountered water was allowed to settle. After settling, two zones contained a dark brown product, while the third zone contained a light yellow product. A very thick black product was encountered a the bottom of trench #2. No product was observed in trench #3.

   CFC returned to observe the trenches on February 16, 1993. Trench #1 continued to exhibit evidence of two types of product covering over 50 percent of the trench, one dark brown and one light yellow, possibly hydraulic oil and motor oil. Trench #2 still contained black product covering approximately 1/4th of the trench. Only a light sheen was noted on the groundwater of trench #3.

   On February 23, 1993, a vacuum truck removed approximately 3,700 gallons of product and water from the surface of trenches #1 and #2. It was estimated that 400 gallons of product were recovered. A return trip on March 3, 1993, resulted in the recovery of approximately 15 more gallons of product. All removed product was properly disposed of by Industrial Technology (Fed ID# 99-0249226).

6. CFC, geotechnical and chemical analysis of soil samples, July 21, 1993 In order to characterize the physical and chemical properties of site soils and groundwater for the modeling of transport characteristics of contaminants, CFC installed three (3) monitoring wells on July 21, 1993 [Appendix E, Figure E-1]. Each boring was made to an approximate depth of 14 feet by an 8 inch hollow stem auger. Soil samples were collected by split spoon sampler from each of the borings in order to log the boring lithology and to collect representative samples of each distinct soil formation encountered.

   Monitoring wells were constructed by inserting 10 feet of 4-inch slotted polyvinyl chloride (PVC) well casing so that at least 2 feet of the slotted casing remained above static groundwater. The remaining depth of the wells were constructed with solid PVC casing which extends 2 feet above ground surface. Well construction was completed by placing a sand pack around the casing and capping the boring with a bentonite seal and a grout seal. After this, each well was developed by removing a minimum of 5 well casings of water by a stainless steel bailer.

   Three distinct formations were encountered which were consistent with previous observations, these were: an upper silty sand layer mixed with debris; a lagoonal clay layer; and a lower silty sand layer [Appendix E, Figures E-2 through E-5].

   We collected representative samples of each layer from each boring. These samples were then analyzed for physical characterization (bulk density, grain density, saturated pore volume, porosity, and wet & dry permeabilities), cation exchange capacity, total organic carbon, hydraulic conductivity, and capillary characteristics. A summary of geotechnical analysis results is presented in Appendix E, Table E-1.

   In addition to geotechnical analysis, samples were collected from just above static water and analyzed for BTEX. The sample collected from MW-1 indicated the presence of BTEX, however, the levels detected did not exceed DOH guidelines [Appendix E, Table E-2].

b. Groundwater Investigation

1. CFC, Environmental Investigation Report, October 26, 1992 - During CFC's August 12, 1992 investigation, four (4) water samples were collected from groundwater encountered in four (4) of the excavations. Water samples were analyzed for nine (9) metals, PCB, TRPH, TPH-D, and PAH.

   Compounds detected in the water samples above applicable or relevant and appropriate requirements (ARARs) were: Arsenic, Cadmium, Chromium, Copper, Lead, and Zinc [Table 3-1]. However, water samples were not filtered prior to total metals analysis and the elevated levels of metals could be attributed to suspended solids in the water of the open trenches. The report recommended further groundwater sampling by the installation of monitoring wells.

2. CFC, total metals analysis of filtered water samples, March 3, 1993 - On March 3, 1993, CFC collected filtered water samples from the groundwater standing in each of the three trenches described in Section 3.1a.5. above [Appendix D, Figure D-1]. Floating product was first skimmed from the surface before collection of water in 1 L amber glass bottles. The water was then transferred into 500 ml plastic bottles by use of an AquaPrep Flex Filter manufactured by Gelman Sciences. The AquaPrep employs a 0.45 um membrane filter to remove suspended solids.

   Each sample was analyzed for nine (9) dissolved metals: antimony, arsenic, cadmium, chromium, cobalt, copper, lead, vanadium, and zinc. Arsenic and zinc were detected, while only zinc was detected above ARAR guidelines [see Table 3 and Appendix D, Table D-1].

3. CFC, chemical analysis of water samples, July 26, 1993 - After completion and development of monitoring wells (described in Section 3.1.a.6 above) on July 21, 1993, water samples were collected from each well on July 26, 1993. Prior to any agitation, first collected water from each well was placed into three 40 ml VOAs for analysis of BTEX content (this was done to minimize "sparging" of volatile organics from the samples, allowing the best representation of actual conditions).

   The water in each well was then agitated and a minimum of three well casing volumes was removed prior to collecting additional water samples. Water was then collected from the top, middle, and bottom of the water column of each well and placed into a 1 L amber glass jar, three 1 L plastic bottles, and one 125 ml plastic bottle.

   Care was taken to fill each container with equal parts of water collected from each point in the water column to ensure that a representative sample was collected from the entire water column within the proximity of the well. Disposable bailers were used for all water collection, agitation, and purging to guard against cross-contamination of wells.

   Water from each well was analyzed for semi volatile organics including PAH, BTEX, major anions and cations, pH, dissolved oxygen, and REDOX potential. Complete analytical results are found at the back of Appendix E, while PAH and BTEX results are summarized in Appendix E, Tables E-3 and E-4. No PAH or BTEX was detected in any of the samples collected from the three wells [Table 3-1].

4. CFC, tidal influence study, August 12 to 13, 1993 - In order to model the hydrologic conditions of the site and their impact on the transport of constituents of concern, the surface gradient of the site groundwater had to be determined. Surface gradient was calculated by studying the fluctuations of the surface of the groundwater over a complete tidal cycle.

On August 12 to 13, 1993, CFC used a combination of transducers and hand measurements to monitor the elevation of the groundwater at four (4) locations over a 24 hour period; three monitoring wells (MW-1, MW-2, MW-3) and one piezometer (P-4) [Appendix F, Figure F-2].

A plot of the fluctuations of measured groundwater elevations at the four observation points verses local tide variations (predicted tidal data for Keehi Lagoon from the National Oceanic and Atmospheric Administration) from 19:30 on August 12 to 19:30 on August 13, 1993 is shown in Appendix F, Figure F-1. Table F-1 in Appendix F lists the raw data which generated the plot.

Site groundwater gradient was calculated from the data and plotted. Thick clay deposits in the MW-3 region appeared to act as an aquitard, causing the groundwater in MW-3 to remain near high tide levels. Piezometer P-4 was located adjacent to an open trench, which apparently acted as a reservoir, dampening any rise in groundwater level and causing groundwater elevations in P-4 to remain near low tide levels.

By comparing the high tide groundwater elevation of MW-3 with the high tide elevation of MW-1 and MW-2, and the low tide groundwater elevation in P-4 with the low tide elevation of MW-1 and MW-2, a gradient of 0.0002 to 0.0004 ft/ft was calculated for the site. Other studies in the region have determined gradients of up to 0.0007 ft/ft [RZA-AGRA, December 1992]. A conservative range of 0.0002 to 0.001 ft/ft was chosen as the site gradient, with a down slope direction of east to west, toward Keehi Lagoon [Appendix F, Figure F-3].

3.2 Selection of Compounds of Concern

During the eight (8) sampling events which occurred between August 21, 1991 and July 26, 1993, a total of eleven (11) metals and twenty-one (21) PAHs were detected along with PCBs, TRPH, TPH-D, and BTEX. A summary of all compounds analyzed for, high and low compound detection quantities, minimum detection limits for non-detected compounds, and applicable or relevant and appropriate requirements (ARARs) is presented in Table 3-1.

a. Compounds Detected in Soil - The results of the Weiss investigation indicate that petroleum hydrocarbons in the approximate carbon range of diesel fuel and oil are present in surface soils over much of the site. With respect to specific petroleum compounds that are regulated by the Hawaii Department of Health [DOH, August 1992] in soil, only benzo(a)pyrene was present above the 1.0 mg/kg limit. No other volatile or semi-volatile hydrocarbons exceeded the DOH limits for soil, even though concentrations of TRPH were detected at concentrations as high as 42,000 mg/kg in one composite sample from surface soils. A sludge sample collected from a sump contained ethylbenzene at a concentration of 5.0 mg/kg (in excess of the 1.4 mg/kg DOH action limit); however, the sludge was removed and is not representative of soil in the vicinity.

In addition to petroleum hydrocarbons, the Weiss investigation revealed the presence of PCBs in soil above the DOH clean-up guideline of 1.0 mg/kg in a number of the composite samples. Weiss reports that the two PCBs detected were Arochlor 1254 and 1210, the latter of which is not a common PCB and in our opinion represents a typographical error. Finally, a number of metals were encountered at relatively high concentrations in surface composites.

Of the metals that are currently regulated in soil by DOH, both lead and cadmium were present in excess of the action limits. Two non-regulated metals, zinc and copper, were detected at concentrations exceeding 10,000 mg/kg, which is orders-of-magnitude higher than maximum levels of the remaining metals analyzed.

CFC [CFC, October 1992] also documented the presence of petroleum hydrocarbons throughout the soil sampled in several areas. The maximum TRPH reported for soil samples was 2,800 mg/kg, which included compounds in the carbon range of diesel fuel and oils. The only PAH detected above the DOH clean-up goal was benzo(a)pyrene at a depth of 5 feet bgs from boring B3. During the 1992 investigation, soil samples were not analyzed for monoaromatic compounds (e.g., BTEX); however, subsequent soil sampling associated with the installation of three groundwater wells in 1993 [Appendix E] indicated that these compounds were not present above the DOH action limits.

Similar to the results of the Weiss investigation, CFC encountered PCBs at elevated concentrations in soil. Initially, a maximum combined PCB concentration of 94 mg/kg was detected in a soil sample from 3 feet below ground surface (bgs) at boring B9 [Appendix B]. This concentration maxima included Arochlors 1242, 1248, 1254 and 1260. Subsequently, soils in the vicinity of B9 were excavated, and confirmation sampling indicated a maximum residual of 12 mg/kg (consisting exclusively of the 1260 cogener) at a depth of 3 feet bgs. Higher PCB concentrations were generally present at the shallow sampling depth (i.e., 3 feet bgs) than at the deeper 5-foot level.

As was noted for the PCB concentrations, the August 1992 investigation indicated that concentrations of metals in soil generally decreased as a function of depth. The August 1992 investigation indicated that DOH clean-up goals for both lead and cadmium in soil were exceeded at a number of locations and depths.

Furthermore, copper and zinc were present at maximum concentrations of 9,900 mg/kg and 14,000 mg/kg, respectively.

b. Compounds Detected in Groundwater - During the August 1992 investigation, groundwater was sampled from open trenches and analyzed for metals, PAHs, and PCBs. Neither the PAHs nor the PCBs were detected above the analytical limits in groundwater samples collected from the trenches. Metals were analyzed from a total of 4 trenches and were encountered at concentrations as high as 54 mg/L. The problem with sampling metals and, to a lesser extent, PAHs and PCBs in trenches is related to the high concentration of suspended particulate matter associated with the trenching process and subsequent caving of the sidewalls. Metals are readily adsorbed to suspended solids; therefore, metal concentrations reported for the trenches probably represent a suspended fraction, as well as the dissolved fraction. Because the "suspended" solids load in groundwater flowing through porous media is minimal, water from three trenches (including B10) were filtered and then analyzed to more closely approximate soluble metal concentrations [Appendix D].

The results of analyzing the filtered water indicate that lead and cadmium were not present above detection limits and that only two other metals (arsenic and zinc) were detected at concentrations of >0.1 mg/L. Subsequent analyses of the three monitoring wells for major anions and cations indicated that copper and zinc were present in groundwater from MW3 at concentrations of 0.34 and 1.2 mg/L, respectively [Appendix E].

As part of the July 1993 subsurface investigation, groundwater from the three monitoring wells was analyzed for monoaromatic hydrocarbons and semi-volatile organic compounds (according to EPA Methods 602 and 625, respectively). Neither BTEX hydrocarbons nor base/neutral extractable organic compounds were present in groundwater samples above their analytical detection limits.

c. Demonstrated Trends - From the data presented in Table 3-1, several trends are evident:

1. The detected amount of metals in the soil have remained relatively stable at their elevated levels above background, even though samples collected on 8/21/91 were only taken from the surface, while samples collected on 8/12/92 were taken from 3, 5, and 7 foot depths, indicating elevated metal content below the immediate surface.
2. Levels of metals detected during the 8/12/92 sampling were high at both the 3 and 5 foot depths, while levels detected at 7 foot depth were dramatically lower, indicating that the majority of elevated metals are confined to the uppermost 5 to 7 feet of surface soils.
3. Levels of TRPH, TPH-D, BTEX, and PAH have decreased by as much as 95 percent of originally detected levels, indicating that natural remediation of these compounds is successfully occurring on-site.

d. Applicable or Relevant and Appropriate Requirements (ARARs) - The primary source of ARARs was the State of Hawaii, Department of Health, Technical guidance Manual for Underground Storage Tank Closure and Release Response, Recommended Cleanup Criteria for Soil and Water, Makai of (below) the Underground Injection Control Line [DOH, August 1992]. For compounds without UST clean-up criteria, a secondary source for water ARARs was Hawaii Administrative Rules, Title 11, Chapter 54, DOH Water Quality Standards. Where provided, the "fish consumption" standards were used [Table 3-1].

e. Selected Compounds of Concern - Based on data summarized in the previous sections, the following compounds of concern have been selected to represent the fate and transport of metals, PAHs and PCBs in the subsurface. Pertinent physical properties of these compounds were taken from Montgomery & Welkom [1990], Verscheuren [1983], Buchter et al. [1989], and MacKay & Shiu [1981]. Additional rationale for selection of the indicators are provided on a compound-specific basis.

1. Benzo(a)pyrene - the only petroleum hydrocarbon encountered in soil above DOH clean up goals. While other monoaromatic and polycylic aromatic compounds present at this site may be more mobile than BaP; this hydrocarbon has the lowest action level due to its carcinogenicity.
2. Polychlorinated Biphenyls - Arochlor 1242 represents the most volatile and soluble of the PCB cogeners present in on-site soils. This Arochlor is comprised predominantly of 2,4,4'-trichlorobiphenyl, which has been selected to represent the PCB group for fate and transport modeling.
3. Cadmium - is one of the two DOH-regulated metals that was detected at several locations and depths in excess of the action limits for soils.
4. Copper - is not one of the DOH-regulated metals for soils and groundwater; however, it was present in a groundwater sample in excess of the "chronic toxicity" limit for saltwater ecosystems.
5. Lead - is the other of the two DOH-regulated metals that was consistently encountered above the action limit in soils.
6. Zinc - is also not one of the DOH-regulated metals for soils and groundwater; however, it too was present in a groundwater sample in excess of the State of Hawaii Clean Water Act guideline limit for saltwater ecosystems.

3.3 Selection of Migration Pathways

a. Vadose Zone - Infiltration Loading of Groundwater - Groundwater and above-ground air were considered the primary environmental targets that were susceptible to chemical migration through the vadose zone. Fate and transport modeling considered the migration of soil contaminants via unsaturated flow (i.e., infiltration as aqueous solutes), non aqueous phase liquid (NAPL) flow, and gas-phase diffusion.

Although groundwater levels measured in the trenches indicated a water table depth of approximately 6 feet bgs, data collected during the 1993 installation of three monitoring wells suggested water levels were between 4.5 and 5.5 feet bgs. For purposes of modeling the potential infiltration of contaminants, a water table depth in the latter range was combined with concentration maxima for compounds of concern at 3 feet bgs, representing a worst case calculation.

This combination was selected in order to estimate the shortest migration period via the infiltration pathway. Specifically, the following depths and concentrations of compounds of concern were used to model infiltration loading to the groundwater.

1. Benzo(a)pyrene - 6.8 mg/kg @ 3 feet bgs (highest concentration encountered in surface soil composites [Composite 8, Weiss, October 1991] — no PAH analyses were conducted at the 3 foot depth).
2. Polychlorinated Biphenyls - Represented by Arochlor 1242: 12 mg/kg @ 3 feet bgs [from B9D, Appendix B].
3. Cadmium - 46 mg/kg @ 3 feet bgs [from B13, CFC, October 1992].
4. Lead - 14,000 mg/kg @ 3 feet bgs [from B9, CFC, October 1992].

b. Vadose Zone - Vapor-Phase Migration - Gaseous diffusion and bulk advection are mechanisms by which volatile compounds may migrate in the vapor-phase. The most conservative estimate for vapor-phase diffusion results from a maximum concentration gradient, the presence of bare soil overlying the entire site, and the absence of vapor barriers such as pavement, building foundations, or ponded water. Advective transport of chemicals in soil gas results from pressure differences induced by changes in temperature and barometric pressure, as well as by certain small-scale phenomena. For purposes of estimating maximal loading rates via the vapor-phase migration pathway, the following depths and concentrations of compounds of concern were used.

1. Benzo(a)pyrene - 6.8 mg/kg @ 1 foot bgs [highest concentration encountered in surface soil composites, Weiss, October 1991].
2. Polychlorinated Biphenyls - Represented by Arochlor 1242: 20 mg/kg @ 1 foot bgs [highest concentration encountered in surface soil composites, Weiss, October 1991].

c. Groundwater - Transport of contaminants in groundwater may occur by either NAPL migration or by dissolution and subsequent advective migration via water flow. Both of these migration pathways are considered in this study. NAPL migration is estimated by calculating the percentage of residual hydrocarbon product in the capillary fringe and then projecting its relative permeability as a function of the moisture characteristic curves. The assumption that all NAPL present is the diesel fuel represents a worst case estimate because the viscosity of diesel fuel is less than that of a diesel/oil mixture (the majority of NAPL present on site) which exists at this site.

Zinc (1.2 mg/L) and copper (0.34 mg/L) were the only compounds of concern present in groundwater samples above their analytical detection limits [MW3, Appendix E]; therefore, an initial concentration for the other compounds of concern in groundwater are based either on a projected loading rate from the vadose zone (i.e., infiltrating solutes) or on contaminant desorption from solids (e.g., porous media) located below the water table. The phase partitioning or desorption process in groundwater is based on the following concentrations of compounds of concern at the 5-foot depth:

1. Benzo(a)pyrene - 2.9 mg/kg @ 5 feet bgs [from B3, CFC, October 1992].
2. Polychlorinated Biphenyls - Represented by Arochlor 1242: 0.05 mg/kg @ 5 feet bgs [from B9A, Appendix B].
3. Cadmium - 26 mg/kg @ 5 feet bgs [from B3, CFC, October 1992].
4. Lead - 4,700 mg/kg @ 5 feet bgs [from B2, CFC, October 1992].

4.0 EXPOSURE ASSESSMENT

4.1 Characterization of Physical Setting

a. Regional Climate - Although the Hawaiian islands lie at the northern margin of the tropics (21° north latitude), they enjoy a subtropical climate because currents from the Bering Sea cool the region. A belt of northeasterly trade winds blanket the islands and persist throughout the year, but are occasionally interrupted by southerly winds. Both trade and southerly winds bring rain to the islands. Heavy storms brought on by tropical storms can bring as much as 24 inches of rain in 4 hours to parts of the islands [Armstrong, 1983].

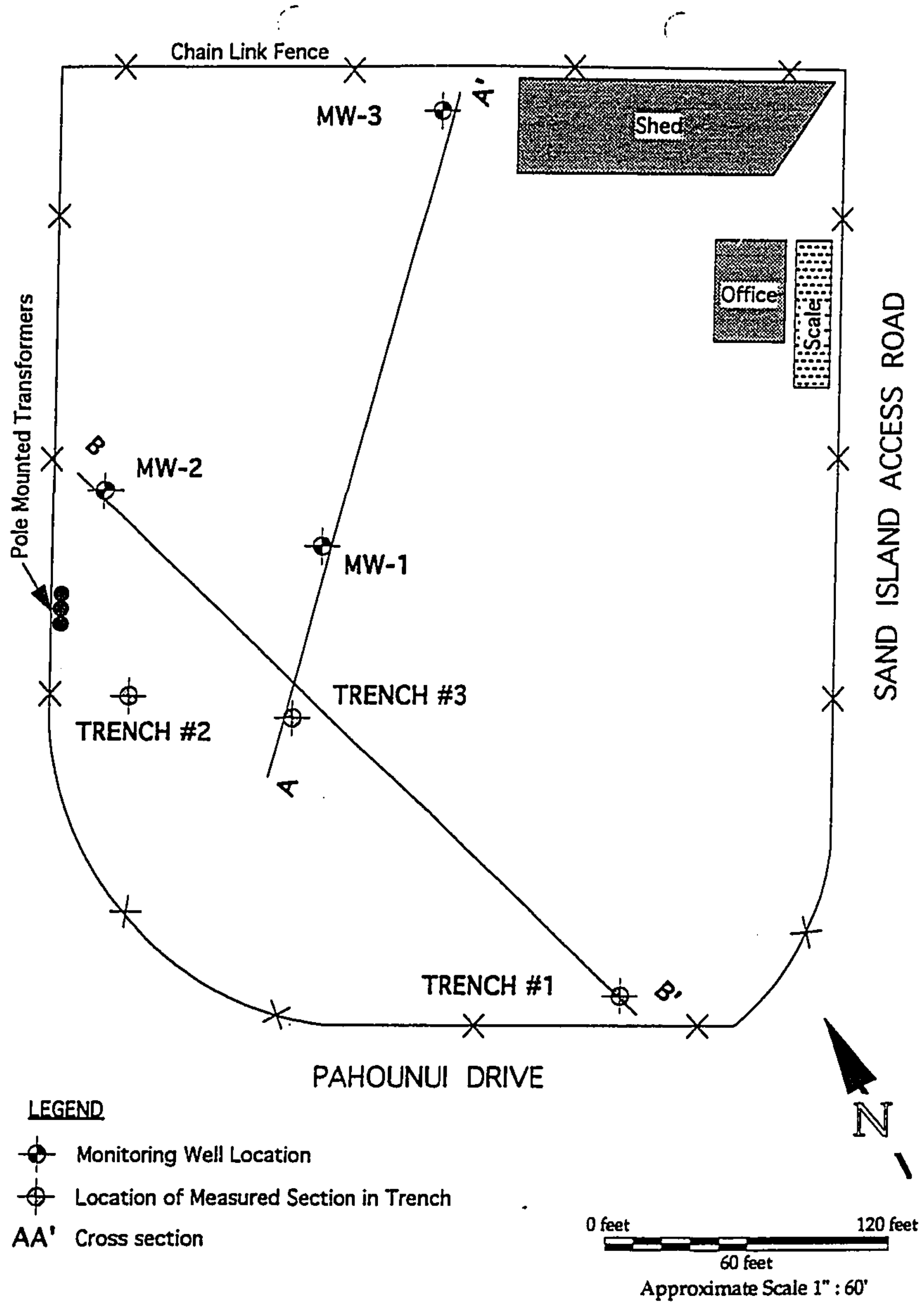
1. Temperature - Daily temperature range varies greater than seasonal variations, with average temperatures in Honolulu varying daily between 62°F and 80°F in winter months and 75°F and 89°F in the summer [Armstrong, 1983].
2. Rainfall - The average annual rainfall for Honolulu is just over 20 inches [Armstrong, 1983].
3. Winds - Northeasterly trades prevail in the Honolulu area, usually blowing from 10-15 mph [Armstrong, 1983].

b. Site Topography - Topographic map coverage of the site vicinity is provided by the U.S. Geological Survey, Island of Oahu, Hawaii quadrangle, 1983.

1. Site Elevation -The site elevation varies between 5 and 7 feet above mean sea level (MSL).
2. Ground Surface Slope - The ground surface of the region is nearly flat, but the site has a very slight slope (less than 1 percent) toward Keehi Lagoon (west).

c. Site Geology/Hydrogeology - The site is located on the western flank of the Koolau shield volcano on the Honolulu plain, an elevated coral reef. The site itself is underlain by silty sand fill material and lagoon clay sediments, which is in turn underlain by a silty sand, then coralline reefal materials with alluvial soils and then with depth, volcanic rock. Regional groundwater flow direction is from the mountains to the sea [CFC, October 1992].

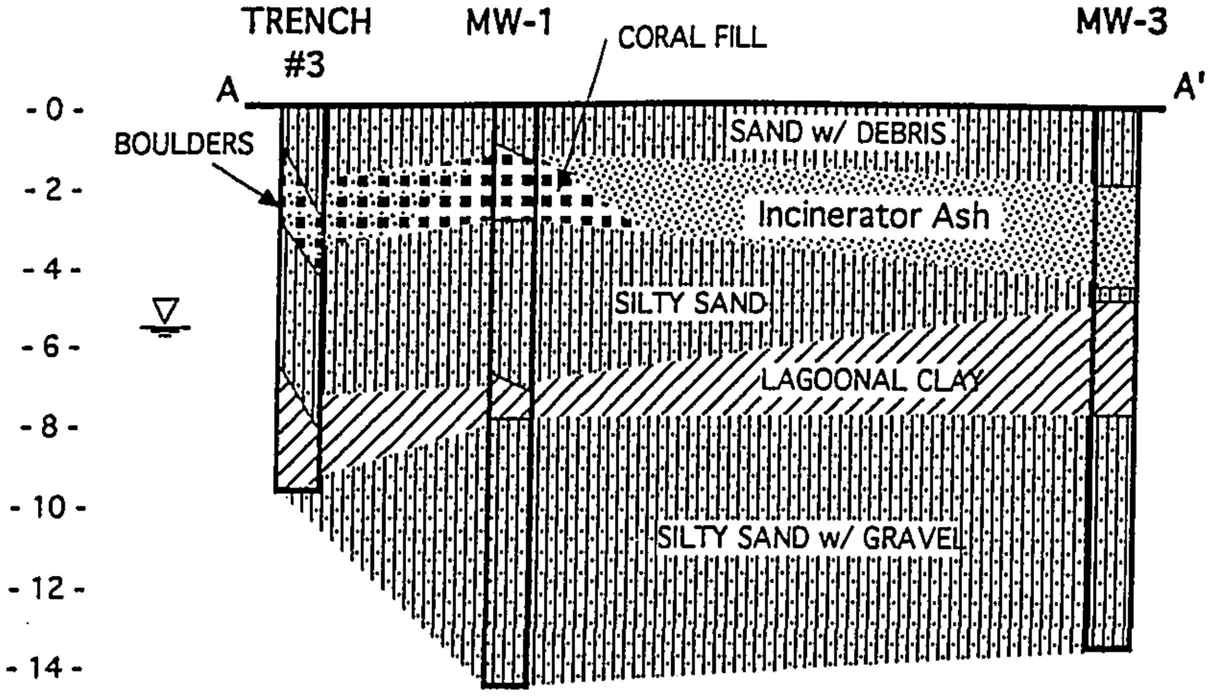
Field observations of site subsurface conditions indicate that the site is underlain by three distinct near surface layers: first a silty sand, then a lagoonal clay, and then a silty sand. Near surface lithology was extrapolated by correlating measured sections made for borings MW-1, MW-2, MW-3 and trenches #1, #2, and #3. The location of these measured sections are shown in Figure 4-1, while the extrapolated cross sections are mapped in Figure 4-2.

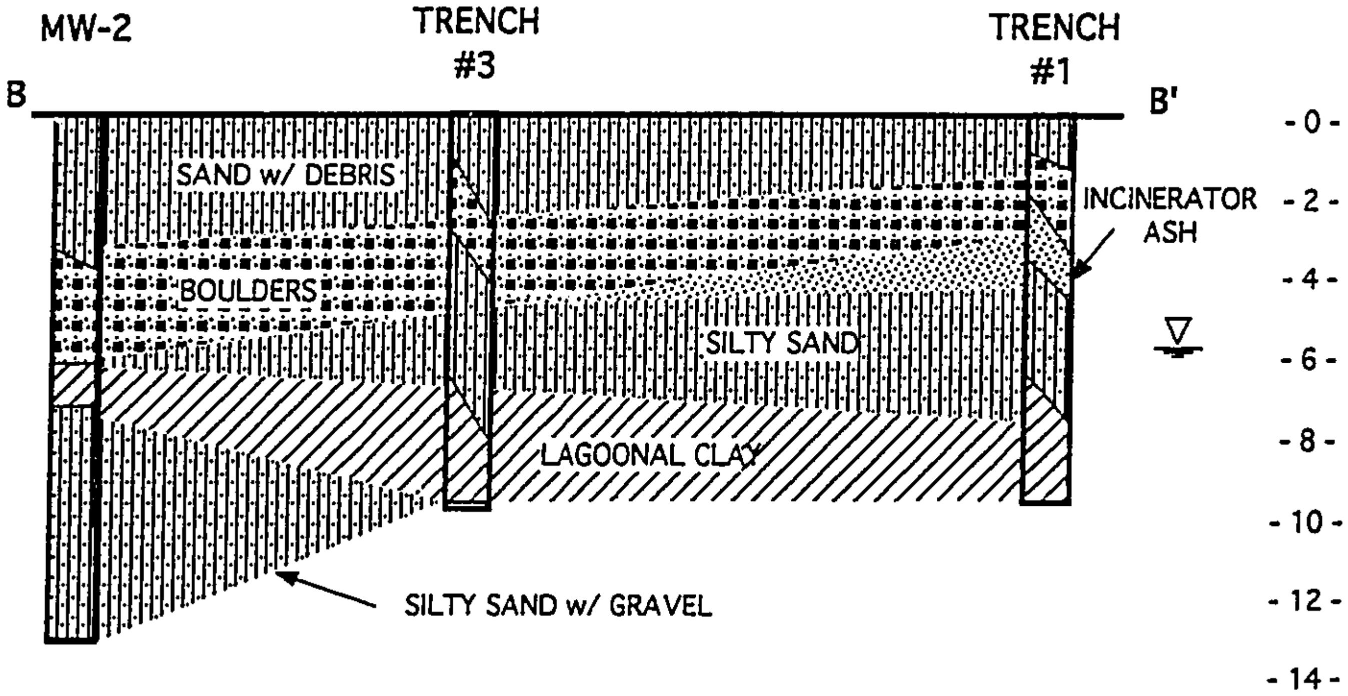


COTTON and FRAZIER
Consultants, Inc.
October 22, 1993

SITE LITHOLOGY - MEASURED SECTIONS
FLYNN-LEARNER
Sand Island, Oahu, Hawaii

Figure 4-1





Horizontal Scale 1" : 60'

NOTE: These cross sections are an estimated depiction based upon field observations and should not be used to predict actual site conditions. See Figure E-5 for key to lithologic symbols.

COTTON and FRAZIER **Consultants, Inc.** October 22, 1993	SITE LITHOLOGY - CROSS SECTIONS FLYNN-LEARNER Sand Island, Oahu, Hawaii	Figure 4-2

1. Vadouse Zone - The first soil layer, a dark brown silty sand with gravel fill extends to 6 to 8 feet bgs, occupying the entire vadose zone and and extending into the aquifer. This layer commonly contains metal fragments, automobile parts and debris in its uppermost region (0 to 2 feet bgs). It is also interspersed with layers of boulders, coralline fill, and incinerator ash between 1 and 6 feet bgs. The boulders are up to 3 foot across and are widely found throughout the western region of the site. The coralline fill is randomly scattered in small pockets. While the source of the incinerator ash was a former incinerator along the northern fence line, the ash is widely scattered throughout the site as a thin layer approximately 3 feet bgs.

   A majority of the site is characterized by the silty sand fill material from the ground surface to the water table, which is representative of subsurface conditions near boring B3 [CFC, October 1992] and well MW2 [Appendix E]. Boring B3 also represents the location at which the highest concentrations of cadmium and benzo(a)pyrene were encountered in soil. Physical characteristics for this soil unit are represented by the sample collected at 2 feet bgs from MW2.

   A lesser percentage of the site is characterized by sand or coralline fill material overlying a sandy lens at depths greater than 3 feet bgs. This lithology is characteristic of the area near well MW1 and boring B9, where the highest concentrations of lead, copper and PCBs were encountered. Physical properties of the coralline fill material (i.e., ground surface to 3 feet bgs) are represented by the 2-foot sample from MW1, while those of the deeper sand lens (i.e., 3 feet bgs to the water table) are represented by a 5-foot sample from the same boring.

   Although saturated hydraulic conductivity was not measured in a sample from the 2-foot depth at MW2, an assumption was made that the conductivity at this point was similar to that of the 5-foot soil sample from MW1. This assumption was based on the similarity in "native state" permeabilities between the two soil samples (e.g., an intrinsic permeability of 0.003 millidarcies was reported for both locations).

2. Aquifer - First encountered groundwater beneath the site is largely influenced by local tides. It is roughly at the elevation of the nearest body of surface water, Keehi Lagoon. Keehi Lagoon normally fluctuates between 0.5 and 1.5 feet AMSL, making the depth to first encountered water between 3.5 and 6.5 feet beneath the ground surface depending on location on site. The State of Hawaii Department of Land and Natural Resources (DLNR) classifies the first encountered groundwater as being used as a non-drinking water source with no ecological importance. DLNR records also indicate that the aquifer has moderate salinity (1000-5000 mg/L Chlorides), is considered to be a replaceable water source, and is considered to be highly vulnerable to contamination.

The interface between the first silty sand layer and the lagoonal clay layer occurs within the uppermost portion of the near surface groundwater. This interface fluctuates between 5 and 8 feet bgs, causing varying degrees of dampening of tidal influence across the site. A gray-white coralline sand was found on the eastern edge of the site at the contact between the silty sand fill and the clay, but it pinched out toward the west side of the site. Beneath the clay layer is a second silty sand layer containing approximately 20 percent gravel. Shell fragments are common in both the silty sand and the clay units.

The on-site surface gradient of this near surface groundwater was calculated from observations of tidal fluctuations on site [Section 3.1.b.4]. A conservative range of 0.0002 to 0.001 ft/ft was chosen as the gradient for the site, with a down slope direction of east to west, toward Keehi Lagoon [Appendix F, Figure F-3].

Within a 1/2 mile up-gradient of the site, and lying at a depth of nearly 600-800 feet bgs, is a basal lense of fresh water (<250 mg/L Chlorides). DLNR lists this groundwater as currently being used as an irreplaceable drinking water source. However, due to its depth and the existence of confining aquitards, it is considered to have a low vulnerability to surface contamination.

Capillary characteristic curves were analyzed for samples of both the silty sand fill material (from MW2) and the sand lens (from MW1) [Appendix E]. These data are used as model inputs for calculating the relative permeability of the soils to NAPL. These capillary characteristic curves are representative of the two major soil types which intercept the groundwater table; hence, any NAPL migration through the capillary fringe would necessarily occur through these lithologic units.

The transport of dissolved constituents in groundwater could occur within either of the two aforementioned soil units or within two other lithologic units, which were encountered below the water table. These other two groundwater units include a sandy aquifer material possessing a hydraulic conductivity of about $5x10^{-4}$ cm/sec and a clayey aquifer material with a slightly lower hydraulic conductivity. Both of these units are reported to have a higher hydraulic conductivity than shallower units which intercept the water table. A worst case estimate of solute transport in groundwater, contaminant migration modeling focuses on the sandy aquifer material (as represented by physical properties from the 8-foot sample at MW1) and the clayey aquifer material (represented by the most conservative properties from the clays sampled at MW2 and MW3).

3. Aquitard/Confining Layer - A lagoonal clay sediment is encountered as a 1 to 4 foot thick layer starting at a depth of 6 to 8 feet. Field observations indicate that this layer acts as an aquitard across at least a portion of the site, causing groundwater elevation in MW-3 to remain consistently near high tide levels of the site [Appendix F, Figure F-1]. Within this clay unit was a 1 to 3 inch black interval. This interval had a sulfur like odor, not petroleum, and is thought to represent an anaerobic condition as would be expected to be produced by degrading carbon material in a restricted lagoonal environment.

4.2 Beneficial Use Analysis

a. Land Use

1. Site - The site has been used exclusively for metal recycling since it was leased to Flynn-Learner in October 1951. It lies within the heavy industrial area of the access to Sand Island. No beneficial use for the site other than that of an industrial nature is practicable in the foreseeable future.

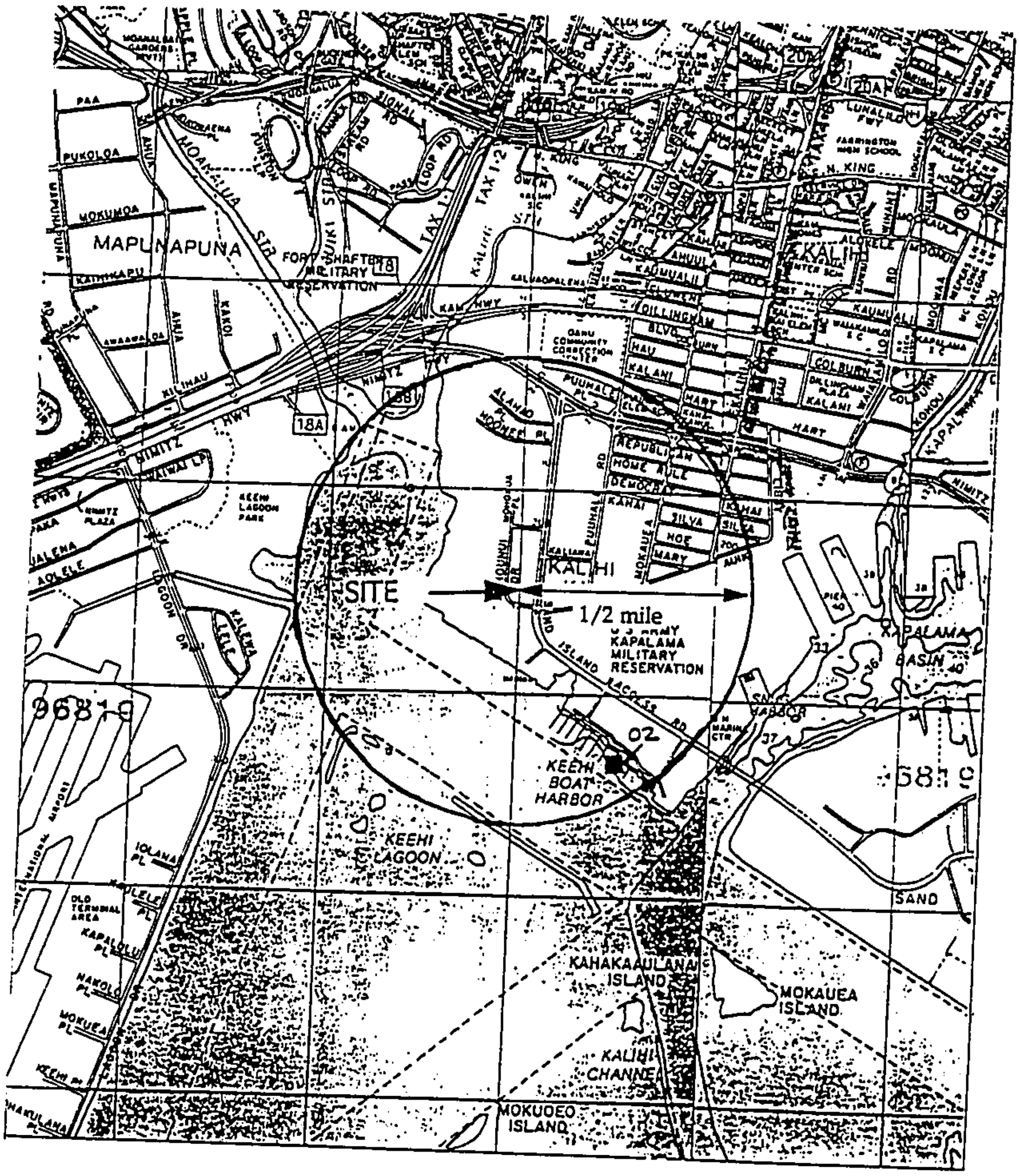
2. Adjacent Properties - A.L. Kilgo Co., a large building supply adjoins the property to the north. Ameron Cement, a cement storage and transfer facility is located to the west between the site and Keehi lagoon; McKesson Industrial complex is to the south; and Empire Pacific Industries, an industrial complex is to the east [Figure 4-3].

3. Region - Sand Island Access is located within the Kalihi industrial district, an area dominated by industrial and commercial properties, with only a small residential population. The closest residence to the site is 1/2 mile up gradient and upwind across Nimitz Highway to the north. The nearest school, Puuhale Elementary, is also 1/2 mile up gradient and upwind across Nimitz Highway.

b. Groundwater Use - The site lies within the Kalihi hydrogeologic unit on the ocean side of the State of Hawaii Department of Health Underground Injection Control line [DLNR 1993], indicating that the near surface groundwater of this site is not a potential source of drinking water. However, the moderately salty water of this unit is occasionally used for industrial purposes.

1. Wells Within 1/2-Mile of Site - There is only one well recorded with DLNR to be located within 1/2 mile of the site. Well 1953-02 is almost 1/2 mile cross-gradient to the site and is not currently in use [Figure 4-4]. A note in the records indicates that the well produces "salt water".

Well No.	Owner	Year Built	Casing Diam	Elev (AMSL)	Total Depth	Casing Depth	Use
1953-02	State	1916	4 in	8 ft	100 ft	100 ft	Unused



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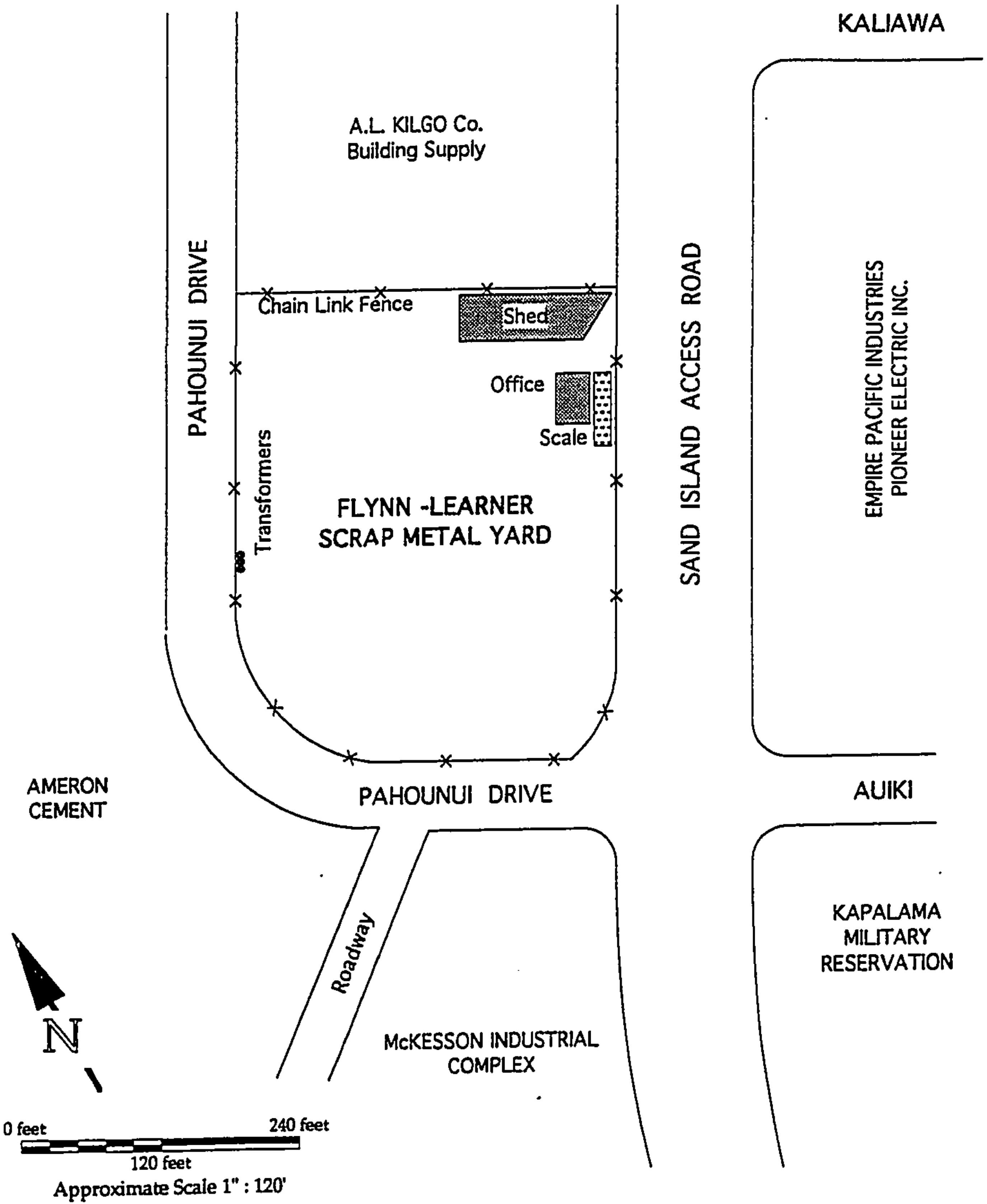
October 22, 1993

VICINITY WELLS & SURFACE WATERS
FLYNN-LEARNER
Sand Island, Oahu, Hawaii

Figure 4-4



COTTON and FRAZIER Consultants, Inc. October 22, 1993	IMMEDIATE VICINITY LAND USE FLYNN-LEARNER Sand Island, Oahu, Hawaii	Figure 4-3

2. Nearest Existing Downgradient Receptor - Other than well no. 1953-02 listed above, there are no other apparent down gradient receptors which could lead to exposure by humans other than the surface water of Keehi Lagoon.

3. Furthest Reasonable Monitoring Location - Monitoring wells could be installed across Pahounui Drive to the south and west with the permission of land owners and occupants of those sites.

4. Reasonable Downgradient Receptor - The most reasonable down gradient receptor of groundwater departing the site is Keehi Lagoon, which at its closest proximity is 620 feet west of the site's southwest corner.

c. Surface Water Use

1. Nearest Downgradient Surface Water - The nearest surface water to the site is Keehi lagoon, which at its closest proximity is 620 feet down gradient and west of the southwest corner of the site.

4.3 Potential Exposure Pathways

a. Potential Exposure Pathways - An exposure pathway describes the mechanism by which a population is exposed to compounds of concern at or originating at the site. It is the route by which the compounds move from the source to the receptor and generally consists of four components: 1.) a source and release mechanism; 2.) a retention or transport medium; 3.) a point of potential human contact (exposure point); and 4.) an exposure route.

1. Sources of Release of compounds of concern - Contamination of the site resulted from the recycling of metal (namely autos), automobile batteries, and releases from equipment used on-site. The sources of release have been removed, leaving only the elevated levels of the compounds of concern in the soils and groundwater of the site.

2. Retention and Transport Medium - Presently, elevated levels of benzo(a)pyrene (BaP), PCBs, cadmium, copper, lead, and zinc are retained in the soils of the site. Elevated levels of copper and zinc are indicated in the groundwater of the site, while leachate from the remaining compounds could migrate to groundwater. Vapor diffusion of BaP and PCBs could lead to a vapor phase human exposure.

3. Exposure Point - Three exposure states are possible for all compounds: solid, liquid or aqueous solution, and vapor states.

   Solid state exposure is only possible through exposure to the contaminated soils of the site. Liquid or aqueous solution state exposure is possible through groundwater contact or ingestion. Vapor phase exposure is possible through the off-gassing of contaminants to the atmosphere.

There are two probable exposure points for the soils of the site: direct contact with the soils at the site itself and contact through windblown transport of soil particles both on-site and off-site. There are also two possible exposure points for compounds migrating from the site via the groundwater: direct contact with the waters of Keehi Lagoon through recreational use and consumption of fish caught in Keehi Lagoon. Only one exposure point exists for vapor phase contaminants: the atmosphere above the site itself.

4. Exposure Routes - The three primary exposure routes are: dermal absorption, inhalation, and ingestion [EPA, 1989].

   (a) Dermal Absorption - Three transport pathways [Section 4.3.b.3] can lead to human exposure by dermal absorption: direct contact with soils of the site, contact with wind-blown soil particles, and contact with contaminated groundwater migrating to Keehi Lagoon.

   (b) Inhalation - There are only two transport pathways from Section 4.3.b.3 which could lead to human exposure through inhalation, that being exposure to windblown soil particles both on-site and off, and inhalation of vapors.

   (c) Ingestion - Because the area groundwater is non-potable, only two transport pathways are possible for exposure to humans by ingestion: 1.) incidental ingestion of contaminated soil particles and 2.) consumption of fish caught in Keehi Lagoon subjected to contaminated waters migrating from the site.

b. Potentially Exposed Populations - There are three distinct exposure populations to be considered: 1.) the permanent employees of the vicinity, 2.) the long-term recreational fishermen of Keehi Lagoon, and 3.) the transient construction workers employed for any improvements to the site.

1. Permanent Employees - Through site visits and a review of the local business directory, the current estimated potentially exposed population consists of 2,500 individuals which are employed at businesses within a 1/2 mile radius of the site. Future population estimates include an additional 500 individuals, if vacant properties in the area are fully developed including the site itself.

   Individuals at greatest risk would be permanent employees of the site itself after it is redeveloped. It is estimated that the three acre site could employ up to 200 full time workers .

2. Recreational Fishermen - It is estimated that less then 100 recreational fishermen regularly consume fish caught in Keehi Lagoon.

3. Transient Construction Workers - Assuming that the three acre site is redeveloped to its fullest industrial potential, it is projected that a maximum population of 200 construction workers would be exposed to surface soils and open excavations during construction.

4.4 Quantification of Potential Exposure

In order to quantify exposure point concentrations, it was necessary to model the expected fate and transport mechanisms of metals and hydrocarbon products in the vadose zone and groundwater. Specifically modeled were: fate of metals, vadose zone migration, and groundwater transport.

a. <u>Fate of Metals</u> - Unlike most organic contaminants, which do not change their compound properties appreciably as a function of environmental chemistry, the fate and transport of metals is very much dependent on local environmental conditions. Transition metals may be transported in the subsurface as a free metal ion or as a complexed or chelated species. Metals are generally not transported in the subsurface as a vapor, non-aqueous phase liquid, or a sorbate on suspended particulate matter (except within coarse-grained geologic materials which is not the case at his site).

The model selected for speciating the metals under the prevailing conditions in soil and groundwater is GEOCHEM [Morel & Moran 1972]. As a physically-based model incorporating chemical thermodynamics, GEOCHEM establishes a mole balance equation for each component of the groundwater (or soil pore water) and corrects for the ionic strength of that solution according to the law of mass action. This mathematical model solves a set of non-linear algebraic expressions simultaneously in order to provide concentrations of each dissolved, solid, and adsorbed species under the specified conditions. The model is typically used either to predict the concentration of inorganic and organic complexes of a metal cation in solution or to estimate the effects of changing pH, ionic strength, redox potential, or water content on the solubility of a metal.

The specified inorganic chemical and physical properties were those analyzed in groundwater collected from MW1 [Appendix E]. This data set was selected because MW1 contained the highest total dissolved solids concentration of the three wells, providing the most conservative estimate for metal migration because of the available inorganic ligands in solution. In addition to predicting metal speciation in groundwater, these physical and mineral data were also used to speciate metals in the vadose zone. While the inorganic chemistry of the soil pore water could not be analyzed, both the pH and redox potentials measured in groundwater (7.9 and +110 mv, respectively) are reasonable for unsaturated media. The Weiss investigation indicates that the shallow soils are slightly basic, with pH measurements ranging from a low of 7.6 to a high of 8.2.

b. Vadose Zone Migration - The primary mechanism for transporting hydrocarbons and metals in the vadose zone is leaching by surface water which percolates through the ground surface and subsequently carries these solutes via unsaturated flow. The governing equation for water flow includes a three dimensional, time-dependent relationship that may be solved by either numerical or analytical techniques. For this study, the combination of a numerical unsaturated transport model (i.e., VLEACH) and a "net" infiltration or recharge model (i.e., the hydrologic subroutine from SESOIL) were used to predict the migration of dissolved solutes in the vadose zone. A mechanism of lesser importance for transporting the organic, but not inorganic species, includes vapor diffusion from the contaminated zones in soil to the above-ground air. Vapor diffusion of benzo(a)pyrene and polychlorinated biphenyls were evaluated using a Fickian model for one-dimensional migration under steady-state conditions.

Organic compounds and metals are retarded in their migration, relative to the wetted front, by partitioning and (ad)sorption processes. Organic compounds partition out of the soil pore water and into soil gas and soil organic matter in accordance with their Henry's Law constants and Koc, which are determined primarily by polarity and molecular weight. Conversely, the positively-charged metals are retarded primarily as a result of their electrostatic adsorption to negatively-charged mineral surfaces. Appropriate partitioning coefficients and retardation factors were internally calculated as part of the solute transport model. However, it was conservatively assumed that there are no sinks for the contaminants (e.g., irreversible sorption, chemical or biological degradation).

1. Solute Transport (Unsaturated) - VLEACH is a one-dimensional, finite-difference, vadose zone leaching model prepared for the U.S. Environmental Protection Agency by CH2M Hill [1990]. The model is designed to simulate the migration of a sorbed component by considering four main processes: liquid-phase advection, solid-phase sorption, vapor-phase diffusion, and three-phase equilibrium. The following assumptions are made by the model:

   - Partitioning between phases is linear and both soil/water distribution coefficients and Henry's Law coefficients are constant in time and space;
   - Contaminants exist in three phases under equilibrium conditions within the soil volume modeled;
   - No free product exists (all organic contaminants are present in a sorbed, aqueous, or vapor phase) and, therefore, there is no migration of an "organic liquid" or NAPL;
   - Neither production nor degradation of contaminants is occurring;
   - No preferential pathways (e.g., fingering or fracture flow) for solute migration exist; and
   - Soils are assumed to be homogeneous within representative volumes.

Chemical parameter (Koc, Henry's Law, solubility, and diffusivity) describe the physical behavior of contaminants, while soil properties (bulk density, total porosity, water content, and organic carbon content) are descriptors of the solid matrix through which contaminants migrate. Site-specific conditions (depth to groundwater, rate of recharge, and the area of soil volume) are used to describe the hydrological properties to be modeled. Finally, model parameters control the timing of calculations and form of data presentation.

The VLEACH model operates by distributing the mass of a contaminant among three phases (soil, pore-water, and soil air) within each cell of a vertical stack of theoretical cells reaching from ground surface to the water table. In each time step of the model, three separate processes occur: (i) aqueous phase migrates advectively downward; (ii) vapor phase diffuses vertically upward and downward, and (iii) the resultant contaminant mass re-equilibrates according to the specified distribution coefficients. Obviously, metals partition exclusively between the soil pore water and the mineral surfaces; there is no partitioning of these compounds into the gas phase.

2. Net Infiltration (Recharge) - SESOIL is a seasonal soil compartment model developed by Bonazountas and Wagner [1984] for the EPA ("seasonal" because it estimates the pollutant distribution in the soil column and on the watershed after a season (month or year) directly by employing a statistical water balance analysis and a wash load routine). SESOIL predicts the rate of vertical chemical transport/transformation in the soil column in terms of mass and concentration distributions among sorbed, aqueous, and vapor phases in the unsaturated zone. The soil column is defined as a compartment (cell) which extends from the ground surface through the unsaturated zone to the groundwater table. The simulations are based upon a three-cycle principle, each cycle being associated with a number of physical or chemical processes.

The advantage of the SESOIL model is its ability to combine the relevant soil processes (recharge, unsaturated flow, solute retardation, biodegradation, and volatilization) into a single simulation. For purposes of this fate and transport study, the SESOIL model is used only for the hydrologic cycle, which specifies rainfall, soil moisture, infiltration, surface runoff, evapotranspiration, and groundwater runoff. The net recharge calculated by SESOIL was then input to the VLEACH model to predict the aqueous solute transport of metals and organics.

Due to the extensive site specific data input parameters required by the SESOIL model (average monthly temperature, average monthly cloud cover, average monthly relative humidity, average monthly shortwave albedo at the surface, average daily evapotranspiration, average monthly precipitation, mean time of rain, mean number of storm events, and the mean length of rain season), NOAA's hydrological and meteorological data collected at Lihue, Hawaii (the nearest NOAA weather station to Honolulu) were used as data inputs.

Since annual rainfalls at Lihue average over 120 inches/year [NOAA, 1992] while rainfall near Sand Island averages under 30 inches/year [Armstron, 1983], use of NOAA data from Lihue overestimates net infiltration and groundwater yield for the site in question, thus leading to very conservative calculations of groundwater loading by the VLEACH model.

3. Residual Hydrocarbon Mobility - In addition to solute transport in an aqueous phase, the organic compounds of concern could also be transported as a solute in a bulk hydrocarbon or NAPL. Both benzo(a)pyrene and polychlorinated biphenyls have a substantial affininity for an organic phase, such as the TRPH fraction encountered in soil samples. In order to assess whether NAPL migration in the vadose zone is a plausible transport mechanism, hydrocarbon concentrations can be compared to the volume of soil required to attain residual saturation. Using the maximum TRPH concentration in soil [CFC, October 1992] of 2,800 mg/kg, the volume of soil required to immobilize hydrocarbon product may be calculated according to Equation 4-1 [Dragun 1988].

$$V_s = 0.2\ V_{hc} / (P \times R_s) \tag{4-1}$$

V_s = Volume of soil required to attain residual saturation (cubic yards).
V_{hc} = Volume of hydrocarbon (barrels) [1 barrel = 159 liters].
R_s = Residual saturation capacity (0.15 for diesel fuel).
P = Total porosity of soil (dimensionless).

4. Vapor-Phase Transport - An estimate of the loading rate for organic compounds of concern (metals do not have a vapor pressure) can be made by estimating the soil/vapor partitioning and then calculating the diffusive or advective flux. The chemical partitioning between soil and vapor phases may be estimated using the fugacity concept as presented by MacKay & Patterson [1981]. Equilibrium partitioning between the adsorbed and aqueous phases were calculated according to Equation 4-2.

$$C_g = (Z_a/Z_s)\,C_s \tag{4-2}$$

C_g = Compound concentration in soil gas (mg/L).
Z_a = Fugacity in gas phase (0.404 mol/m^3-kPa).
C_s = Compound concentration in absorbed phase (mg/kg).
Z_s = Fugacity in sorbed phase (mol/m^3-kPa) [Kd/HLC].
Kd = Soil/water distribution coefficient (L/kg) [Koc x foc].
Koc = Soil organics/water partitioning coefficient (L/kg).
foc = Organic carbon content in uncontaminated soil (dimensionless).
HLC = Henry's Law constant (m^3-kPa/mol).

The soil/water distribution coefficient (Kd) overestimates the partitioning of benzo(a)pyrene and polychlorinated biphenyls from the sorbed phase because it assumes the only organic material in the soil is natural (e.g., background levels associated with the various soil units). The soil chemistry data from this site indicate that residual hydrocarbons are present in soil at concentrations as high as 2,800 mg/kg.

The contaminated soil has a higher organic carbon content due to the presence of diesel and oil hydrocarbons, which have a net effect of decreasing the desorption and increasing the vapor-phase retardation of benzo(a)pyrene and polychlorinated biphenyls compared to that in uncontaminated soils. Boyd & Sun [1990] have found that residual heavy hydrocarbons are actually more effective sorbents for hydrophobic organic compounds than are natural organic substances.

The primary mechanisms by which vapor-phase contaminants are transported include gaseous diffusion and bulk advection. Given the assumptions of [i] a very *short distance* between soil contamination maxima at 1 foot bgs and [ii] the absence of buildings (which normally create local pressure differences) at this site, only diffusive flux rates were estimated. Vapor diffusion can be approximated by a derivation of Fick's law (Equation 4-4) as described in Silka (1988). Equation 4-3 gives the calculation for the effective diffusion coefficients, which are always less than air diffusivities because of the tortuous path which diffusing molecules must follow in the subsurface. The effective diffusion coefficient is a function of the soil porosity (total and air-filled), physical properties of compounds of concern, and characteristics of the soil air. Air diffusivities for the two compounds of concern at this site were calculated according to the method described by Fuller et al. [1966].

$$D_{sg} = D_a (ap^{3.3}/tp^2)[(bd \times Kd/HLC)+(wc/HLC)+ap] \qquad (4\text{-}3)$$

$$q = D_{sg} (C_g - C_b) Ac/b \qquad (4\text{-}4)$$

A_c = Unit area of soil contamination (1 m^2).
ap = Air-filled porosity (dimensionless).
b = Height of soil through which compounds diffuse (0.3 m).
bd = Soil bulk density (kg/L).
C_g = Vapor conc. in contaminated soil (mg/m^3).
C_b = Vapor conc. in above-ground air (mg/m^3).
D_{sg} = Effective diffusion coefficient (m^2/day).
D_a = Air diffusivity (m^2/day).
q = Diffusive flux (mg/day).
tp = Total porosity (dimensionless).

c. Groundwater Transport -

1. Solute Transport (Saturated) - An analytical, one dimensional, convective-dispersive solute transport model was selected for predicting the migration of metals and organics in groundwater. A relatively simple model, ONE-D [van Genuchten & Alves 1992], is appropriate for this purpose because of the limited groundwater data that are available as inputs. Laboratory-measured hydraulic conductivities, regionally-estimated hydraulic gradients, absence of data regarding saturated thickness, and an unknown degree of anisotopy are major factors which precluded the use of more sophisticated models requiring a substantial number of site-specific hydraulic parameters.

In addition, this model may be combined with conservative estimates for (i) retardation factors, (ii) soil/water partitioning, (iii) degradation, and (iv) distances to receiving waters, in order to provide "worst-case" projections for contaminant transport toward Keehi Lagoon.

The governing transport equation for ONE-D is a partial differential describing chemical transport under transient fluid flow conditions. The initial and boundary conditions selected to best represent this site include the following:

- Hydraulic conductivities ranging from 7.6×10^{-5} to 5.0×10^{-4} cm/sec;
- Longitudinal dispersivity of 0.4 mm [estimated from Bouwer 1978];
- No production or decay of solutes during transport;
- Linear sorption isotherms;
- Constant initial concentration of solutes at the source;
- Semi-infinite vertical profile;
- Hydraulic gradient of 0.0002 to 0.001 ft/ft to the north and west (piezometric surface varies with tidal cycle).

The introduction of compounds of concern to groundwater was projected according to the following assumptions:

- Aqueous solubility limits as the sum of predominant species (cadmium and lead);
- Aqueous concentrations measured in the groundwater (copper and zinc);
- Desorption from aquifer solids (benzo(a)pyrene and polychlorinated biphenyls).

Retardation factors for various soluble species of the four metals were provided (as a function of valence state and soil type) by Buchter et al. [1989]. Conversely, partitioning of organic compounds between the solid and aqueous phases in the saturated zone was described by the fugacity concept as presented by MacKay & Patterson [1981]. Equilibrium partitioning between the sorbed and aqueous phases was calculated according to Equation 4-5. As noted previously, it has been conservatively assumed that these organic compounds partition as individual constituents from soils that are not contaminated with residual product (e.g., TRPH concentrations are assumed be to zero).

$$C_w = (Z_w/Z_s)\,C_s \qquad (4\text{-}5)$$

C_w = Compound concentration in aqueous phase (mg/L).
Z_w = Fugacity in aqueous phase [1/HLC].

Retardation factors for the organic compounds of concern were calculated according to Equation 4-6 [Wilson et al. 1981], which combines the soil/water distribution coefficient with aquifer-specific inputs for bulk density and total porosity of the porous media.

$$R_f = 1 + [bd \times K_d/tp] \qquad (4\text{-}6)$$

R_f = Solute retardation factor (dimensionless).

2. <u>Non Aqueous Phase Liquid (NAPL) Migration</u> - An estimate of NAPL migration was made by assessing its relative permeability in the capillary fringe. Capillary characteristic curves, generated for the two soil units intercepting the water table, were used to project the relative percentages of oil and water. Assuming that the porous medium is locally isotropic, the relative permeability of the NAPL fraction may be defined as the ratio of its effective permeability under actual site conditions to its corresponding permeability at saturation (e.g., a hydrocarbon-wetted media). Due to the presence of water in the capillary fringe, hydrocarbon product must establish its own tortuous path within the porous medium. As the saturation of the NAPL decreases, the channels for that fluid are diminished to the point that pressure can no longer be transmitted through the product and its permeability vanishes [Bear & Verruijt 1987].

Using the maximum height of product reported in the groundwater trenches (approximately 1 inch), a residual saturation of NAPL in the capillary fringe may be estimated according to the method of Farr et al. [1990]. This maximum residual saturation of the NAPL phase was input to Equations 4-7 and 4-8 in order to evaluate the permeability of the soils to hydrocarbon product [Parker 1989]. The resulting permeability actually overestimates that of the residual product because physical properties of diesel fuel were used as inputs. Results of groundwater analyses according to EPA Method 8015d indicate that a substantial percentage of the residual product consists of hydrocarbons that are "heavier" than those comprising diesel fuel.

$$k_{wr} = S_w^{0.5} [1 - (1 - S_w^{1/m})m]^2 \qquad (4\text{-}7)$$

$$k_{rn} = (S_t - S_w)^{0.5} \times [(1 - S_w^{1/m})m - (1 - S_t^{1/m})m]^2 \qquad (4\text{-}8)$$

S_w = $(S_w - S_{res})/(1 - S_{res})$.
S_t = $(S_t - S_{res})/(1 - S_{res})$.
S_w = Water saturation.
S_t = Total saturation.
S_{res} = Residual saturation.
k_{wr} = Permeability of the wetting fluid (cm^2).
k_{rn} = Permeability of the non-wetting fluid (cm^2).

As was noted previously, benzo(a)pyrene and polychlorinated biphenyls have a high affinity for any organic or product phase that may be present in the capillary fringe. Should these compounds reach the groundwater table, they would partition preferentially into the NAPL, as opposed to the groundwater, and could be transported as a solute in the product layer.

4.5 Modeling Results

a. Vadose Zone -

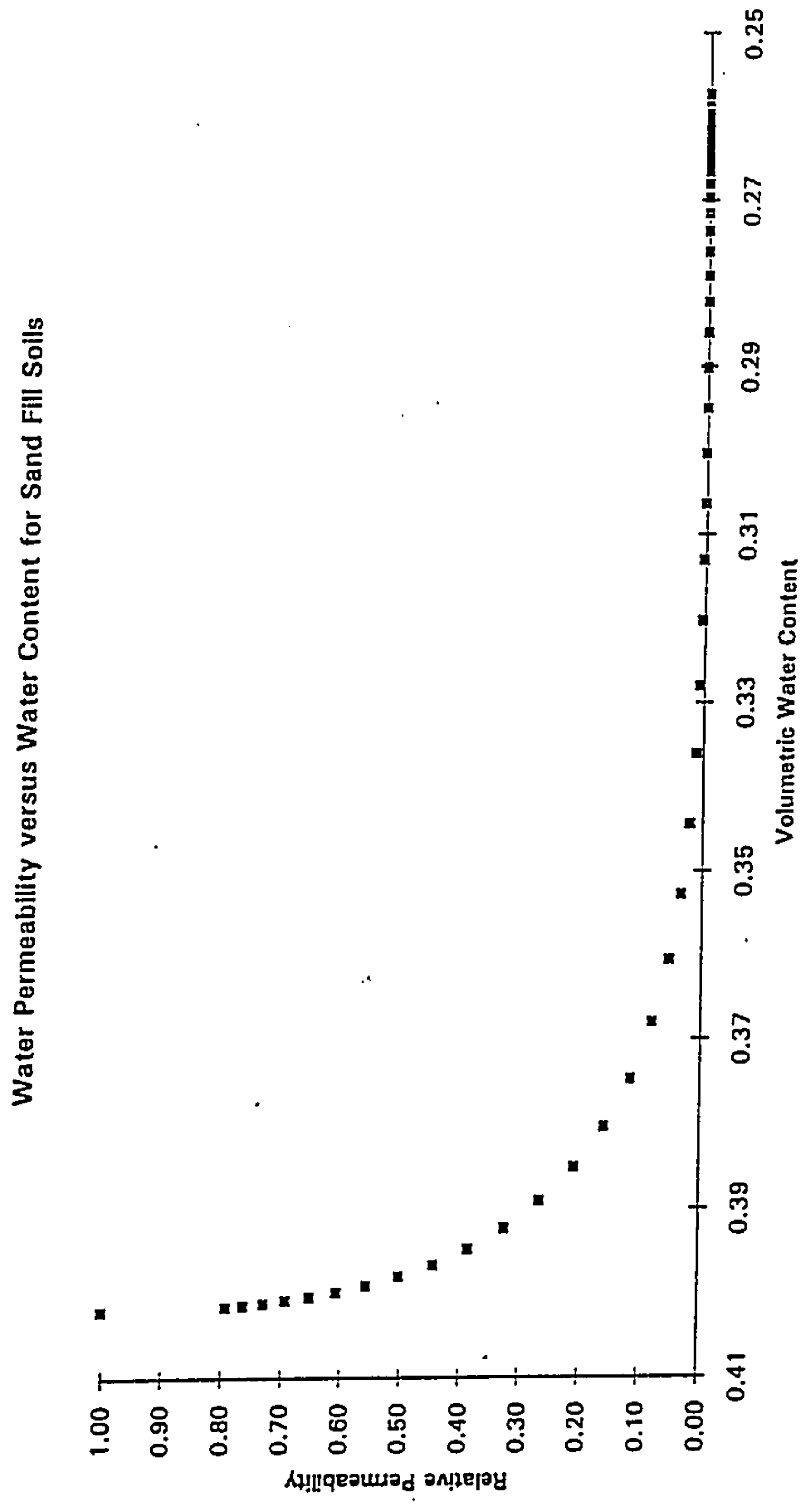
1. Solute Transport (Unsaturated) - The GEOCHEM model indicated that lead and cadmium would partition into soil pore water at their solubility limit under the assumed soil concentrations and environmental conditions input for the vadose zone. Model predictions of these two metals solubilizing into soil pore water at their solubility limit is probably due to the fact that metal scraps (representing the zero valence state) were present in soil samples. This form of the metal is not considered by GEOCHEM because the zero valence form does not attain an equilibrium with other soluble, precipitated or adsorbed forms.

The major anions considered to be ligands for the metals included hydroxide, sulfate, chloride, nitrate and bicarbonate (no organic ligands other than carboxylic acids were analyzed). The combined solubility of these metal-ligand complexes yielded the total solubility of a particular metal.

Considering the distance between the soil contamination and the water table (only 1.5 to 2.5 feet), it was conservatively predicted that lead and cadmium would reach the groundwater table at their solubility limit. Respective solubility limits for lead and cadmium were 0.19 and 3.4 ug/L, which includes only the species actually in solution (as opposed to soluble and adsorbed species measured in an unfiltered water sample). Although some retardation and sorption would be expected to occur during the infiltration of Pb and Cd via unsaturated flow, the vertical distribution of these metals throughout the soil column could offset the effects of such processes.

SESOIL predicted a net infiltration or recharge of 32.3 inches/year. In addition, the capillary characteristic curves were used to construct unsaturated permeability curves describing water flow in the vadose zone. The permeability curves [relative permeability vs. volumetric water content shown on Figures 4-5 and 4-6] were used to estimate an unsaturated hydraulic conductivity from the moisture contents and saturated hydraulic conductivities measured for the two soil units. The SESOIL output and the unsaturated hydraulic conductivities were used as inputs to the VLEACH model.

VLEACH predicted that maximum benzo(a)pyrene loading to the groundwater would be 0.18 and 1.2 mg/m^2-year for the sand lens and sandy fill materials, respectively. Similarly, polychlorinated biphenyls were predicted to load groundwater at 24 to 28 mg/m^2-year within the same soil units. These loading rates represent "first year" estimates, which were predicted to decrease in subsequent years due to mass removal at the source. The results suggest that mass loading rates for both organic compounds are quite limited, probably because they partition so minimally into soil pore water.



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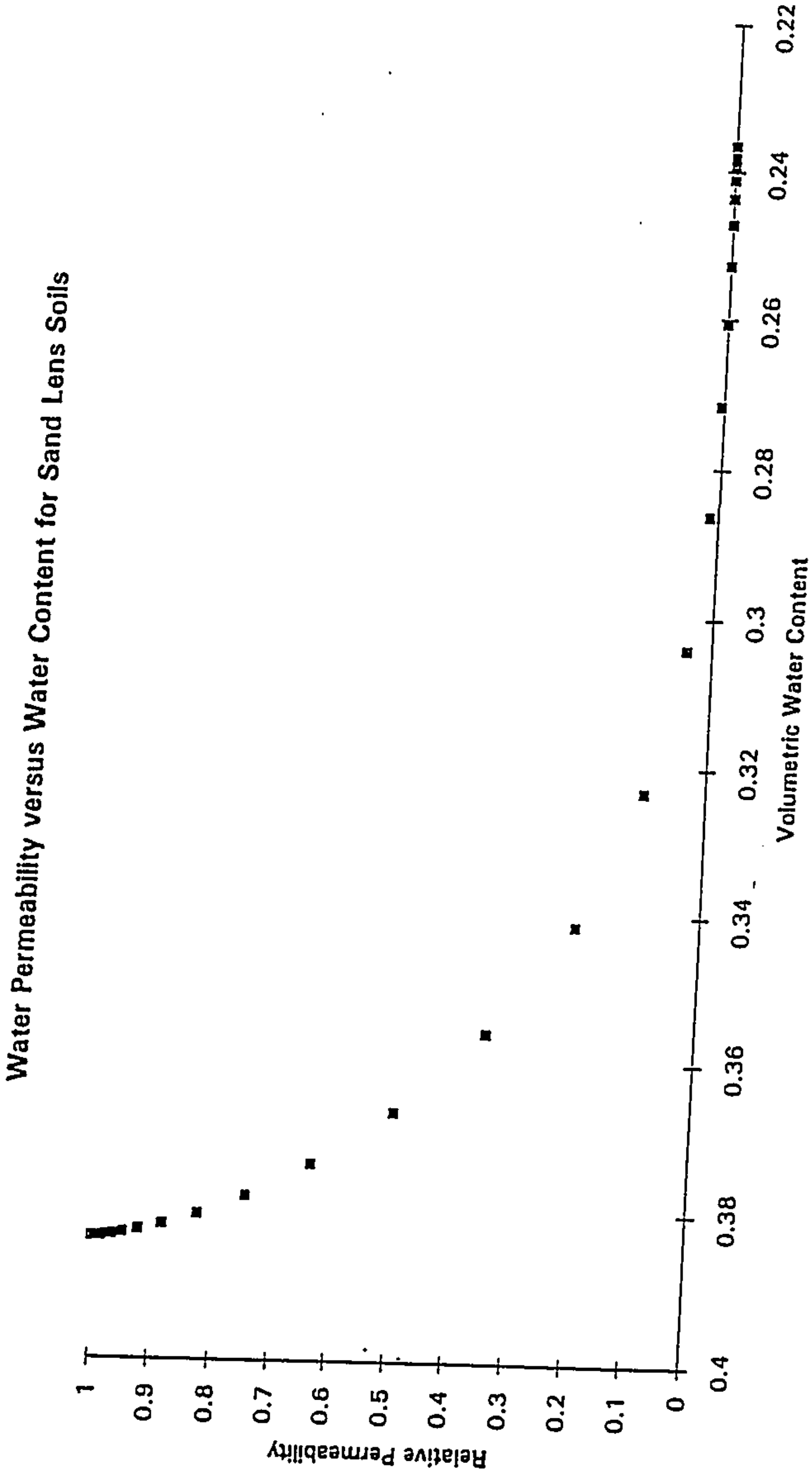
WATER PERMEABILITY vs. WATER CONTACT
for
SAND FILLED SOILS

Figure 4-5



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WATER PERMEABILITY vs. WATER CONTACT
for
SAND LENS SOILS

Figure 4-6

Maximum aqueous concentrations of benzo(a)pyrene and polychlorinated biphenyls at the source (adjacent to the most highly contaminated soils in the sand lens) during the initial year of the modeling were calculated to be 0.6 and 87 ug/L, respectively [Table 4-1]. Initial concentrations in the sandy fill are predicted to equal solubility limits, 4 ug/L for benzo(a)pyrene and 100 ug/L for polychlorinated biphenyls [Table 4-1]. The higher predicted concentrations in soil pore water within the sandy fill is a result of the relatively low natural organic carbon, compared to that in the sand lens. Concentrations in the soil pore water were predicted to decline over time as the source is depleted.

Table 4-1 Predicted Pore Water Concentrations of Organics

Physical Parameters (Appendix F)	Sandy Fill	Sand Lens
Total Porosity (L/L)	0.402	0.384
Water Content (L/L)	0.34	0.354
Air Porosity (L/L)	0.062	0.03
Bulk Density (kg/L)	1.44	1.54
foc (gm/gm)	0.0038	0.027
Benzo(a)pyrene Partitioning		
Aqueous Solubility (ug/L)	4	4
Concentration in Soil (mg/kg)	6.8	6.8
Kd (L/kg)	1,513	10,749
Predicted Concentration in Pore Water (ug/L)	*4.0*	*0.6*
Polychlorinated Biphenyl Partitioning		
Aqueous Solubility (ug/L)	100	100
Concentration in Soil (mg/kg)	12	12
Kd (L/kg)	19	138
Predicted Concentration in Pore Water (ug/L)	*100*	*87*

2. Residual Hydrocarbon Mobility - According to Dragun's [1988] method for estimating the immobilization of hydrocarbon product in soil, the residual TRPH concentration of 2,800 mg/kg, if present as an immiscible phase (rather than as a sorbed phase), would not migrate. The calculation was performed using an average porosity and bulk density for the sandy fill and sand lens units. This simple equation suggested that the residual TRPH concentration in soil was less than one-tenth of that required to sustain diesel product flow.

Comparatively, Kia & Abdul [1990] tested a wide range of sandy soils and found that diesel fuel was immobile below 8 percent residual saturation (by volume) in even the most transmissive aquifer materials. Assuming a density of 0.88 g/ml for diesel fuel and an average soil bulk density of 1.49 g/ml, the TRPH concentration of 2,800 mg/kg corresponds to a residual saturation of less than 0.5 percent by volume.

3. Vapor-Phase Transport - The fugacity model predicted that the maximum concentrations of benzo(a)pyrene and polychlorinated biphenyls in soil gas within the coral fill material would be 0.19 mg/m^3 and $1.1x10^{-8}$ mg/m^3, respectively [Table 4-2].

Due to a low concentration of natural organic carbon in the sandy fill materials, the maximum vapor concentrations were projected to be 7.6 mg/m^3 and $1.3x10^{-8}$ mg/m^3 for benzo(a)pyrene and polychlorinated biphenyls, respectively [Table 4-2]. These levels represent "worst-case" conditions because the TRPH fraction of the soil, which acts as a sorbent, was ignored and because equilibrium partitioning of high molecular weight organics between sorbed and vapor phases is very unlikely.

Based on the aforementioned concentrations of benzo(a)pyrene and polychlorinated biphenyls in soil gas at 1-foot bgs and on an assumed concentration of zero for both compounds in the above-ground air, a flux rate for the compounds of concern was calculated. Flux values for benzo(a)pyrene ranged from $6.9x10^{-23}$ to $5.3x10^{-22}$ mg/m^2-day in the coralline and sandy fill materials, respectively; while the vapor flux rate for polychlorinated biphenyls was calculated to be $1.0x10^{-6}$ mg/m^2-day for both near-surface soils [Table 4-2]. *These projected flux rates for benzo(a)pyrene are extremely low, while those for polychlorinated biphenyls indicate that about one nanogram per day would diffuse up through a square meter of ground surface.*

Table 4-2 Predicted Vapor Diffusion of Organics

	Coral Fill	Coral Fill	Sand Fill	Sand Fill
	BaP	PCB	BaP	PCB
De (m^2/day)	$1.9x10^{-15}$	$1.6x10^{-6}$	$2.1x10^{-15}$	$2.3x10^{-7}$
Soil Concentration (mg/kg)	6.8	20	6.8	20
Vapor Concentration (mg/m^3)	$1.1x10^{-8}$	0.19	$7.6x10^{-8}$	1.33
Distance (meters)	0.3	0.3	0.3	0.3
Predicted Flux (mg/m^2-*day*)	$6.9x10^{-23}$	$1.0x10^{-6}$	$5.3x10^{-22}$	$1.0x10^{-6}$

b. Groundwater -

1. Solute Transport (Saturated) - The ONE-D model predicted maximum darcian velocities of 0.5 and 0.08 feet/year for the sandy and clayey aquifer materials, respectively [Table 4-3]. These two lithologic units were characterized as having the highest hydraulic conductivities of those tested. The hydraulic conductivities were combined with a hydraulic gradient of 0.0002 to 0.001 ft/ft, which was estimated on the basis of both on-site and regional groundwater data.

Retardation factors for the organic compounds of concern in the sandy aquifer material were calculated at 41,000 and 530 for benzo(a)pyrene and polychlorinated biphenyls, respectively; while retardation factors in the clayey aquifer material were about an order-of-magnitude less (4,400 and 58, respectively) [Table 4-3].

The lower retardation factors for the clayey unit are related to minimal natural organic carbon values (foc) relative to those in the sand aquifer unit [Table 4-3]. Assuming that groundwater contamination is present at the southwest boundary of the site (i.e., closest to Keehi Lagoon) and that the distance to the Lagoon is 620 feet, *the projected arrival times for the organic compounds range from 460,000 to 50 million years.* These estimates assume that [i] properties of the saturated zone underlying the subject site are representative of those in groundwater between the site boundary and Keehi Lagoon, [ii] isotropic groundwater flow occurs through homogeneous soil units 9e.g., there are no high-permeability channels), and [iii} substantial differences in total dissolved solids and other water quality parameters are associated only with the Lagoon.

Table 4-3 Predicted Groundwater Migration of Organic Compounds

	Sand Aquifer	Clay Aquifer
Hydraulic Conductivity (cm/sec)	5.0x10-4	7.6x10-5
Hydraulic Conductivity (ft/day)	1.42	0.22
Dispersity (ft)	0.40	0.40
Darcian Velocity (ft/yr)	0.52	0.08
Distance to Receptor (ft)	620	620
Intercept Time of Groundwater (yr)	*1,200*	*7,900*
Solute Migration		
Bulk Density (kg/L)	1.55	1.48
Porosity (L/L)	0.45	0.52
foc (gm/gm)	0.03	0.0039
Koc of BaP (L/kg)	398,000	398,000
Koc of PCB (L/kg)	5100	5100
Retardation Factor for BaP	41,000	4,400
Retardation Factor for PCB	530	58
Arrival Time for BaP (yr)	*50,000,000*	*35,000,000*
Arrival Time for PCB (yr)	*640,000*	*460,000*

Retardation factors for the metals ranged from 650 to $1.5x10^8$ in the sandy aquifer material and from 230 to 23,000 in the clayey groundwater unit [Table 4-4]. These retardation factors were based on Kd values presented by Buchter et al. [1989] for the predominant metal species identified by GEOCHEM, including Cd2+, Pb2+, Cu2+ and Zn2+. Furthermore, these Kd values were measured for sandy Hawaiian soils possessing cation exchange capacities similar to those reported for this site.

Based on the same groundwater darcian velocity presented for the organic indicators, *metal species were projected to reach the lagoon via groundwater transport in time periods ranging from 780,000 to 1.8x10^{11} years.* The shortest travel time corresponds to cadmium and the longest to lead [Table 4-4]. *Transport times for metals are similar to those projected for the two organics, suggesting that solute transport in groundwater to the Lagoon under the assumed conditions is unlikely.* Hence, concentrations at which these compounds of concern may reach the lagoon were not estimated.

Table 4-4 Predicted Groundwater Migration of Metals

	Sand Aquifer	Clay Aquifer
Hydraulic Conductivity (cm/sec)	5.0x10-4	7.6x10-5
Hydraulic Conductivity (ft/day)	1.42	0.22
Dispersity (ft)	0.40	0.40
Darcian Velocity (ft/yr)	0.52	0.08
Distance to Receptor (ft)	620	620
Intercept Time of Groundwater (yr)	*1,200*	*7,900*
Solute Migration		
Bulk Density (kg/L)	1.55	1.48
Porosity (L/L)	0.45	0.52
foc (gm/gm)	0.03	0.0039
Kd of Cadmium (L/kg)	186	91
Kd of Lead (L/kg)	43,000,000	8,200
Kd of Copper (L/kg)	2,000	370
Kd of Zinc (L/kg)	240	80
Retardation Factor for Cadmium	650	260
Retardation Factor for Copper	6,900	1,100
Retardation Factor for Lead	150,000,000	23,000
Retardation Factor for Zinc	830	230
Arrival Time for Cadmium (yr)	*780,000*	*2,100,000*
Arrival Time for Copper (yr)	*8,300,000*	*8,700,000*
Arrival Time for Lead (yr)	$1.8x\,10^{+11}$	*180,000,000*
Arrival Time for Zinc(yr)	*1,000,000*	*1,800,000*

2. NAPL Migration - NAPL detected on-site has been characterized to consist of a mixture of hydraulic fluids, motor oils, and diesel fuel. Diesel fuel was chosen to model NAPL migration because it is the least viscous of the products encountered and therefore has the highest permeability and "quickest" migration through soil.

Based on observations of a maximum height of 1 inch of "free product" in any of the trenches during all investigations, it is assumed that any "free product" remaining on site would have a maximum residual NAPL saturation of 36 percent. This was calculated according to the method described by Farr at al. [1990]. This calculation suggests that any "free product" layer in the capillary fringe would consist of 64 percent water and that the number of NAPL-wetted pores is limited.

Using the capillary characteristic curves [Appendix E], as well as the residual NAPL saturation of 36 percent, a relative permeability of approximately 0.02 was calculated for the free product. This indicates that diesel fuel possesses a permeability that is about 50-fold less than that of water in the capillary fringe. Soil units intercepting the capillary fringe included the silty sand fill and sand lens, which were characterized by hydraulic conductivities of 7.1x10^{-6} cm/sec. Given the physical properties of diesel fuel, it is unlikely that the hydraulic conductivity of the NAPL exceeds 1x10^{-7} cm/sec.

The estimated time of arrival for NAPL to reach the nearest surface water (Keehi Lagoon) assumes the following:

- Sufficient product is present in the subsurface to maintain a residual saturation of 36% during the migration period.
- Velocity of NAPL flow is based on the same hydraulic gradient (piezometric surface) used to estimate groundwater velocities.
- No "high-permeability" channels for product (hydrocarbon wetted) are present between the site boundaries and the lagoon.

The estimated product conductivity is approximately 500-fold less than that for water in the least permeable of the groundwater units (lagoonal clay). Based on the above, it is estimated that *NAPL would require over 4 million years to reach Keehi Lagoon.*

5.0 TOXICITY ASSESSMENT

5.1 Risk Characterization

a. Exposure Point Concentrations of Compounds of Concern - The previous chapter dealt with assessing the potential of compounds of concern to migrate to human exposure routes. Section 4.5. concluded that only polychlorinated biphenyls will migrate to the surface in a vapor phase with only one nanogram per square meter-day diffusing through the ground surface.

Assuming a worst case exposure scenario of an air conditioned one story building constructed on grade, maximum obtained concentration of polychlorinated biphenyl vapor in the building is predicted to be 1.67 x 10^{-7} mg/m^3.

Solute transport modeling, as summarized in Section 4.5, predicted it will take at least 460,000 years for compounds of concern to reach Keehi lagoon via groundwater transport. This negates the possibility for human exposure via contact with waters or consumption of fish from Keehi Lagoon.

Direct exposure to contaminated site soils becomes the primary mechanism of concern for the site. During construction operations, soil from various depths will be disturbed, therefore, worst case levels of detection for the compounds of concern were used for modeling exposure risk.

Table 5.1 summarizes those values:

Table 5.1 Worst Case Exposure Point Concentrations of Compounds of Concern

	Concentration In Soil (mg/kg)	Vapor-Phase Concentration (mg/m^3)
Benzo(a)pyrene	6.81	--
Polychlorinated Biphenyls	20	1.67×10^{-7}
Cadmium	124	--
Copper	31,700	--
Lead	14,000	--
Zinc	48,925	--

b. Exposure Scenarios -

1. Permanent Employees - Permanent employees of the area would be subject to wind-blown soil particles, becoming exposed to site contaminants through dermal contact, inhalation, and incidental ingestion of contaminated soil particles.

   A worst case scenario was chosen to calculate the risk of exposure to permanent employees. Assumptions are presented in Table 5.2.

2. Transient Construction Workers - Any improvements made to the site will subject construction workers to residual concentrations of site-related contaminants through direct contact with the soil and exposure to wind-blown soil particles. Anticipated exposure routes for construction workers are: dermal contact, inhalation, and incidental ingestion of contaminated soil particles.

   A worst case scenario was chosen to calculate the risk of exposure to transient construction workers. Assumptions are presented in Table 5.2:

Table 5.2 Assumptions Used to Calculate Exposure Risk

	Permanent Employees	Transient Construction
BR	0.83 m^3/hr	2.5 m^3/hr
BW	70 kg	70 kg
ED	20 yr	15 wk
EF	5 days/wk	6 days/wk
ET	8 hrs/day	10 hrs/day
IR	100 mg/day	480 mg/day

BR = Breathing rate (m^3/hour).
BW = Body weight (kg).
ED = Exposure duration (weeks).
EF = Exposure frequency (days/week).
ET = Exposure time (hours/day).
IR = Incidental ingestion rate for soil (mg/day).

5.2 Toxicity Profiles of Compounds of Concern

Profiles for each compound of concern are presented in Appendix G. They summarize: chemical properties, potential exposure routes, target organs, acute toxicity, carcinogenicity, developmental/reproductive toxicity, and standards/regulations. The profiles were compiled from Micromedex, Inc. Toxicology, Occupational, Medicine and Environmental Services data bases which include: IRIS, Reprotext®, New Jersey Hazardous Substance Fact Sheets, and the NIOSH Pocket Guide™, 1993.

a. Summary of Non carcinogenic and Carcinogenic Effects -

1. Benzo(a)pyrene (BaP) - Although specific medical research is lacking, BaP is classified as a probable human carcinogen, with possible links to lung, skin, and bladder cancers. Dermal contact and inhalation are the primary exposure routes for BaP.

2. Polychlorinated Biphenyls (PCBs) - Although specific medical research is lacking, PCBs are classified as probable human carcinogens, with possible links to skin cancer. Dermal contact and inhalation are the primary exposure routes which can cause severe rashes, nervous system disorders, and liver damage.

3. Cadmium (Cd) - Evidence exists linking chronic inhalation of cadmium dusts to respiratory and prostrate cancers. The primary exposure routes for cadmium are inhalation and ingestion.

4. Copper (Cu) - Copper is not classified as a carcinogen and poisoning by copper exposure probably does not occur in humans. Inhalation and ingestion of high levels of copper dust mostly cause short term irritations with a possibility of liver and kidney damage if high level exposures are chronic in nature.

5. Lead (Pb) - Although debated by health officials, lead is classified as a probable carcinogen by the EPA. Most lead exposure is by ingestion, but inhaled lead dust will also migrate to the gastrointestinal tract where it can cause anemia, nervous system disorders and liver damage. Most publicized are links to developmental disabilities in young children.

6. Zinc (Zn) - Zinc, an essential element to human life, is not linked to any human toxicities. However, inhalation of zinc dust is well known to cause metal fume fever, a temporary flu-like disorder with no lasting effects.

Table 5.3 Summary of Toxicity Data for Compounds of Concern

	REL	MCL	RL	CSF_i	CSF_o	CSF_a	RfD_i	RfD_o	RfD_a
BaP	0.1	0.2	0.005	0.000035*	7.3	1.5*	--	--	--
PCB	0.001	0.5	0.005	0.0035*	7.7	1.6*	--	--	--
Cd	0.0025	5	0.0006	--	--	--	0.0007*	0.001	0.0002*
Cu	1	1	NA	NA	NA	NA	0.286*	0.340†	1.7*
Pb	0.1	0	--	--	--	--	0.029*	0.006	0.0012*
Zn	5	5	NA	NA	NA	NA	1.428*	1.7	8.5*

-- = No published value available.
* = Value was calculated using one of the following equations, derived from Chaudhuri, et al. [1993]:

$$CSF_o = \frac{R \times BW \times LT}{RL \times I \times A \times ED}$$

$$CSF_i = \frac{R \times W}{REL \times B}$$

$$CSF_a = 0.20 \times CSF_o$$

$$RfD_i = \frac{REL \times B}{BW}$$

$$RfD_a = 5 \times RfD_o$$

A = Absorption Factor (1).
B = Daily air consumption (20 m^3/day).
CSF_a = Cancer slope factor for dermal exposure, adjusted for absorbed dose $(mg/kg\text{-}day)^{-1}$.
CSF_i = Cancer slope factor for inhalation exposure $(mg/kg\text{-}day)^{-1}$.
CSF_o = Cancer slope factor for oral exposure $(mg/kg\text{-}day)^{-1}$.
I = Intake assumption (2 L/day).
LT = Assumed lifetime (70 years).
MCL = Maximum contamination level (ug/L).
NA = Not applicable.
R = Allowable risk (10^{-6}).
RfD_a = Reference dose adjusted to an absorbed dose (mg/kg-day).
RfD_i = Reference dose for inhalation exposure (mg/kg-day).
RfD_o = Reference dose for oral exposure (mg/kg-day).
REL = Recommended exposure level (mg/m^3).
RL = Risk Level (ug/L).

5.3 Risk Calculation

Excess lifetime cancer risks for carcinogenic effects and hazard quotient for non carcinogenic effects were calculated by first estimating daily exposure doses to soil contaminants. Daily soil exposure doses were calculated using standardized equations and exposure assumptions that are consistent with U.S EPA risk assessment guidance for Superfund sites. The specific equations used were taken from Heat, et al [1993]. Site-specific information was used when available. The equations used to calculate risk were:

1. Carcinogenic Excess Lifetime Cancer Risk (ELCR) -

$$ELCR = (SExD_o \times CSF_o) + (SExD_i \times CSF_i) + (SExD_d \times CSF_a) \qquad [5\text{-}1]$$

2. Non carcinogenic Hazard Index (HI) -

$$HI = (SExD_o + RfD_o) + (SExD_i + RfD_i) + (SExD_d + RfD_a) \qquad [5\text{-}2]$$

3. Where, Soil Exposure Doses (SExD) are calculated as -

$$SExD_o = \frac{C_s \times IR \times EF \times ED \times UC}{BW \times AP} \qquad \text{[Oral]} \qquad [5\text{-}3]$$

$$SExD_i = \frac{C_s \times SPM \times FIP \times BR \times ET \times EF \times ED \times UC}{BW \times AP} \qquad \text{[Inhalation of particles]} \qquad [5\text{-}4]$$

$$+ \frac{C \times BR \times ET \times EF \times ED}{BW \times AP} \qquad \text{[Inhalation of vapors]} \qquad [5\text{-}5]$$

$$SExD_d = \frac{C_s \times SSA \times SAR \times ABS \times EF \times ED \times UC}{BW \times AP} \qquad \text{[Dermal contact]} \qquad [5\text{-}6]$$

ABS = Dermal absorption efficiency (0.25).
AP = Average period (25,550 days for carcinogens and ED in days for non carcinogens).
C = Constituent concentration released to confined airspace (ug/m^3).
C_s = Constituent concentration in the soil (mg/kg).
ELCR = Excess lifetime cancer risk (no units).
FIP = Fraction inhaled particulates (0.125).
HI = Hazard index (no units).
SAR = Soil adherence rate (1 mg/cm^2-day).
$SExD_d$ = Soil exposure dose from dermal contact (mg/kg-day).
$SExD_i$ = Soil exposure dose from inhalation of vapors or soil particles (mg/kg-day).
$SExD_o$ = Soil exposure dose from oral exposure (mg/kg-day).
SPM = Suspended particulate matter (0.075 mg/m^3).
SSA = Exposed skin surface area (2,940 cm^2).
UC = Unit conversion (10^{-6} kg/mg).

a. Risk Calculation - Compound concentrations [Table 5.1] and assumptions [Table 5.2] were plugged into Equations 5-3 through 5-6 in order to determine permanent employee and transient construction worker soil exposure doses for dermal contact, inhalation, and incidental ingestion.

   1. Soil Exposure Doses - Permanent employee soil exposure doses ranged from a low of 1.18×10^{-9} mg/kg-day for inhalation of BaP to a high of 0.352 mg/kg-day for dermal contact with zinc. Dermal contact was the dominant exposure mechanism, with exposure doses for all compounds being 1,000 times higher than exposure doses via inhalation or ingestion.

Transient construction worker soil exposure doses ranged from 8.02×10^{-11} mg/kg-day for inhalation of BaP to 0.44 mg/kg-day for dermal contact with zinc. Dermal contact and incidental ingestion exposures overshadowed inhalation exposures by a factor of 100.

2. Non carcinogenic Effects - Exposure risks for non carcinogenic compounds (Cu and Zn) and the non carcinogenic effects of Cd and Pb were calculated using Equation 5-2, which derives a representative "Hazard Index" by dividing each exposure dose (dermal, inhalation, and oral) by their corresponding reference dose listed in Table 5.3. Equation 5-2 was used for Cd and Pb, because no cancer slope factors have been published yet for these compounds, while RfDs were available.

   If the resultant HI [Table 5.4] is less than unity, it can be concluded that the exposed individual will not exceed promulgated maximum exposures. If it is greater than unity, it can be concluded that the exposed individual will exceed recommended exposure levels.

3. Carcinogenic Effects - Excess lifetime cancer risk for carcinogenic compounds (BaP and PCB) were calculated using Equation 5-1, which multiplies each exposure dose (dermal, inhalation, and oral) by their corresponding cancer slope factor (an estimate of the increase in cancer deaths per million individuals for each unit increase in compound concentration) listed in Table 5.3.

   The resulting ELCR [Table 5.4] represents the increased risk of contracting terminal cancer for the exposed individual. A value of 1×10^{-6} (or 1 cancer death in 1,000,000 people) is generally the maximum allowable risk to human health which is acceptable [EPA, 1986a].

Table 5.4 Calculated Exposure Risks

	BaP	PCB	Cd	Cu	Pb	Z
Permanent Employee						
ELCR	2.1×10^{-5}	6.6×10^{-5}	--	--	--	--
HI	--	--	4.46	0.13	83.3	0.04
Transient Construction						
ELCR	5.2×10^{-7}	4.9×10^{-6}	--	--	--	--
HI	--	--	6.33	0.23	118.7	0.22

ELCR = Excess lifetime cancer risk.
HI = Hazard index.
-- = Value not calculated.

5.4 Risk Assessment

a. <u>Summary of Calculated Risk</u> - Based upon the calculation of risk presented in the previous sections, individuals having the highest risk of adverse health effects from contaminants present in site soils are the projected 200 transient construction workers. Those individuals will greatly exceed recommended exposure levels for Pb (HI = 118.7) and Cd (HI = 6.33) and increase their lifetime cancer risk due to exposure to PCB (ELCR = $4.9x10^{-6}$) via dermal contact with and incidental ingestion of site soils. Also, the projected 200 permanent employees of the redeveloped site will also exceed recommended exposure levels for Pb (HI = 83.3) and Cd (HI = 4.46) via dermal contact and will increase their risk of contracting cancer in their lifetime slightly above acceptable levels ($1x10^{-6}$) due to exposure to BaP (ELCR = $2.1x10^{-5}$) and PCBs (ELCR = $6.6x10^{-5}$).

b. <u>Sensitivity</u> - Concentrations presented in Table 5-1 were worst case concentrations from all samples collected. Since hazard index and excess cancer risk equations [Equations 5-1 through 5-6] are based upon average exposures over time, this worst case basis does not lead to realistic assumptions about site risks.

Averaging detected concentrations from the Weiss investigation [Weiss, October 1991] leads to a closer approximation of uniform surface soil conditions (top 6 inches), while averaging detected concentrations from CFC's August 1992 investigations leads to a closer approximation of uniform near surface soil conditions (3 to 7 feet bgs). Average concentrations are presented in Table 5.5:

Table 5.5 Average Exposure Point Concentrations of Compounds of Concern

	Worst Case Concentration (mg/kg)	Weiss Ave. Conc. (mg/kg)	CFC Ave. Conc. (mg/kg)
BaP	6.81	2.43	0.58
PCB	20	9	4
Cd	124	20	12
Pb	14,000	3,159	1,540

If the average compound concentrations [Weiss, October 1991] are used to calculate HI and ELCR, the average exposure risks are as presented in Table 5.6:

If the average compound concentrations [Weiss, October 1991] are used to calculate HI and ELCR, the average exposure risks are as presented in Table 5.6:

Table 5.6 Calculated Average Exposure Risks

	BaP	PCB	Cd	Pb
Permanent Employee				
ELCR	$7.5x10^{-6}$	$3.0x10^{-5}$	--	--
HI	--	--	0.71	18.8
Transient Construction				
ELCR	$1.9x10^{-7}$	$2.2x10^{-6}$	--	--
HI	--	--	1.4	26.8

ELCR = Excess lifetime cancer risk.
HI = Hazard index.
-- = Value not calculated.

Given no alteration of site conditions, the above figures still lead to the conclusion that a BaP, PCB, and Pb exposure risk exists for permanent employees through dermal contact with wind blown soil particles and that transient construction workers suffer increased risks due to dermal contact with and incidental ingestion of PCB, Cd, and Pb contaminated surface soils. The hazard index for Pb can be extrapolated to conclude that any unprotected construction worker remaining on site without protective gear (e.g. face mask) more than 33 hours is subjected to a risk of elevated blood levels of Pb.

c. Uncertainty - As is the case with any environmental investigation, it is impossible to fully characterize site conditions with 100 percent certainty of analytical results. Limitations are induced by not only the fact that discrete samples make up only a small fraction of the total volume of site soils and groundwater present, but also by the sampling techniques, analysis selection, and laboratory performance. Further, of the compounds modeled, lead has had the greatest body of human research associated with its toxicologic effects, and yet the medical and regulatory communities are far from agreement as to the hazards of lead exposure.

Every effort has been made to perform this risk assessment in accordance with the best available practices and to the highest standards of quality. Throughout this assessment, worst case scenarios were chosen, leading to very conservative conclusions about the risks of the site.

6.0 RISK ABATEMENT

6.1 Comparison of Corrective Action Alternatives

The following possible corrective action alternatives were subjectively compared for mitigating the long-term effects of the presence of metals and hydrocarbons in the soils of the site:

For Cadmium and Lead:

- No Further Corrective Action Required
- Metals Fixation
- Encapsulation (via a site "cap")
- Excavation and Treatment/Disposal

For Benzo(a)pyrene and Polychlorinated Biphenyls:

- No Further Corrective Action Required
- Natural Remediation with Monitoring
- Encapsulation (via a site "cap")
- In-situ Bioremediation
- Excavation and Treatment/Disposal

No further corrective action required was eliminated from evaluation because of the risks demonstrated by the analysis performed in the previous chapter. Excavation and treatment/disposal is by far the most expensive option, costing up to $3.5 million for this three acre site. In-situ bioremediation is not proven to be an effective technology for the mitigation of BaP and PCBs and does not address elevated levels of metals. While natural remediation will eventually dissipate BaP and PCB levels, it does nothing to address the immediate concerns for metals exposures. While metals fixation can very effectively neutralize the metals in question, it involves disturbing the entire contaminated soil layer (increasing short-term exposure risks) is estimated to cost over $1.5-2 million and does not address non-metalic contaminants such as PCBs and PHCs.

Since exposure risks are driven by contact with surface soils and exposure to wind-blown soil particles, encapsulation of site soils by way of constructing a "site cap" offers the most reasonable long-term solution for the site. Any site development will cause a portion of the site to be "capped" by buildings and pavements constructed. Because infiltration of water is not a concern, the rest of the site need not be "capped" with an impermeable layer, but only needs a barrier to human contact with the soils. This can best be supplied by paving remaining areas of the site not already addressed by development. As a side benefit, any additional paving fits well with the industrial nature of the area and its cost is minimal when constructed as part of overall site development.

7.0 SUMMARY and CONCLUSIONS

7.1 Summary

a. <u>Introduction</u> - COTTON and FRAZIER Consultants Inc. (CFC) was engaged by Flynn Learner to perform a risk assessment of the environmental conditions known to exist on their leased property at 120 Sand Island Access Road. The 130,000 sq. ft. site has been used by Flynn-Learner for metals recycling from 1951 to 1991 and releases of several compounds of concern were confirmed by environmental investigations of the site commencing in 1991.

b. Identification of Compounds of Concern - Contamination of the soil and groundwater of the site was investigated and reported on by Weiss Associates in August 1991 [Weiss, October 1991] and by CFC in August 1992 [CFC, October 1992]. CFC personnel conducted six additional investigative events between October 1992 and August 1993 to further quantify contaminants and the physical parameters of the site. During the eight (8) sampling events between August 21, 1991 and July 26, 1993 a total of eleven (11) metals and twenty-one (21) PAHs were detected along with PCBs, TRPH, TPH-D, and BTEX. Based upon a comparison of the indicated levels of detected compounds and ARARs, the following compounds were chosen as the compounds of concern for the site: benzo(a)pyrene, polychlorinated biphenyls, cadmium, copper, lead, and zinc.

c. Exposure Assessment - The physical setting of the site was characterized and the potential beneficial uses of the immediate area were analyzed in order to determine potential exposure pathways and predict potential exposures. Modeling of the vadose zone enabled us to predict the maximum loading to the groundwater of the compounds of concern and the maximum concentrations of vapor-phase product released to the air above the site. Modeling of the groundwater transport mechanisms enabled us to predict the amount of time necessary for site contaminants to migrate to the nearest surface water, Keehi Lagoon. Modeling results predicted that only PCBs would diffuse up through the ground surface (1 ng/m^2) and that it would take a minimum of 460,000 years for any of the compounds (BaP, PCB, and metals) to reach Keehi Lagoon through groundwater transport.

d. Toxicity Assessment - Given the results of the exposure assessment, the only exposure scenarios which could lead to human contact with contaminants were found to be dermal contact with, inhalation and incidental ingestion of site soils by permanent employees and transient construction workers. An examination of the toxic effects of the compounds of concern lead to the development of cancer slope factors and recommended doses for each compound.

This data was used in conjunction with exposure assumptions to calculate excess lifetime cancer risks and hazard indexes for workers exposed to the compounds of concern. Calculations indicate that unprotected construction workers employed to redevelop the site would have the highest risk of adverse health effects due to contaminants remaining in the site soils. Given no alteration of site conditions, any future unprotected permanent employee of the site as well as any unprotected individual remaining on site more than 33 hours would also be exposed to significant health risks.

e. Risk Abatement - An examination of possible corrective actions for the site lead to the conclusion that a site "cap" is the most feasible long-term alternative to abate the risks of this site.

7.2 Conclusions

COTTON and FRAZIER Consultants Inc. has performed an assessment, within the scope of published EPA guidance, of the risks due to known environmental conditions existing at 120 Sand Island Access Road, Honolulu, Hawaii 96819 (TMK 1-2-23, parcel 9). Based upon the review of site investigations and an assessment of the potential exposure to compounds of concern and their toxic effects, we conclude that significant human health-based risks exist from the known environmental conditions of the site.

7.3 Recommendations

COTTON and FRAZIER Consultants Inc. recommends the following corrective actions:

a. Long-term Risk Abatement -- Based upon the comparison of alternatives in Section 6.1, we recommend abating long-term exposure risks through encapsulating site soils. Encapsulation can best be executed by "capping" the site with a traffic grade asphalt pavement in areas not developed with structures.

b. Short-term Risk Abatement - Any construction worker employed at the site runs the greatest risk of impact to their health due to exposure to site soils. In order to mitigate any incidental ingestion and dermal contact, we recommend the following precautions be exercised during construction at the site:

1. All workers wear respiratory protection (half-face masks).
2. All workers minimize their exposed skin (boots, long pants, long-sleeved shirts, gloves, safety goggles, and hard hats).
3. No food be consumed on-site.
4. Best management practices be employed for the control of dust and erosion (frequent wetting of surface soils, gravel construction entrance and roads, proper erosion control measures).

c. Abatement of Risk Prior to Construction - Interim to any site improvements, health-based risks exists for anyone entering the site and for the permanent employees immediately down wind of the site who are subjected to wind-blown soil particles. We recommend that the following actions be taken immediately to abate those risks:

1. For anyone remaining on site more than 3 hours - follow all recommendations provided above for transient construction workers.

2. For down-wind permanent employees - To avoid risks created by exposure of soils to wind, we recommend constructing a site "cap" as soon as is practical. This can be done as a temporary measure, laying a geotextile membrane (such as Wisdom's 130 EX) over the entire site and covering it with a 3-6 inch layer of base course as ballast. This allows greatest immediate protection while remaining flexible for future site improvements. The estimate for such a measure is $100,000. This cost can possibly be recouped by reducing future paving material costs.

7.4 Limitations and Exclusions

As is the case with any environmental investigation, it is impossible to fully characterize site conditions. Limitations are induced not only by the mere nature of forensic sampling, but also by the limited available knowledge on the health effects of individual compounds.

Every effort was made to perform this risk assessment in accordance with the best available practices and to the highest standards of quality. Throughout this assessment, worst case scenarios were chosen, leading to very conservative conclusions about the risks of the site.

Mark Frazier
Senior Hydrogeologist and
Vice President

Lee R. Cranmer, P.E.
Project Manager

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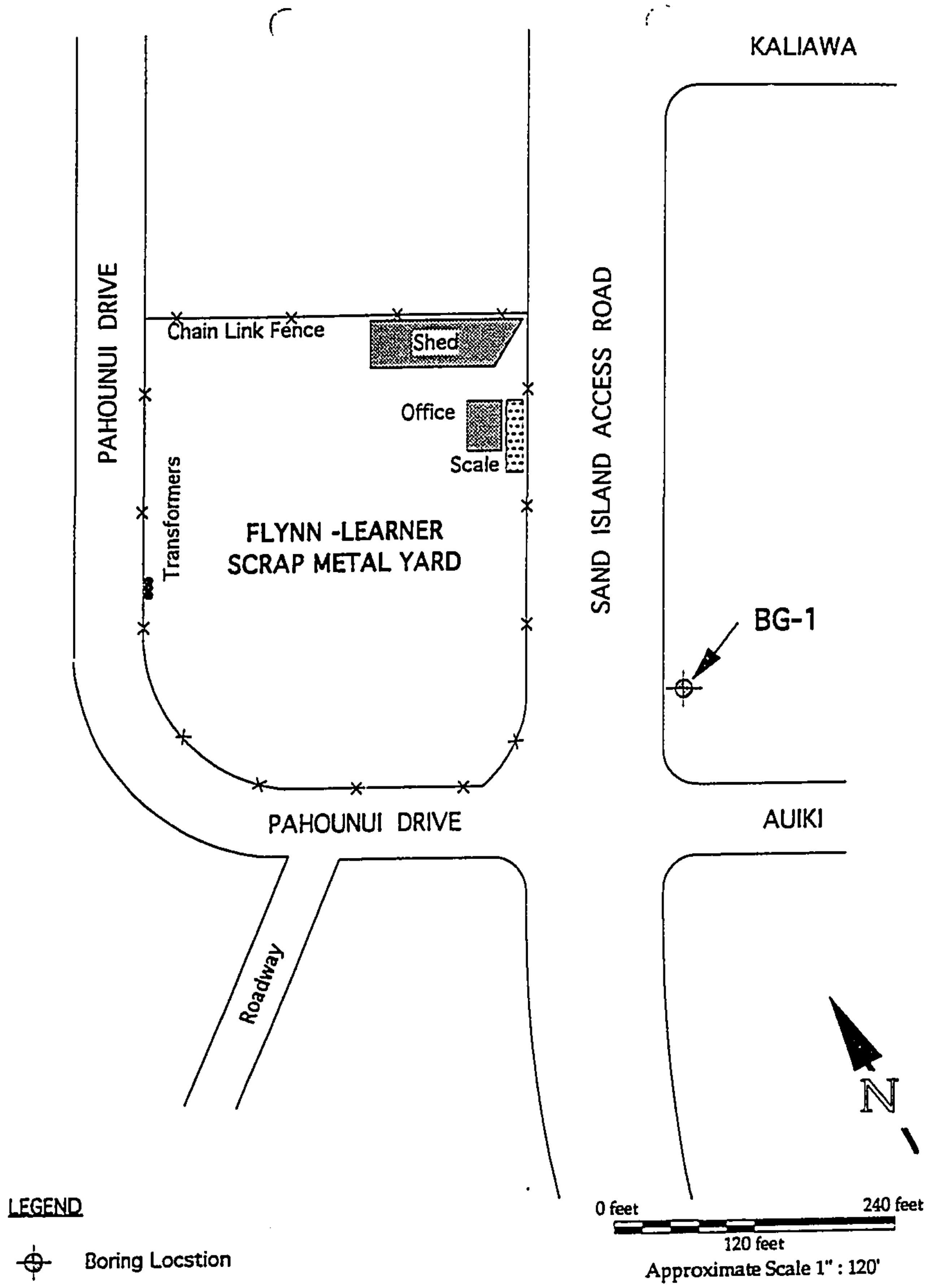
APPENDIX A

Table A-1 Total Metals Detected in Background Samples
Collected October 15, 1992

	BK-1-2.5	BK-1-4.5	BK-1-6.5	Units	DOH	MDL
Arsenic	ND	ND	ND	mg/kg	NS	5
Barium	110	15	14	mg/kg	NS	1
Cadmium	ND	ND	ND	mg/kg	2	1
Chromium	ND	ND	3.6	mg/kg	NS	1
Lead	ND	ND	ND	mg/kg	400	10
Mercury	ND	ND	0.03	mg/kg	NS	0.02
Selenium	ND	ND	ND	mg/kg	NS	5
Silver	ND	ND	ND	mg/kg	NS	1

DOH = State of Hawaii, Department of Health's recommended cleanup guidelines
MDL = Minimum Detection Limit
NS = No standard
ND = Non-detected
-- = Not analyzed



COTTON and FRAZIER
Consultants, Inc.
October 22, 1993

METALS BACKGROUND - BORING LOCATION

FLYNN-LEARNER
Sand Island, Oahu, Hawaii

Figure A-1

pace
INCORPORATED
THE ASSURANCE OF QUALITY

REPORT OF LABORATORY ANALYSIS

Cotton and Frazier Consultants, Inc.
P.O. Box 27126
Honolulu, HI 96827

October 26, 1992
PACE Project Number: 421016507

Attn: Mr. Mark Frazier

Client Reference: Flynn-Learner

PACE Sample Number: 70 0226724
Date Collected: 10/15/92
Date Received: 10/16/92

Parameter	Units	MDL	BK-1-2.5	DATE ANALYZED
INORGANIC ANALYSIS				
INDIVIDUAL PARAMETERS				
Arsenic (EPA Method 7060, Furnace AAS)	mg/kg wet	5	ND	10/20/92
Barium (EPA Method 6010/200.7, ICP)	mg/kg wet	1	110	10/19/92
Cadmium (EPA Method 6010/200.7, ICP)	mg/kg wet	1	ND	10/19/92
Chromium (EPA Method 6010/200.7, ICP)	mg/kg wet	1	ND	10/19/92
Lead (EPA Method 6010/200.7, ICP)	mg/kg wet	10	ND	10/19/92
Mercury (EPA Method 7471, Cold Vapor AA)	mg/kg wet	0.02	ND	10/20/92
Selenium (EPA Method 7740, Furnace AAS)	mg/kg wet	5	ND	10/20/92
Silver (EPA Method 6010/200.7, ICP)	mg/kg wet	1	ND	10/19/92

REPORT OF LABORATORY ANALYSIS

Mr. Mark Frazier
Page 2

October 26, 1992
PACE Project Number: 421016507

Client Reference: Flynn-Learner

PACE Sample Number:			70 0226732	
Date Collected:			10/15/92	
Date Received:			10/16/92	
Client Sample ID:			BK-1-4.5	
Parameter	Units	MDL		DATE ANALYZED
INORGANIC ANALYSIS				
INDIVIDUAL PARAMETERS				
Arsenic (EPA Method 7060, Furnace AAS)	mg/kg wet	5	ND	10/20/92
Barium (EPA Method 6010/200.7, ICP)	mg/kg wet	1	15	10/19/92
Cadmium (EPA Method 6010/200.7, ICP)	mg/kg wet	1	ND	10/19/92
Chromium (EPA Method 6010/200.7, ICP)	mg/kg wet	1	ND	10/19/92
Lead (EPA Method 6010/200.7, ICP)	mg/kg wet	10	ND	10/19/92
Mercury (EPA Method 7471, Cold Vapor AA)	mg/kg wet	0.02	ND	10/20/92
Selenium (EPA Method 7740, Furnace AAS)	mg/kg wet	5	ND	10/20/92
Silver (EPA Method 6010/200.7, ICP)	mg/kg wet	1	ND	10/19/92

Mr. Mark Frazier
Page 3

October 26, 1992
PACE Project Number: 421016507

Client Reference: Flynn-Learner

PACE Sample Number: 70 0226740
Date Collected: 10/15/92
Date Received: 10/16/92
Client Sample ID: BK-1-6.5

Parameter	Units	MDL		DATE ANALYZED
INORGANIC ANALYSIS				
INDIVIDUAL PARAMETERS				
Arsenic (EPA Method 7060, Furnace AAS)	mg/kg wet	5	ND	10/20/92
Barium (EPA Method 6010/200.7, ICP)	mg/kg wet	1	14	10/19/92
Cadmium (EPA Method 6010/200.7, ICP)	mg/kg wet	1	ND	10/19/92
Chromium (EPA Method 6010/200.7, ICP)	mg/kg wet	1	3.6	10/19/92
Lead (EPA Method 6010/200.7, ICP)	mg/kg wet	10	ND	10/19/92
Mercury (EPA Method 7471, Cold Vapor AA)	mg/kg wet	0.02	0.03	10/20/92
Selenium (EPA Method 7740, Furnace AAS)	mg/kg wet	5	ND	10/20/92
Silver (EPA Method 6010/200.7, ICP)	mg/kg wet	1	ND	10/19/92

These data have been reviewed and are approved for release.

Darell Cain for
Mark A. Valentini, Ph.D.
Regional Director

REPORT Or LABORATORY ANALYSIS

Mr. Mark Frazier
Page 4

FOOTNOTES
for pages 1 through 3

October 26, 1992
PACE Project Number: 421016507

Client Reference: Flynn-Learner

MDL	Method Detection Limit
ND	Not detected at or above the MDL.

Mr. Mark Frazier
Page 5

QUALITY CONTROL DATA

October 26, 1992
PACE Project Number: 421016507

Client Reference: Flynn-Learner

Arsenic (EPA Method 7060, Furnace AAS)
Batch: 70 16324
Samples: 70 0226724, 70 0226732, 70 0226740

METHOD BLANK:

Parameter	Units	MDL	Method Blank
Arsenic (EPA Method 7060, Furnace AAS)	mg/kg wet	5	ND
Selenium (EPA Method 7740, Furnace AAS)	mg/kg wet	5	ND

LABORATORY CONTROL SAMPLE AND CONTROL SAMPLE DUPLICATE:

Parameter	Units	MDL	Reference Value	Recv	Dupl Recv	RPD
Arsenic (EPA Method 7060, Furnace AAS)	mg/kg wet	5	50.0	77%	78%	1%
Selenium (EPA Method 7740, Furnace AAS)	mg/kg wet	5	50.0	94%	100%	6%

REPORT Ur LABORATORY ANALYSIS

Mr. Mark Frazier
Page 6

QUALITY CONTROL DATA

October 26, 1992
PACE Project Number: 421016507

Client Reference: Flynn-Learner

Mercury (EPA Method 7471, Cold Vapor AA)
Batch: 70 16335
Samples: 70 0226724, 70 0226732, 70 0226740

METHOD BLANK:

Parameter	Units	MDL	Method Blank
Mercury (EPA Method 7471, Cold Vapor AA	mg/kg wet	0.02	ND

LABORATORY CONTROL SAMPLE AND CONTROL SAMPLE DUPLICATE:

Parameter	Units	MDL	Reference Value	Recv	Dupl Recv	RPD
Mercury (EPA Method 7471, Cold Vapor AA	mg/kg wet	0.02	1.0	96%	96%	0%

REPORT OF LABORATORY ANALYSIS

Mr. Mark Frazier
Page 7

QUALITY CONTROL DATA

October 26, 1992
PACE Project Number: 421016507

Client Reference: Flynn-Learner

METALS IN SOIL MATRIX, ICP SCAN
Batch: 70 16315
Samples: 70 0226724, 70 0226732, 70 0226740

METHOD BLANK:

Parameter	Units	MDL	Method Blank
INDIVIDUAL PARAMETERS			
Barium (EPA Method 6010/200.7, ICP)	mg/kg wet	1	ND
METALS IN SOIL MATRIX, ICP SCAN			
Antimony (EPA Method 6010/200.7, ICP)	mg/kg wet	10	ND
Beryllium (EPA Method 6010/200.7, ICP)	mg/kg wet	1	ND
Cadmium (EPA Method 6010/200.7, ICP)	mg/kg wet	1	ND
Chromium (EPA Method 6010/200.7, ICP)	mg/kg wet	1	ND
Copper (EPA Method 6010/200.7, ICP)	mg/kg wet	1	ND
Lead (EPA Method 6010/200.7, ICP)	mg/kg wet	10	ND
Nickel (EPA Method 6010/200.7, ICP)	mg/kg wet	2	ND
Silver (EPA Method 6010/200.7, ICP)	mg/kg wet	1	ND
Thallium (EPA Method 6010/200.7, ICP)	mg/kg wet	20	ND
Zinc (EPA Method 6010/200.7, ICP)	mg/kg wet	1	ND

LABORATORY CONTROL SAMPLE AND CONTROL SAMPLE DUPLICATE:

Parameter	Units	MDL	Reference Value	Recv	Dupl Recv	RPD
INDIVIDUAL PARAMETERS						
Barium (EPA Method 6010/200.7, ICP)	mg/kg wet	1	100	100%	100%	0%
METALS IN SOIL MATRIX, ICP SCAN						
Antimony (EPA Method 6010/200.7, ICP)	mg/kg wet	10	100	95%	93%	2%
Beryllium (EPA Method 6010/200.7, ICP)	mg/kg wet	1	100	89%	88%	1%
Cadmium (EPA Method 6010/200.7, ICP)	mg/kg wet	1	100	94%	93%	1%
Chromium (EPA Method 6010/200.7, ICP)	mg/kg wet	1	100	86%	84%	2%
Copper (EPA Method 6010/200.7, ICP)	mg/kg wet	1	100	96%	96%	0%
Lead (EPA Method 6010/200.7, ICP)	mg/kg wet	10	100	95%	95%	0%
Nickel (EPA Method 6010/200.7, ICP)	mg/kg wet	2	100	88%	86%	2%
Silver (EPA Method 6010/200.7, ICP)	mg/kg wet	1	100	115%	112%	2%
Thallium (EPA Method 6010/200.7, ICP)	mg/kg wet	20	100	92%	92%	0%
Zinc (EPA Method 6010/200.7, ICP)	mg/kg wet	1	100	97%	97%	0%

Mr. Mark Frazier
Page 8

FOOTNOTES
for pages 5 through 7

October 26, 1992
PACE Project Number: 421016507

Client Reference: Flynn-Learner

MDL	Method Detection Limit
ND	Not detected at or above the MDL.
RPD	Relative Percent Difference

pace INCORPORATED
THE ASSURANCE OF QUALITY

J7271

CHAIN-OF-CUSTODY RECORD
Analytical Request

Cotton + Frazier

Client Cotton + Frazier
Address P.O. Box 27126
Honolulu Hawaii 96827
Phone 808 599-1993
Sampled By (PRINT): W. Mark Frazier
Sampler Signature W M Frazier
Date Sampled 10/15/92

Report To: W. Mark Frazier
Bill To: ~~FZ~~ Joan Price
P.O. # / Billing Reference
Project Name / No. FLynn-Lennar

Pace Client No.
Pace Project Manager
Pace Project No. 421016.507
*Requested Due Date:

ITEM	SAMPLE DESCRIPTION	TIME	MATRIX	PACE NO.	NO. OF CONTAINERS	PRESERVATIVES: UNPRESERVED	H₂SO₄	HNO₃	VOA			ANALYSES REQUEST: RCRA Total Metals (As, Ba, Cd, Cr, Pb, Hg, Se, Ag)								REMARKS
1	BK-1-2'/2		Soil	226724								X								
2	BK1-4'/2		↓	73.2								X								
3	BK1-6'/2			74.0								X								
4																				
5																				
6																				
7																				

COOLER NOS.	BAILERS	SHIPMENT METHOD OUT / DATE	SHIPMENT METHOD RETURNED / DATE

ITEM NUMBER	RELINQUISHED BY / AFFILIATION	ACCEPTED BY / AFFILIATION	DATE	TIME
	W M Frazier 10/15/92 via Fed Ex	Jim Opp / Pace	10/16/92	1015

Additional Comments

#4 Fridge 6

ORIGINAL

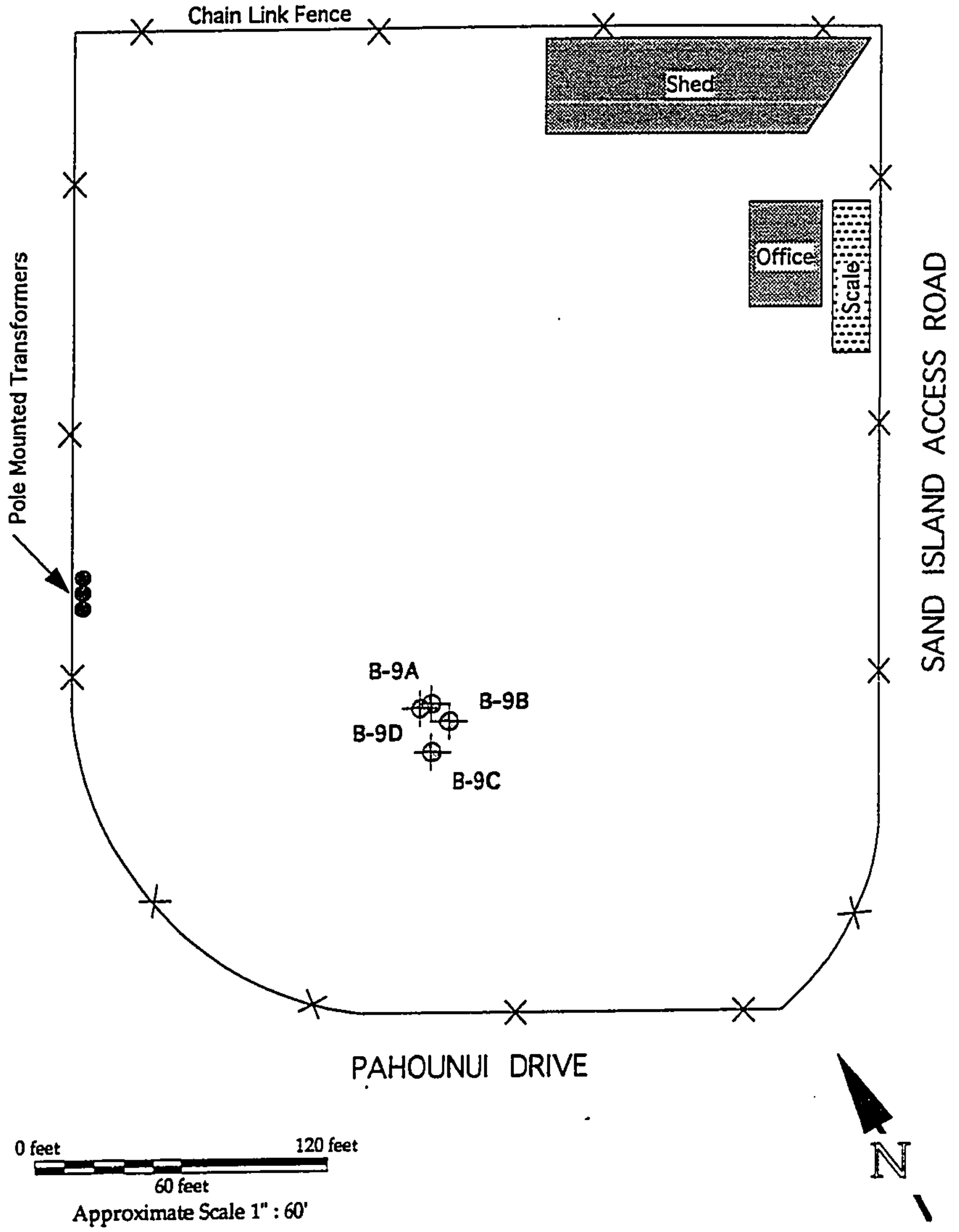
SEE REVERSE SIDE FOR INSTRUCTIONS

APPENDIX B

Table B-1 Polychlorinated Biphenyls Detedted in Soil Sapmples
Collected Februry 17, 1993

Sample	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	TOTAL
B-9A-3	ND	ND	ND	ND	ND	ND	6.700	6.700
B-9A-5	ND	ND	ND	ND	ND	ND	0.049	0.049
B-9B-3	ND	ND	ND	ND	ND	ND	0.004	0.004
B-9B-5	ND	ND	ND	ND	ND	ND	0.006	0.006
B-9C-3	ND	ND	ND	ND	ND	ND	0.040	0.040
B-9C-5	ND	ND	ND	ND	ND	ND	0.013	0.013
B-9D-3	ND	ND	ND	ND	ND	ND	12.000	12.000
B-9D-5	ND	ND	ND	ND	ND	ND	0.012	0.012
Units	mg/kg	mgkg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
DOH	NS	NS	NS	NS	NS	NS	NS	1.000
MDL	0.003	0.003	0.003	0.003	0.003	0.003	0.003	

DOH = State of Hawaii, Department of Health's recommended cleanup guidelines
MDL = Minimum Detection Limit ND = Non-detected
NS = No standard -- = Not analyzed



COTTON and FRAZIER **Consultants, Inc.** October 22, 1993	**PCB INVESTIGATION - BORING LOCATIONS** FLYNN-LEARNER Sand Island, Oahu, Hawaii	Figure B-1

Superior Precision Analytical, Inc.
1555 Burke, Unit I • San Francisco, California 94124 • (415) 647-2081 / fax (415) 2[illegible]-7123

RECEIVED
MAR 5 1993

Cotton and Frazier Consultants, Inc
Attn: W. Mark Frazier

Project 92010
Reported 27-February-1993

ANALYSIS FOR POLYCHLORINATED BIPHENYLS

Laboratory Number 87861

Chronology

Identification	Sampled	Received	Extracted	Analyzed	Lab #
B-9A-3	02/17/93	02/18/93	02/24/93	02/26/93	1
B-9A-5	02/17/93	02/18/93	02/24/93	02/26/93	2
B-9B-3	02/17/93	02/18/93	02/24/93	02/26/93	3
B-9B-5	02/17/93	02/18/93	02/24/93	02/26/93	4
B-9C-3	02/17/93	02/18/93	02/24/93	02/26/93	5
B-9C-5	02/17/93	02/18/93	02/24/93	02/26/93	6
B-9D-3	02/17/93	02/18/93	02/24/93	02/26/93	7
B-9D-5	02/17/93	02/18/93	02/24/93	02/26/93	8

Superior Precision Analytical, Inc.
1555 Burke, Unit I • San Francisco, California 94124 • (415) 647-2081 / fax (415) 821-7123

RECEIVED
MAR 5 1993

Cotton and Frazier Consultants, Inc.
Attn: W. Mark Frazier

Project 92010
Reported 27-February-1993

ANALYSIS FOR POLYCHLORINATED BIPHENYLS

Laboratory Number	Sample Identification	Matrix
87861- 1	B-9A-3	Soil
87861- 2	B-9A-5	Soil
87861- 3	B-9B-3	Soil
87861- 4	B-9B-5	Soil
87861- 5	B-9C-3	Soil
87861- 6	B-9C-5	Soil
87861- 7	B-9D-3	Soil
87861- 8	B-9D-5	Soil

RESULTS OF ANALYSIS

Laboratory Number:	87861- 1	87861- 2	87861- 3	87861-4	87861-5
AROCLOR 1016:	ND<30	ND<3	ND<3	ND<3	ND<3
AROCLOR 1221:	ND<30	ND<3	ND<3	ND<3	ND<3
AROCLOR 1232:	ND<30	ND<3	ND<3	ND<3	ND<3
AROCLOR 1242:	ND<30	ND<3	ND<3	ND<3	ND<3
AROCLOR 1248:	ND<30	ND<3	ND<3	ND<3	ND<3
AROCLOR 1254:	ND<30	ND<3	ND<3	ND<3	ND<3
AROCLOR 1260:	6700	49	4	6	40
Concentration:	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg

Laboratory Number:	87861- 6	87861- 7	87861- 8
AROCLOR 1016:	ND<3	ND<30	ND<3
AROCLOR 1221:	ND<3	ND<30	ND<3
AROCLOR 1232:	ND<3	ND<30	ND<3
AROCLOR 1242:	ND<3	ND<30	ND<3
AROCLOR 1248:	ND<3	ND<30	ND<3
AROCLOR 1254:	ND<3	ND<30	ND<3
AROCLOR 1260:	13	12000	12
Concentration:	ug/kg	ug/kg	ug/kg

Superior Precision Analytical, Inc.
1555 Burke, Unit I • San Francisco, California 94124 • (415) 647-2081 / fax (415) 82[illegible]23

ANALYSIS FOR POLYCHLORINATED BIPHENYLS
Quality Assurance and Control Data - Soil
Laboratory Number 87861

Compound	Method Blank (ug/kg)	PQL (ug/kg)	Average Spike Recovery (%)	Limits (%)	RPD (%)
AROCLOR 1016:	ND<3	3			
AROCLOR 1221:	ND<3	3			
AROCLOR 1232:	ND<3	3			
AROCLOR 1242:	ND<3	3			
AROCLOR 1248:	ND<3	3			
AROCLOR 1254:	ND<3	3	109	40-140	6
AROCLOR 1260:	ND<3	3			

Definitions:

ND = Not Detected
RPD = Relative Percent Difference
PQL = Practical Quantitation Limit

QC File No. 87861

3/1/93
Senior Analyst

~~87862~~ 128-2

Cotton and Frazier Consultants, Inc.
"Environmental Solutions"
P.O. Box 27126
Honolulu, Hawaii 96827

Phone: (808) 599-1993
FAX: (808) 599-1502

Chain of Custody Record/ Analysis Record

RECEIVED
MAR 5 1993

PROJECT NAME: FLYNN LEBNER
CFC JOB NUMBER: 93016
LOCATION: SAND ISLAND
PROPOSAL NUMBER:
PROJECT MANAGER: W. MARK FRAZIER
SAMPLER: JOHN RALL

SAMPLE NUMBER	LAB SAMPLE ID#	DATE COLLECTED	TIME COLLECTED	MATRIX: S=SOIL W=WATER A=AIR	CONTAINERS 40 ml. VOA	1 L. Glass	Brass Ring			Analysis Requested Mod 8015 - BTEX	Mod 8015 - Diesel	TRPH	8270-PAHs	TCLP: Cd & Pb	8240	8080 - PCB's			Hold for Further Analysis	RUSH (See Below)
B-9A-3		2/17/93	11:00	S			✓									✓				
B-9A-5		"	11:16	S			✓									✓				
B-9B-3		"	12:13	S			✓									✓				
B-9B-5		"	12:30	S			✓									✓				
B-9C-3		"	11:33	S			✓									✓				
B-9C-5		"	11:38	S			✓									✓				
B-9D-3		"	1245	S			✓									✓				
B-9D-5		"	1255	S			✓									✓				

Please initial — A>
Samples stored in ice. — ✓
Appropriate containers — ✓
Samples preserved — NA
VOA's without headspace NA
Comments:

Relinquished By Sampler:	Relinquished By	Relinquished By
Signature: John P Rall	Signature:	Signature:
Printed Name: JOHN P RALL	Printed Name: PHALER	Printed Name:
Date/Time: 2/17/93 14:17 hrs	Date/Time: 2/18/93 1650.	Date/Time:

Received By:	Received By:	Received By:
Signature:	Signature:	Signature: [illegible]
Printed Name: PHALER	Printed Name:	Printed Name: [illegible]
Date/Time: 2/18/93 1650	Date/Time:	Date/Time: [illegible]

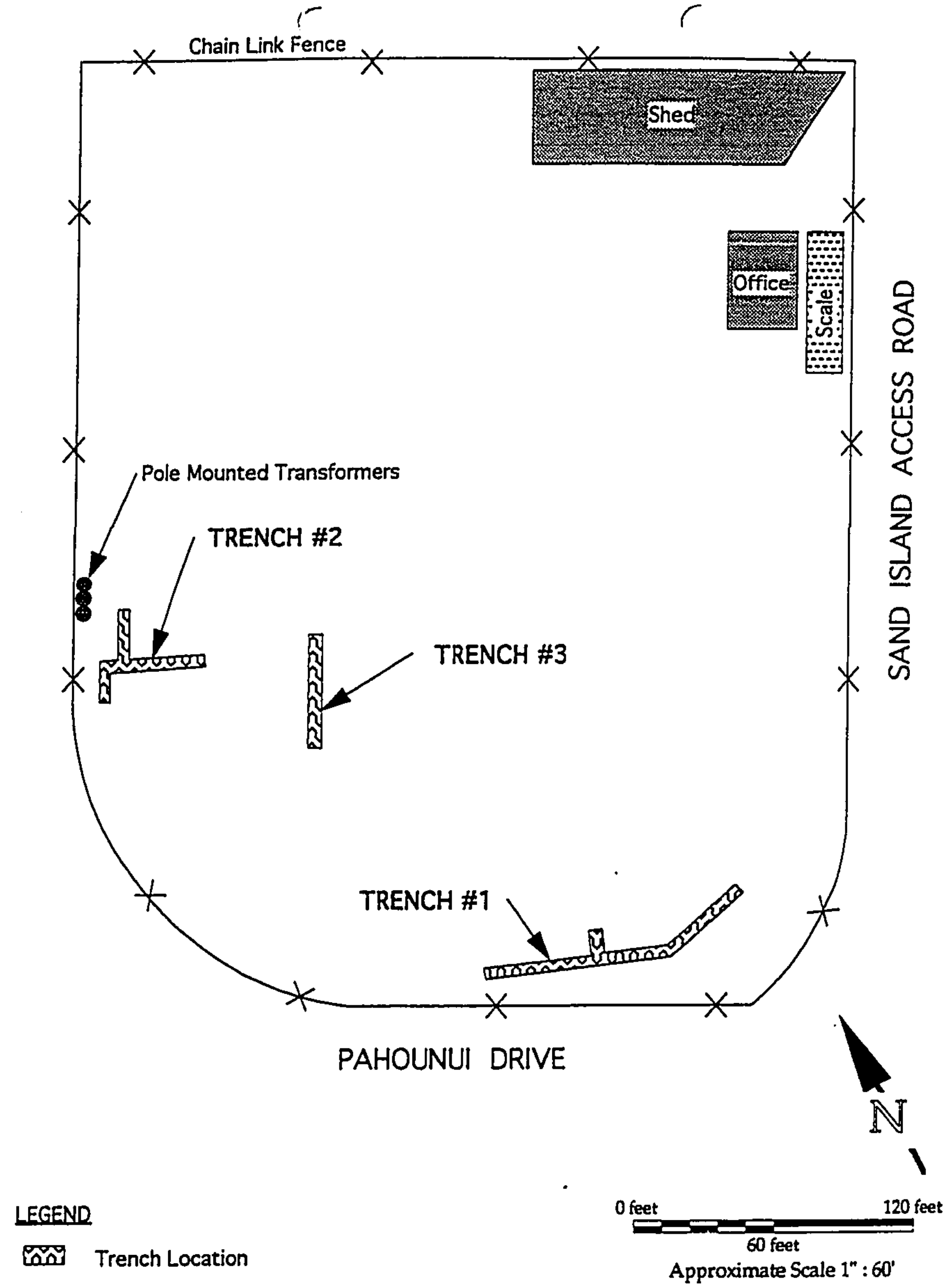
LABORATORY:
Total # Containers: 8
Samples Received Chilled? [✓ Yes] No
Samples in good condition? [✓ Yes] No

Comments: OK

Special Handling
Turnaround:
24 hour 48 hour
72 hour Regular
Other ______

PAGE 1 OF 1

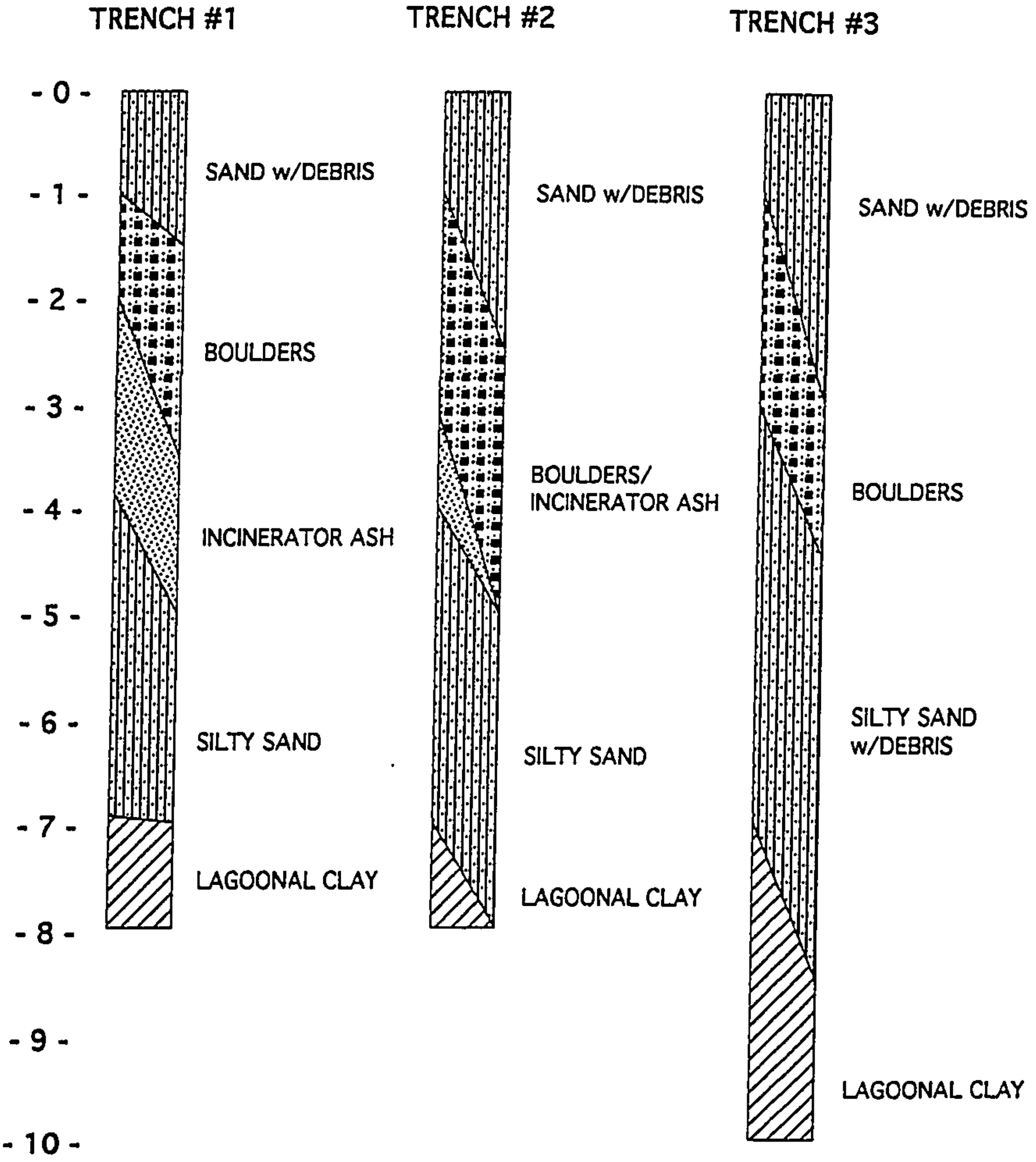
APPENDIX C



COTTON and FRAZIER
Consultants, Inc.
October 22, 1993

TRENCH LOCATION MAP
FLYNN-LEARNER
Sand Island, Oahu, Hawaii

Figure C-1



NOTE: These cross sections are an estimated depiction based upon field observations and should not be used to predict actual site conditions. See Figure E-5 for key to lithologic symbols.

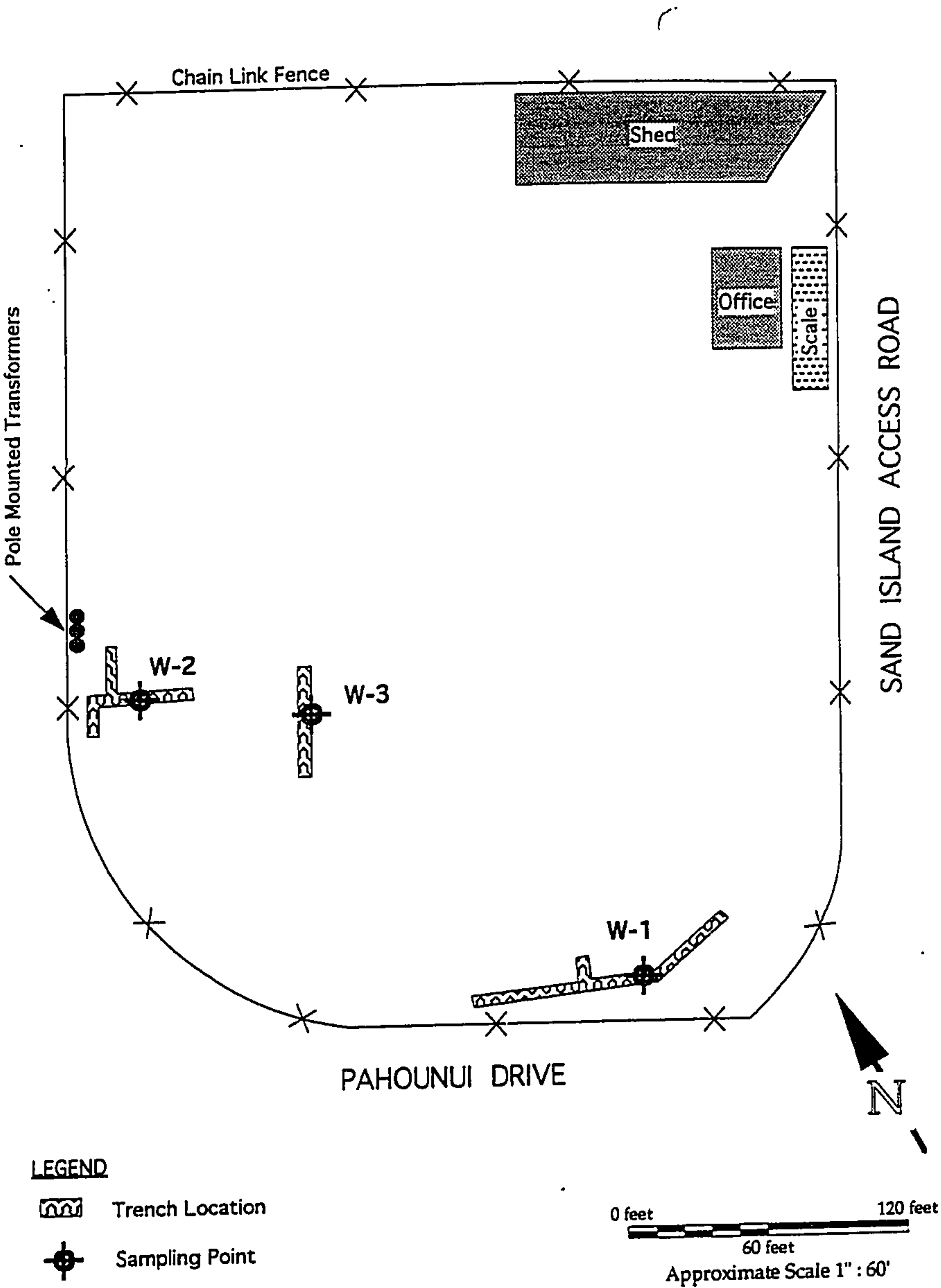
COTTON and FRAZIER **Consultants, Inc.** October 22, 1993	TRENCH LITHOLOGY FLYNN-LEARNER Sand Island, Oahu, Hawaii	Figure C-2

APPENDIX D

Table A-1 Total Metals Detected in Background Samples
Collected October 15, 1992

	BK-1-2.5	BK-1-4.5	BK-1-6.5	Units	DOH	MDL
Arsenic	ND	ND	ND	mg/kg	NS	5
Barium	110	15	14	mg/kg	NS	1
Cadmium	ND	ND	ND	mg/kg	2	1
Chromium	ND	ND	3.6	mg/kg	NS	1
Lead	ND	ND	ND	mg/kg	400	10
Mercury	ND	ND	0.03	mg/kg	NS	0.02
Selenium	ND	ND	ND	mg/kg	NS	5
Silver	ND	ND	ND	mg/kg	NS	1

DOH = State of Hawaii, Department of Health's recommended cleanup guidelines
MDL = Minimum Detection Limit
NS = No standard
ND = Non-detected
-- = Not analyzed



COTTON and FRAZIER
Consultants, Inc.
October 22, 1993

FILTERED WATER SAMPLE LOCATIONS
FLYNN-LEARNER
Sand Island, Oahu, Hawaii

Figure D-1

Superior Precision Analytical, Inc.
P.O. Box 1545 • Martinez, California 94553 • (510) 229-1590 / fax (510) 229-0916

COTTON & FRAZIER
Attn: MARK FRAZIER

Project 92010
Reported 10-March-1993

ANALYSIS FOR TOTAL METALS

SW-846 6010 & 7000 series.

Chronology

Laboratory Number 87953

Identification	Sampled	Received	Extracted	Analyzed	Run #	Lab #
W-1	03/03/93	03/04/93		03/09/93		1
W-2	03/03/93	03/04/93		03/09/93		2
W-3	03/03/93	03/04/93		03/09/93		3

Superior Precision Analytical, Inc.
P.O. Box 1545 • Martinez, California 94553 • (510) 229-1590 / fax (510) 229-0916

COTTON & FRAZIER
Attn: MARK FRAZIER

Project 92010
Reported 10-March-1993

ANALYSIS FOR TOTAL METALS

Laboratory Number	Sample Identification	Matrix
87953- 1	W-1	Water
87953- 2	W-2	Water
87953- 3	W-3	Water

RESULTS OF ANALYSIS

Laboratory Number:		87953- 1	87953- 2	87953- 3
Antimony	(Sb):	ND<0.1	ND<0.1	ND<0.1
Arsenic	(As):	0.02	ND<0.01	ND<1
Cadmium	(Cd):	ND<0.05	ND<0.05	ND<0.05
Chromium	(Cr):	ND<0.05	ND<0.05	ND<0.05
Cobalt	(Co):	ND<0.1	ND<0.1	ND<0.1
Copper	(Cu):	ND<0.1	ND<0.1	ND<0.1
Lead	(Pb):	ND<0.1	ND<0.1	ND<0.1
Vanadium	(V):	ND<0.1	ND<0.1	ND<0.1
Zinc	(Zn):	0.10	ND<0.05	0.07
Concentration:		mg/L	mg/L	mg/L

QAQC SUMMARY:

MS/MSD AVERAGE RECOVERY =90%
DUPLICATE RPD =2%

For Richard Srna, Ph.D.
Laboratory Director

Cotton and Frazier Consultants, Inc.
"Environmental Solutions"
P.O. Box 27126
Honolulu, Hawaii 96827

Phone: (808) 599-1993
FAX: (808) 599-1502

Chain of Custody Record/ Analysis Record

3/4/93

RECEIVED
MAR 15 1993

PROJECT NAME: FLYNN LEARNER
CFC JOB NUMBER: 92010
LOCATION: SAND ISLAND
PROPOSAL NUMBER:
PROJECT MANAGER: W. MARK FRAZIER
SAMPLER: JOHN RAU

SAMPLE NUMBER	LAB SAMPLE ID#	DATE COLLECTED	TIME COLLECTED	MATRIX: S=SOIL W=WATER A=AIR	CONTAINERS						Analysis Requested										
					40 ml VOA	1 L Glass	Brass Ring	500 mL Plast			Mod 8015 - BTEX	Mod 8015 - Diesel	TRPH	8270-PAHs	TCLP: Cd & Pb	8240	8080 - PCB's	TOTAL METALS - Sb, As, Cd, Cr, Co, Cu, Pb, V, Zn		Hold for Further Analysis	RUSH (See Below)
W-1		3-3-93	11:15	W				✓										✓			
W-2		3-3-93	12:13	W				✓										✓			
W-3		3-393	11:46	W				✓										✓			

Relinquished By Sampler:
Signature: John P. Rau
Printed Name: JOHN P. RAU
Date/Time: 3-3-93 / 14:30

Relinquished By
Signature:
Printed Name:
Date/Time:

Relinquished By
Signature:
Printed Name:
Date/Time:

Received By:
Signature:
Printed Name:
Date/Time:

Received By:
Signature:
Printed Name:
Date/Time:

Received By:
Signature:
Printed Name: [illegible]
Date/Time: 3-4-93
1:35 PM

LABORATORY:
Total # Containers:
Samples Received Chilled? Yes No
Samples in good condition? Yes No

Special Handling
Turnaround:
24 hour
48 hour
72 hour
[✓ Regular]
Other

Comments: Superior.

PAGE 1 OF 1

APPENDIX E

October 22, 1993
CFC Job#93064

COTTON and FRAZIER Consultants, Inc.
"Environmental Solutions"

Table E-1 Geotechnical Analysis of Soil Samples Collected July 21, 1993

Layer		Coral Fill	Upper Sand	Upper Sand	Lagoonal Clay	Lagoonal Clay	Lagoonal Clay	Lower Sand
Sample No.		1-2	1-5	2-2	2-7	3-7	3-8	1-8
	Units							
Physical Characteristics								
Bulk Density	gm/cc	1.56	1.54	1.44	1.44	1.48	1.52	1.55
Grain Density	gm/cc	2.75	2.65	2.59	2.67	2.72	2.76	2.76
Saturated Pore Volume	percent	50.2	99.5	98.4	99.8	99.9	99	92.8
Porosity	percent	43.5	38.4	40.2	51.8	49.8	46.1	44.7
Permeablity (Native State)	mD	14023	0.003	0.003	<0.001	<0.001	<0.001	31
Permeability (Dried)	mD	14280	90	450	479	4813	1426	1246
Cation Exchange Capacity	meg/100gm	4.5	18.1	>100	19.3	11.7	10.9	9.6
Total Organic Carbon	mg/kg	27000	27000	3800	3900	48000	69000	30000
Saturated Soils								
Hydraulic Conductivity	mD		7.4			20.3	78.9	515.4
Unsaturated Soils								
Capilary Characteristic			Note 1	Note 1				

Note 1 - Capilary characteristic curves are included in attached laboratory data sheets.

Table E-2 Volitile Petroleum Hydrocarbons Detected in Soil Samples Collected July 21, 1993

	64S01-5	64S03-4	Units	DOH	MDL
Benzene	0.0005	ND	mg/kg	1.7	0.0005
Toluene	0.0084	ND	mg/kg	1.4	0.0005
Ethylbenzene	0.0005	ND	mg/kg	21.0	0.0005
Xylenes	0.0024	ND	mg/kg	NS	0.0005

DOH = State of Hawaii, Department of Health's recommended cleanup guidelines
MDL = Minimum Detection Limit
NS = No standard
ND = Non-detected
-- = Not analyzed

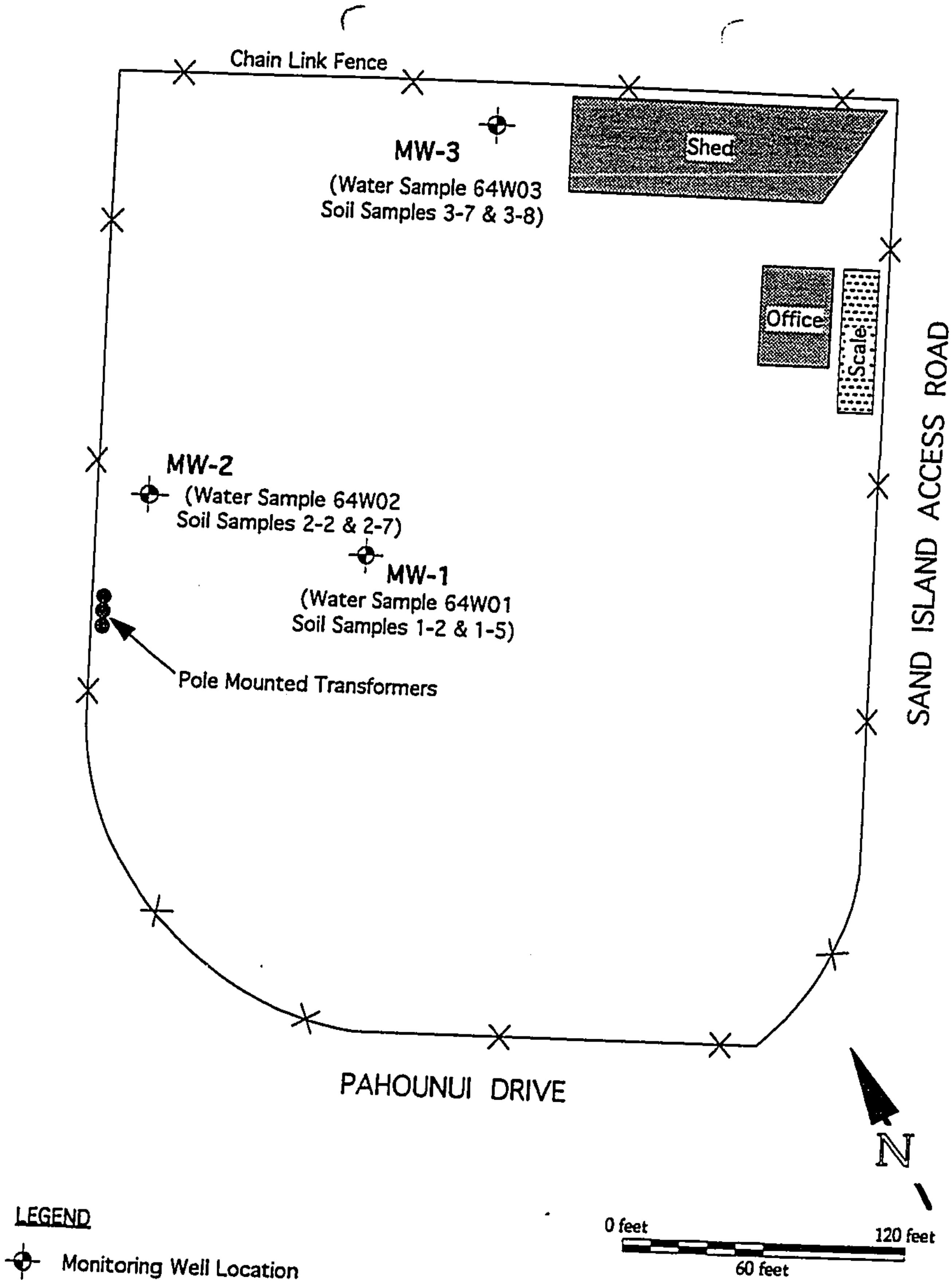
Table E-3 Polynuclear Aromatic Hydrocarbons Detected in Water Samples Collected July 26, 1993

	64W01	64W02	64W03	Units	DOH	MDL
Acenapthene	ND	ND	ND	mg/L	0.32	0.02
Acenaphthylene	ND	ND	ND	mg/L	NS	0.02
Anthracene	ND	ND	ND	mg/L	NS	0.02
Benzo(a)anthracene	ND	ND	ND	mg/L	NS	0.02
Benzo(b)flouranthene	ND	ND	ND	mg/L	NS	0.02
Benzo(k)flouranthene	ND	ND	ND	mg/L	NS	0.02
Benzo(a)pyrene	ND	ND	ND	mg/L	NS	0.02
Benzo(ghi)perylene	ND	ND	ND	mg/L	NS	0.02
Chlorobenzene	ND	ND	ND	mg/L	NS	0.02
Chrysene	ND	ND	ND	mg/L	NS	0.02
Dibenzo(ah)anthracene	ND	ND	ND	mg/L	NS	0.02
1,2-Dichlorobenzene	ND	ND	ND	mg/L	NS	0.02
1,3-Dichlorobenzene	ND	ND	ND	mg/L	NS	0.02
1,4-Dichlorobenzene	ND	ND	ND	mg/L	NS	0.02
Flouranthene	ND	ND	ND	mg/L	0.013	0.02
Flourene	ND	ND	ND	mg/L	NS	0.02
Indeno(1,2,3-cd)pyrene	ND	ND	ND	mg/L	NS	0.02
Napthalene	ND	ND	ND	mg/L	0.78	0.02
Phenathrene	ND	ND	ND	mg/L	NS	0.02
Pyrene	ND	ND	ND	mg/L	NS	0.02

Table E-4 Volitile Petroleum Hydrocarbons Detected in Water Samples Collected July 26, 1993

	64W01	64W02	64W03	Units	DOH	MDL
Benzene	ND	ND	ND	mg/L	1.7	0.0005
Toluene	ND	ND	ND	mg/L	0.14	0.0005
Ethylbenzene	ND	ND	ND	mg/L	2.1	0.0005
Xylenes	ND	ND	ND	mg/L	NS	0.0005

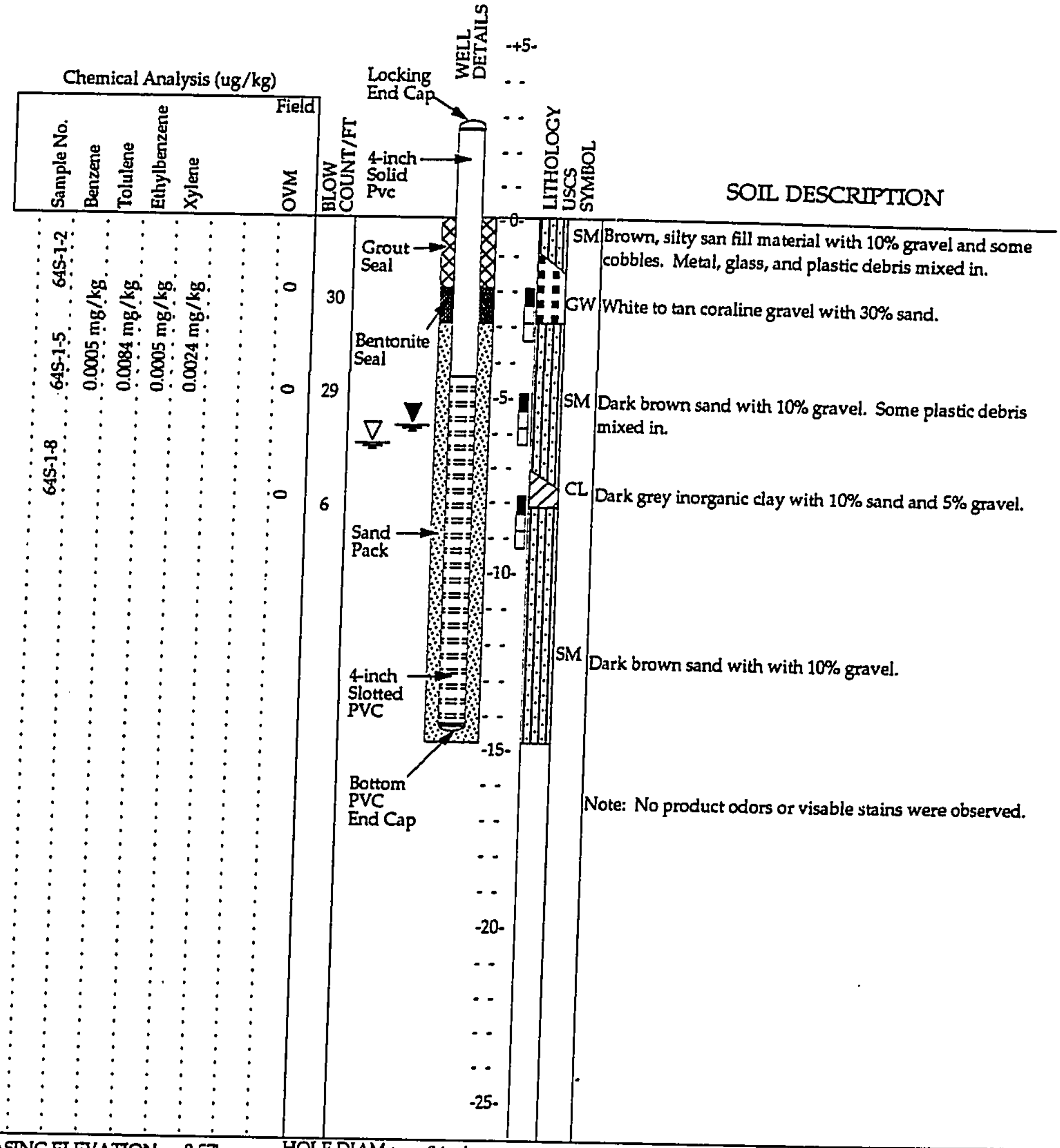
DOH = State of Hawaii, Department of Health's recommended cleanup guidelines
MDL = Minimum Detection Limit
ND = Non-detected
NS = No standard
-- = Not analyzed



COTTON and FRAZIER
Consultants, Inc.
October 22, 1993

MONITORING WELL LOCATION MAP
FLYNN-LEARNER
Sand Island, Oahu, Hawaii

Figure E-1



SOIL DESCRIPTION

SM Brown, silty san fill material with 10% gravel and some cobbles. Metal, glass, and plastic debris mixed in.

GW White to tan coraline gravel with 30% sand.

SM Dark brown sand with 10% gravel. Some plastic debris mixed in.

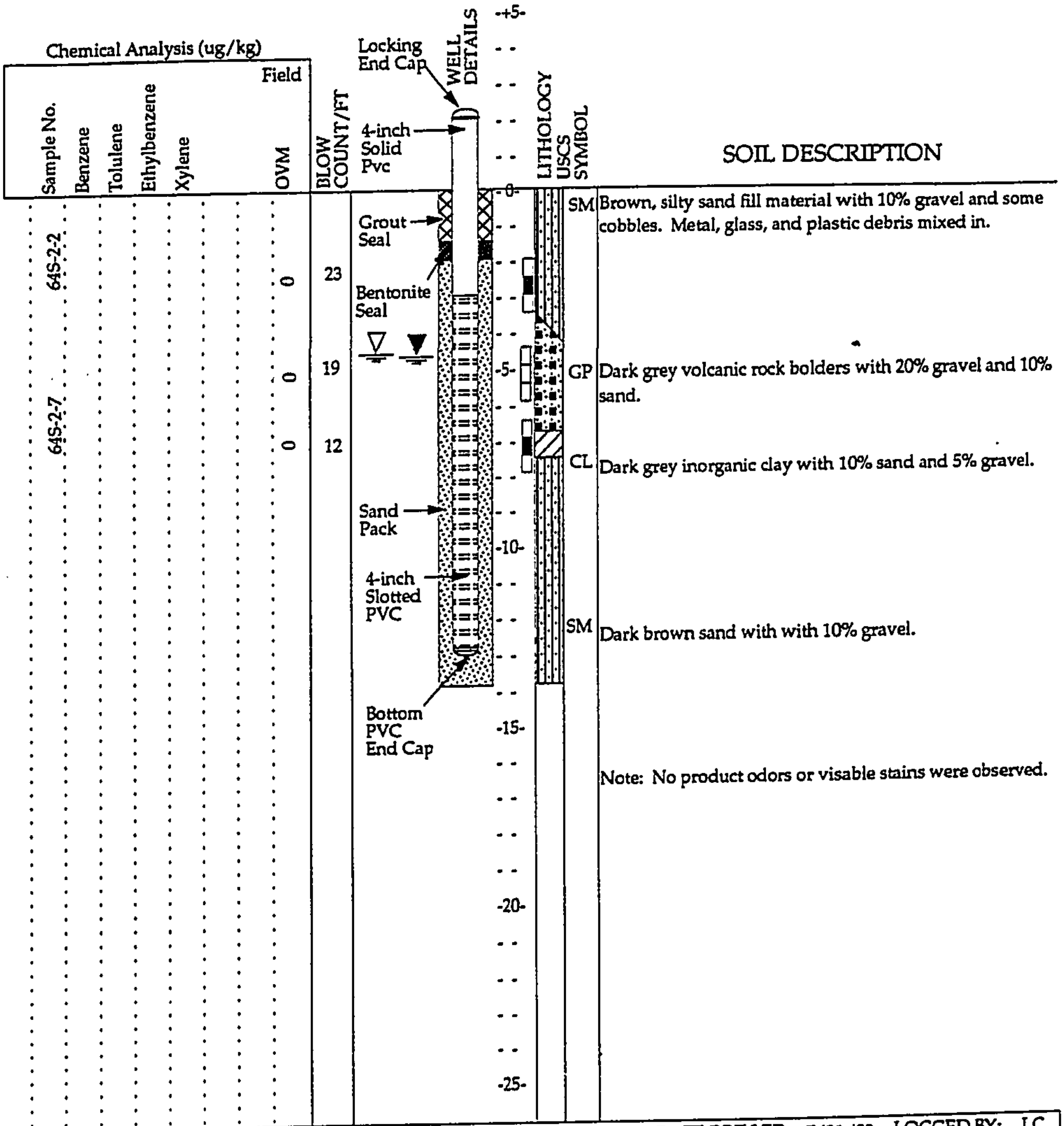
CL Dark grey inorganic clay with 10% sand and 5% gravel.

SM Dark brown sand with with 10% gravel.

Note: No product odors or visable stains were observed.

CASING ELEVATION: 9.57'	HOLE DIAM.: 8 inch	DATE DRILLED: 7/21/93	LOGGED BY: LC
SURFACE ELEVATION: NA	DRILL METHOD: H/S Auger	DRILLED BY: Islands Pacific Exploration	

COTTON and FRAZIER Consultants, Inc.	LOG OF BORING MW-1 Flynn - Leamer Sand Island, Oahu, Hawaii	Date 10/22/93	Figure E-2



SOIL DESCRIPTION

SM Brown, silty sand fill material with 10% gravel and some cobbles. Metal, glass, and plastic debris mixed in.

GP Dark grey volcanic rock bolders with 20% gravel and 10% sand.

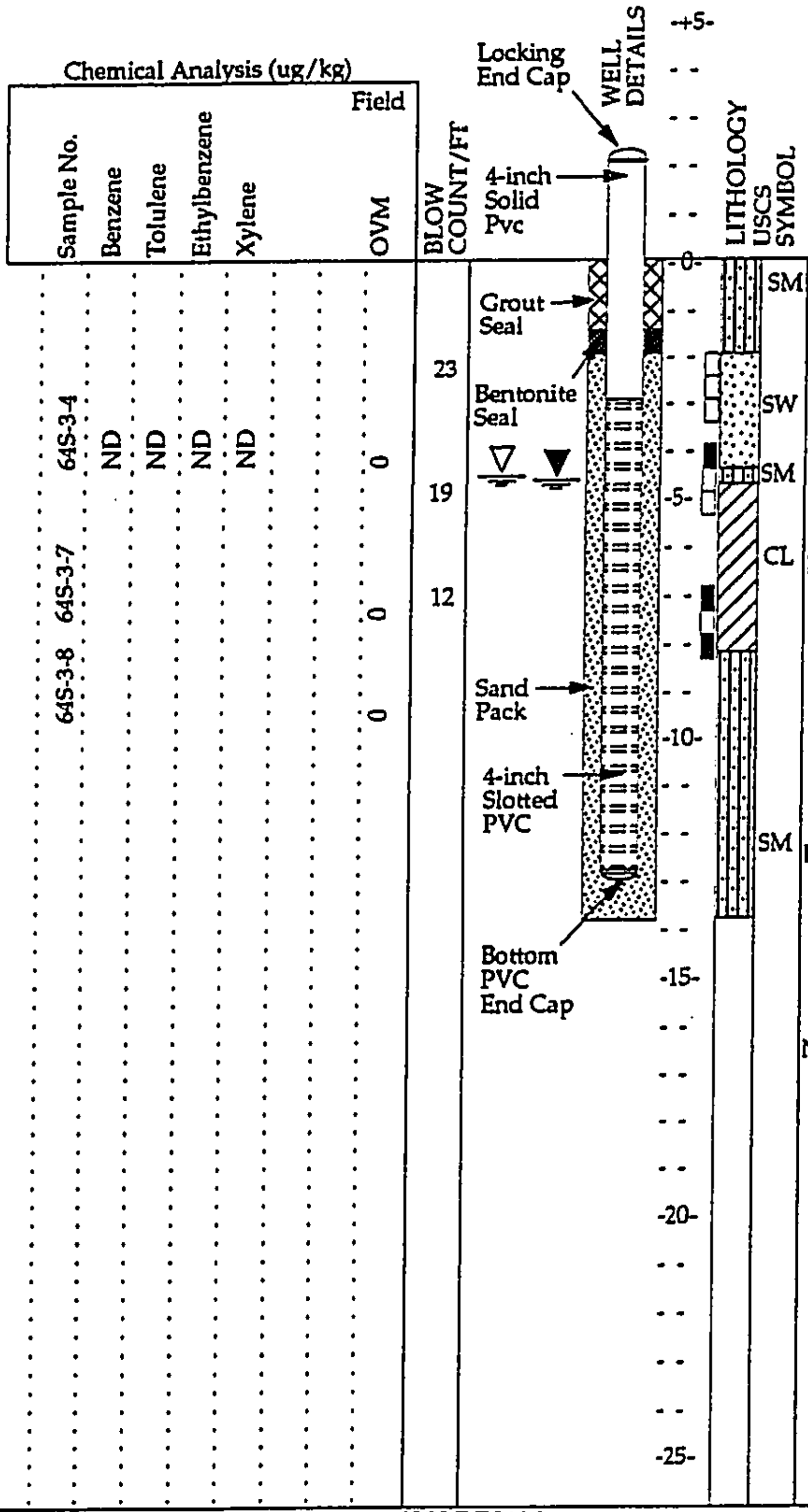
CL Dark grey inorganic clay with 10% sand and 5% gravel.

SM Dark brown sand with with 10% gravel.

Note: No product odors or visable stains were observed.

CASING ELEVATION: 7.89'	HOLE DIAM.: 8 inch	DATE DRILLED: 7/21/93 LOGGED BY: LC
SURFACE ELEVATION: NA	DRILL METHOD: H/S Auger	DRILLED BY: Islands Pacific Exploration

COTTON and FRAZIER **Consultants, Inc.**	LOG OF BORING MW-2 Flynn - Learner Sand Island, Oahu, Hawaii	Date 10/22/93	Figure E-3



SOIL DESCRIPTION

SM Brown, silty sand fill material with 10% gravel and some cobbles. Metal, glass, and plastic debris mixed in.

SW Black Sand with 20% gravel, mostly consisting of fused incinerator ash.

SM Dark grey silty sand, greater than 50% fines

CL Dark grey inorganic clay with 10% sand and 5% gravel.

SM Dark brown sand with with 10% gravel.

Note: No product odors or visable stains were observed.

CASING ELEVATION: 7.73'
HOLE DIAM.: 8 inch
DATE DRILLED: 7/21/93
LOGGED BY: LC
SURFACE ELEVATION: NA
DRILL METHOD: H/S Auger
DRILLED BY: Islands Pacific Exploration

COTTON and FRAZIER
Consultants, Inc.

LOG OF BORING MW-3
Flynn - Learner
Sand Island, Oahu, Hawaii

Date
10/22/93

Figure
E-4

MAJOR DIVISIONS					TYPICAL NAMES
COARSE-GRAINED SOILS MORE THAN HALF IS COARSER THAN NO. 200 SIEVE	GRAVELS MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	▦	WELL GRADED GRAVELS WITH OR WITHOUT SAND, LITTLE OR NO FINES.
			GP	▦	POORLY GRADED GRAVELS WITH OR WITHOUT SAND, LITTLE OR NO FINES
		GRAVELS WITH OVER 12% FINES	GM	▥	SILTY GRAVELS, SILTY GRAVELS WITH SAND
			GC	▩	CLAYEY GRAVELS, CLAYEY GRAVELS WITH SAND
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS WITH LITTLE OR NO FINES	SW	░	WELL GRADED SANDS WITH OR WITHOUT GRAVEL, LITTLE OR NO FINES
			SP	░	POORLY GRADED SANDS WITH OR WITHOUT GRAVEL, LITTLE OR NO FINES
		SANDS WITH OVER 12% FINES	SM	▥	SILTY SANDS WITH OR WITHOUT GRAVEL
			SC	▨	CLAYEY SANDS WITH OR WITHOUT GRAVEL
FINED-GRAINED SOILS MORE THAN HALF IS FINER THAN NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT 50% OR LESS		ML	▥	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTS WITH SANDS AND GRAVELS
			CL	▨	INORGANIC CLAYS OF LOW TO MEDIUM PLACTICITY, CLAYS WITH SANDS AND GRAVELS, LEAN CLAYS
			OL	▥	ORGANIC CLAYS AND SILTS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50%		MH	▥	INORGANIC SILTS, MICACEOUS OR DIATOMACIOUS, FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	▨	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	▩	ORGANIC SILTS OR CLAYS OF MEDIUM TO HIGH PLASTICITY
HIGHLY ORGANIC SOILS			Pt	≋	PEAT OR OTHER HIGHLY ORGANIC SOILS

UNIFIED SOIL CLASSIFICATION
ASTM D2487-85

▤	Coral
░	Basalt
▦	Saprolite
▯	Soil Sample collected for logging.
▮	Soil Sample collected for laboratory.
∇	First Encountered Ground Water Level.
▼	Piezometric Ground Water Level.
2.5YR 6/2	Soil Color according to Munsell Soil Color Charts (1975 Edition).
Penetration	Sample drive hammer weight-140 pounds falling 30 inches. Blows required to drive sampler 1 foot are indicated on the logs.
Auger H/S	Hollow Stem, Continuous Flight Auger Drilling Methods.
Auger S/S	Solid Stem, Continuous Flight Auger Drilling Methods.

COTTON and FRAZIER
Consultants, Inc.
October 22, 1993

KEY TO BORING LOGS
FLYNN-LEARNER
Sand Island, Oahu, Hawaii

Figure E-5

Western Atlas International
A Litton/Dresser Company

CORE LABORATORIES

COTTON & FRAZIER CONSULTANTS, INC.

GEOTECHNICAL ANALYSIS FLYNN-LEARNER PROJECT

CL FILE #093169

PERFORMED BY:
CORE LABORATORIES
3430 UNICORN ROAD
BAKERSFIELD, CA 93308
(805) 392-8600

FINAL REPORT PRESENTED
AUGUST 13, 1993

INTRODUCTION

Core Laboratories was requested by Cotton & Frazier Consultants, Incorporated, to perform geotechnical analysis upon environmental core samples recovered from the Flynn-Learner site project. Presented herein are the results of this study as well as a brief description of the requested procedures and tests.

We appreciate this opportunity to be of service to you and to Cotton & Frazier Consultants, Inc., and hope these data prove beneficial to this project.

Analysis Techniques

Fluid Saturation, Porosity, Permeability

The samples were analyzed utilizing techniques described in API RP-40. Please note: there is no prescribed method for determining effective permeability, the method used is a modification of the RP-40 technique.

Sample Preparation

A one-inch diameter plug was drilled from each submitted sample. Liquid nitrogen was used as the bit coolant.

The plugs were encased in a thin-walled metal jacket and fitted with 120 mesh end-screens. The jacket was set to the frozen plug under hydrostatic loading conditions at a pressure equal to 400 psi. Prior to analysis, the sample was placed into a zip-lock bag and allowed to come to laboratory temperature.

Effective Permeability to Air

Effective permeability determination was performed on the samples immediately after temperature stabilization. The measurement was made with pore fluids in place using steady state methods. A confining pressure of 250 psig was used. Permeability was calculated using Darcy's Equation for compressible fluids Equation 1.

$$K_{eff} = \frac{Pa\ v_g\ (1000)}{(P_1 - P_2)\frac{(P_1 + P_2)}{2}} \times \frac{Qa \cdot L^2}{V_b} \qquad (1)$$

Where: K_{eff} = EffectivePermeability to Air

v_g = Gas Viscosity

$P_1 - P_2$ = Differential Pressure

$\frac{(P_1 + P_2)}{2}$ = Mean Pressure

Pa = Atmospheric Pressure

Qa = Flow Rate

L = Length

V_b = Bulk Volume

Extraction and Saturation Determination

Water was extracted by Dean Stark technique using toluene. The samples were dried in a vacuum oven at 60°C until stable weights were attained. After drying, the samples were cooled to room temperature in a desiccator.

Water saturation was calculated by Dean Stark methods by using Equation 2.

$$S_w = [H_2O/V_p] \times 100 \qquad (2)$$

Where: S_w = Water Saturation, Percent

W_1 = Natural Weight

W_2 = Extracted and Dried Weight

H_2O = Extracted Water, Density Assumed 1.0 gm/cc

V_p = Pore Volume

Grain Density Determination

Grain volume determinations were performed using an extended range helium porosimeter according to Boyle's Law. Metal jacket and end-screen weight and volume corrections were applied to the jacketed samples. Grain density was calculated using Equation 3.

$$D_{ma} = M_g / V_g \quad (3)$$

Where:
D_{ma} = Grain Density
V_g = Grain Volume
M_g = Grain Mass

Porosity Determination

The sample was loaded into a hassler core holder and a direct pore volume measurement was made utilizing Boyle's Law methods with helium as the gaseous medium. Appropriate screen pore volume tares were applied to the sample. Porosity was calculated using Equation 4.

$$\phi = [V_p / (V_p + V_g)] \times 100 \quad (4)$$

Where:
ϕ = Porosity, Percent
V_g = Grain Volume
V_p = Pore Volume

Permeability to Air (Dean Stark Analysis) Dried

Permeability determinations for the dried sleeved plugs were made after the pore volume determinations with pressure release. Where sample integrity allowed, permeabilities were measured with sleeves removed. Permeability values were calculated using Darcy's Equation for compressible fluids, Equation 5.

$$K_a = \frac{Pa\ v_g\ (1000)}{(P_1 - P_2)\frac{(P_1 + P_2)}{2}} \times \frac{Qa \cdot L^2}{V_b} \quad (5)$$

Where: K_a = Permeability to Air
v_g = Gas Viscosity
$P_1 - P_2$ = Differential Pressure
$\frac{(P_1 + P_2)}{2}$ = Mean Pressure
Pa = Atmospheric Pressure
Qa = Flow Rate
L = Length
V_b = Bulk Volume

Bulk Density Determination (ASTM D-1188)

One inch diameter plugs were taken from each submitted sample. Bulk density was determined upon each plug as described in ASTM D-1188.

The bulk volume of each sample was calculated using Equation 6. Appropriate sleeve and endscreen corrections were applied to each sample.

$$V_b = V_p + V_g \tag{6}$$

Where: V_b = Bulk Volume
V_p = Pore Volume
V_g = Grain Volume

Bulk Density was calculated using Equation 7. Again, appropriate correction factors were applied for sleeves and screens.

$$D_b = M_g / V_b \tag{7}$$

Where: D_b = Bulk Density
M_g = Dry Grain Mass
V_b = Bulk Volume

Total Organic Carbon

Representative samples were taken from each submitted tube and forwarded to our Anaheim California Laboratory for determination of the total organic carbon content. The samples were analysis by procedures described in EPA 415.1.

Hydraulic Conductivity

Sample Preparation

The soil sample tubes were trimmed down in length to fit into the hydraulic conductivity apparatus. The end surfaces were plane and perpendicular to the longitudinal axis of sample. 120 mesh screens were applied to top and bottom of the samples to reduce the possibility of sample movement during testing. The samples were undisturbed and tested in the state in which they were received. Once mounted in the conductivity system, the samples were vacuumed for one-half hour to remove any trapped air in the soil and apparatus. While under vacuum the samples were then saturated with water. A graduated burette was used to measure the initial and final hydraulic head and determine volumes of water introduced to the sample.

Coefficient of Permeability

The samples were tested and measured a total of six times apiece. A five percent accuracy parameter was used to determine the validity of the experiments. The tests were consistent with the constant tailwater pressure method, Equation 2-1. Water flowed through the sample until constant flow condition was observed.

$$k = (a * L/ A * t) * \ln(h_0/h_1) \qquad (2\text{-}1)$$

Where:

k = Permeability, meters/second

a = Cross-sectional area of the reservoir containing the influent liquid in meters^2

L = Length of sample, meters

A = Cross-sectional area of the sample, meters^2

t = Total time in seconds

h_0 = initial height of water column above chamber outflow port in meters

h_1 = final height of water column above chamber outflow port in meters

Sample Disposition

The residual samples will be stored for thirty days pending instructions for further analysis.

Western Atlas International

A Litton/Dresser Company

CORE LABORATORIES

COMPANY : COTTON AND FRAZIER
PROJECT NAME: FLYNN-LEARNER
LOCATION : SAND ISLAND

FILE # 93169
DATE: 10-AUG-1993

GEOTECHNICAL ANALYSIS RESULTS

SAMPLE #	SAMPLE ID	PERM (Dried) Kair md	PERM (Native) State md	POROSITY %	SATURATION PORE VOLUME %	GRAIN DENSITY gm/cc	BULK DENSITY gm/cc	CATION EXCHANGE CAPACITY meq/100 gm	TOTAL ORGANIC CARBON mg/kg	VOLATILE AROMATICS (BTEX) ppb Benz/Tol/Eth/Xylene
1	64S01-2	14280	14023	43.5	50.2	2.75	1.56	4.5	27000	N/R
2	64S01-5	90	0.003	38.4	99.5	2.65	1.54	18.1	27000	0.5/ 8.4 /0.5 /2.4
3	64S01-8	1246	31	44.7	92.8	2.76	1.55	9.6	30000	N/R
4	64S02-2	450	0.003	40.2	98.4	2.59	1.44	100+ Off Scale	3800	N/R
5	64S02-7	479	<0.001	51.8	99.8	2.67	1.44	19.3	3900	N/R
6	64S03-4	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	Non Detectable
7	64S03-7	4813	<0.001	49.8	99.9	2.72	1.48	11.7	48000	N/R
8	64S03-8	1426	<0.001	46.1	99.0	2.76	1.52	10.9	69000	N/R

N/R denotes that analysis was not requested.

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CORE LABORATORIES

COMPANY   : COTTON AND FRAZIER
PROJECT NAME: FLYNN-LEARNER
LOCATION   : SAND ISLAND

FILE # 93169
DATE: 10-AUG-1993

GEOTECHNICAL ANALYSIS RESULTS

SAMPLE #	SAMPLE ID	MOISTURE CONTENT ASTM 2216 %
1	64S01-2	14.0
2	64S01-5	23.0
3	64S01-8	31.9
4	64S02-2	23.6
5	64S02-7	44.1
6	64S03-4	N/R
7	64S03-7	39.5
8	64S03-8	36.1

N/R denotes that analysis was not requested.

COTTON AND FRAZIER
HYDRAULIC CONDUCTIVITY DATA
FLYNN-LEARNER, SAND ISLAND

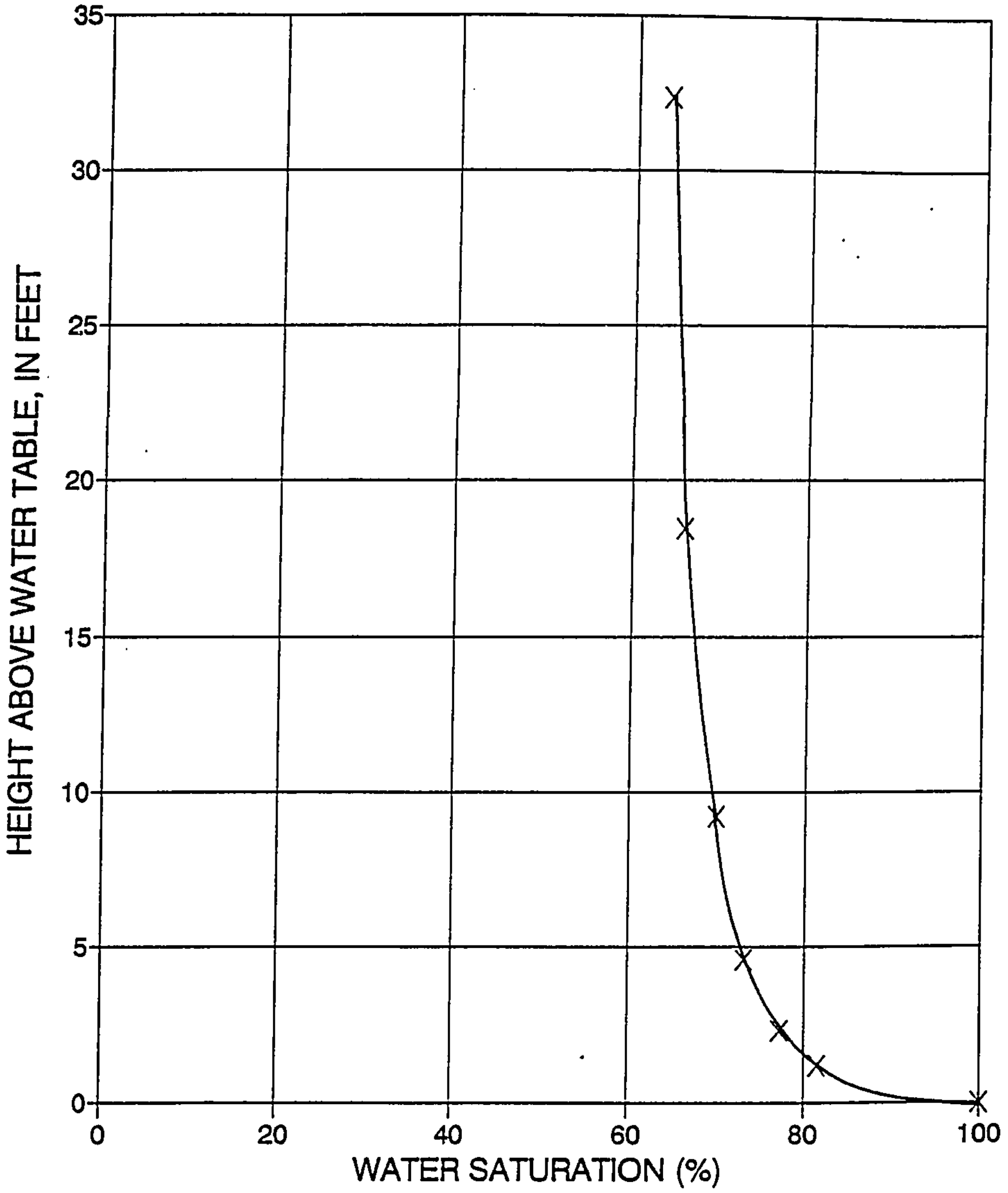
SAMPLE	HYDRAULIC CONDUCTIVITY, mD	HYDRAULIC CONDUCTIVITY, m/sec
64SO3 - 7	20.3	1.96×10^{-7}
64SO3 - 8	78.9	7.63×10^{-7}

CAPILLARY-MOISTURE RELATIONS FOR SOILS
SAMPLE: 64SO1 - 5

CAPILLARY PRESSURE (psi)	HEIGHT ABOVE WATER TABLE (ft)	WATER SATURATION (%)
0.5	1.15	81.5
1.0	2.31	77.2
2.0	4.62	73.2
4.0	9.23	69.9
8.0	18.47	66.0
14.0	32.32	63.8
INITIAL MOISTURE CONTENT (%)		19.1
INITIAL DRY UNIT WEIGHT (g/cc)		1.50
POROSITY (%)		42.5
SPECIFIC GRAVITY		2.55

CAPILLARY-MOISTURE RELATIONS FOR SOILS

SAMPLE: 64S01-5

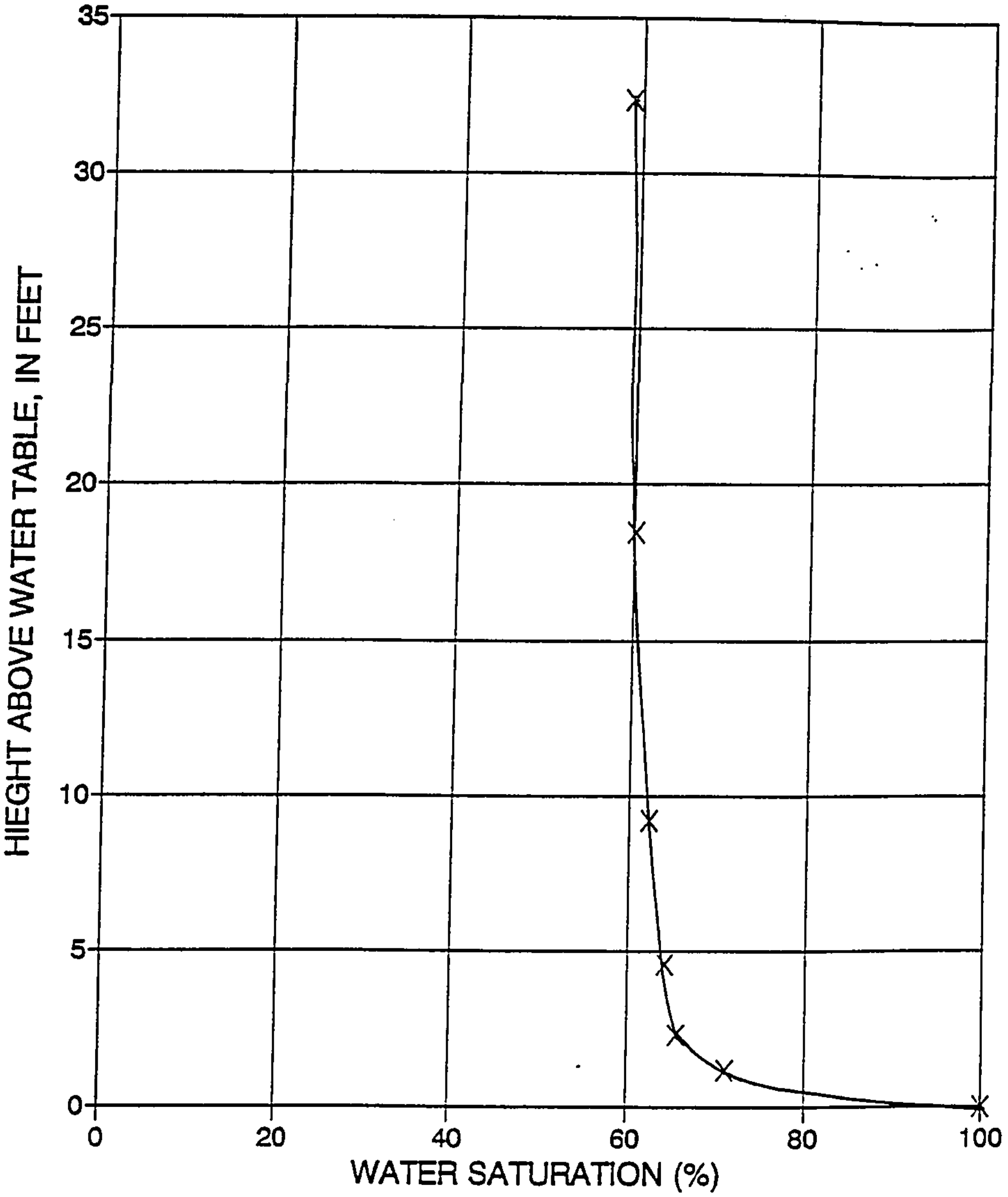


CAPILLARY-MOISTURE RELATIONS FOR SOILS
SAMPLE: 64SO2 - 2

CAPILLARY PRESSURE (psi)	HEIGHT ABOVE WATER TABLE (ft)	WATER SATURATION (%)
0.5	1.15	71.2
1.0	2.31	65.8
2.0	4.62	64.4
4.0	9.23	62.3
8.0	18.47	60.2
14.0	32.32	58.8
INITIAL MOISTURE CONTENT (%)		18.5
INITIAL DRY UNIT WEIGHT (g/cc)		1.4
POROSITY (%)		46.1
SPECIFIC GRAVITY		2.60

CAPILLARY-MOISTURE RELATIONS FOR SOILS

SAMPLE: 64S02-2



L A B O R A T O R Y   T E S T S   R E S U L T S

08/13/93

JOB NUMBER: 931540

CLIENT I.D..........: 93064
DATE SAMPLED........: 07/21/93
TIME SAMPLED........: 09:00
WORK DESCRIPTION...: 64S01-5

LABORATORY I.D...: 931540-0002
DATE RECEIVED....: 07/27/93
TIME RECEIVED....: 10:00
REMARKS..........: 1, 8RS SLV-SOIL

TEST DESCRIPTION	FINAL RESULT	LIMITS/*DILUTION	UNITS OF MEASURE	TEST METHOD	DATE	TECHN
Volatile Aromatics by GC/PID		*1		EPA 8020	08/10/93	CDG
Benzene	0.5	0.5	ug/kg	EPA 8020		
Toluene	8.4	0.5	ug/kg	EPA 8020		
Ethylbenzene	0.5	0.5	ug/kg	EPA 8020		
Xylenes	2.4	0.5	ug/kg	EPA 8020		
m-Chlorotoluene (SURROGATE)	45(a)	0	% Recovery	48-166% QC LIMITS		
Total Organic Carbon	27000	100	mg/kg	EPA 415.1	08/09/93	JEM

Western Atlas
International

CORE LABORATORIES

LABORATORY TESTS RESULTS

08/13/93

JOB NUMBER: 931540

CLIENT I.D.........: 93064
DATE SAMPLED.......: 07/21/93
TIME SAMPLED.......: 13:10
WORK DESCRIPTION...: 64S03-4

LABORATORY I.D...: 931540-0006
DATE RECEIVED....: 07/27/93
TIME RECEIVED....: 10:00
REMARKS..........: 1, BRS SLV-SOIL

TEST DESCRIPTION	FINAL RESULT	LIMITS/*DILUTION	UNITS OF MEASURE	TEST METHOD	DATE	TECHN
Volatile Aromatics by GC/PID		*1		EPA 8020	08/10/93	GDG
Benzene	ND	0.5	ug/kg	EPA 8020		
Toluene	ND	0.5	ug/kg	EPA 8020		
Ethylbenzene	ND	0.5	ug/kg	EPA 8020		
Xylenes	ND	0.5	ug/kg	EPA 8020		
m-Chlorotoluene (SURROGATE)	84	0	% Recovery	48-166% QC LIMITS		

QUALITY ASSURANCE REPORT
08/11/93

JOB NUMBER: 931540 CUSTOMER: Core Laboratories - Bakersfield

ANALYSIS				DUPLICATES		REFERENCE STANDARDS		MATRIX SPIKES		
ANALYSIS TYPE	ANALYSIS SUB-TYPE	ANALYSIS I.D.	ANALYZED VALUE (A)	DUPLICATE VALUE (B)	RPD or (|A-B|)	TRUE VALUE	PERCENT RECOVERY	ORIGINAL VALUE	SPIKE ADDED	PERCENT RECOVERY

PARAMETER: Total Organic Carbon DATE/TIME ANALYZED: 08/09/93 08:27 QC BATCH NUMBER: 929472
REPORTING LIMIT/DF: 100 UNITS: mg/kg METHOD REFERENCE EPA 415.1 TECHNICIAN: JEH

LANK	METHOD	080993	<100							
STANDARD	REFERENCE	S130140	2000			2000	100			
DUPLICATE	MATRIX	931540-7	48000	53000	10					

QUALITY ASSURANCE FOOTER

08/11/93

All methods are taken from one of the following references:
(1) EPA SW-846, Test Methods For Evaluating Solid Waste, Third Edition, November 1986
(2) Standard Methods For The Examination Of Water And Wastewater, 16th Edition, 1985
(3) EPA 600/4-79-020, Methods of Chemical Analysis for Waters and Wastes, March 1983
(4) *Federal Register, Friday, October 26, 1984 (40 CFR Part 136)*

NC = Not calculable due to values lower than the detection limit. N.I. = Not Ignitable

All methods of chemical analysis have a statistical uncertainty associated with the results. Unless otherwise indicated, the data in this report is within those limits of uncertainty. Quality control acceptance criteria are based on either actual laboratory performance or on limits specified in the referenced method.

Notes: The time of analysis indicated on the QA report does not reflect the actual time of analysis.
Quality control acceptance criteria are method dependent.
All data are reported on a "as received" basis unless otherwise noted.
Data reported in QA Report may be lower then values on sample data page due to dilution of sample into the calibration range of the analysis.

Cotton and Frazier Consultants, Inc.
"Environmental Solutions"
P.O. Box 27126
Honolulu, Hawaii 96827

Telephone: (808) 599-1993 FAX: (808) 599-1502

Chain of Custody Record/ Analysis Record

PROJECT NAME: FLYNN-LEARNER

LOCATION: FLYNN-LEARNER JOB NUMBER: 93064

SAMPLER: Lee Cranmer PROJECT MGR: Lee Cranmer

					CONTAINERS						Analysis Requested										
SAMPLE #	LAB SAMPLE ID#	TIME COLLECTED	DATE COLLECTED	MATRIX: S=SOIL W=WATER A=AIR	40 ml VOA	1 L Glass	Brass Ring				418.1 - TRPH	8020 - BTEX	Mod 8015 - Diesel	5520F - TPH-O&G	①	②	TOTAL ORGANIC CARBON	(ABS. WATER) CATION EX	RP-40	Hold for Further Analysis	RUSH (See Below)
64S01-2		0850	7-21-93	S			3										All	✓	✓		
64S01-5		0900					3					✓				✓	Add	All	All		
64S01-8		0910					3										All	✓	✓		
64S02-2		1055					3									✓	Add	✓	✓		
64S02-7		1120					3										Add	✓	✓		
64S03-4		1310					1					✓									
64S03-7		1315					3								✓		Add	✓	✓		
64S03-8		1315	↓	↓			3								✓		All	✓	✓		

Relinquished by Sampler:
Signature:
Printed Name: Lee Cranmer
Date/Time: 7-21-93/ 1600

Received By:
Signature: Fed Ex
Printed Name:
Date/Time:

Relinquished By:
Signature:
Printed Name:
Date/Time:

Received By:
Signature: Daniel 12/23/93
Printed Name:
Date/Time:

Relinquished By:
Signature:
Printed Name:
Date/Time:

Received By:
Signature:
Printed Name:
Date/Time:

LABORATORY:
Total # Containers:
Samples Received Chilled? Yes No
Samples in good condition? Yes No

Special Handling
Turnaround:
24 hour 48 hour
72 hour [✓ Regular]
Other

Comments:
① ASTM D-5084 :: HYDRAULIC CONDUCTIVITY
② ASTM D-2325 CAPILLARY CHAR. CURV

Page 1 of 2

DOCUMENT CAPTURED AS RECEIVED

Co[illegible] and [illegible] Consultants, Inc.
"Environmental Solutions"
P.O. Box 27126
Honolulu, Hawaii 96827

Telephone: (808) 599-1993 FAX: (808) 599-1502

Chain of Custody Re[illegible]ord/ Analysis Record

PROJECT NAME: FLYNN - LEARNER
LOCATION: SAND ISLAND
SAMPLER: Lee Cranmer
JOB NUMBER: 93064
PROJECT MGR: Lee Cranmer

SAMPLE #	LAB SAMPLE ID#	TIME COLLECTED	DATE COLLECTED	MATRIX: S=SOIL W=WATER A=AIR	CONTAINERS						Analysis Requested										
					40 ml. VOA	1 L. Glass	Brass Ring	250 ml Glass			418.1-TRPH	8020-BTEX	Mod 8015-Diesel	8520F-TPH-O&G	8100-PAHs	8270-PAHs	CARBON RANGE I.D.	DENSITY	VISCOSITY	Hold for Further Analysis	RUSH (See Below)
64P04		1500	7-21-93	PRODUCT	4			1		Do	Not Analyze						✓	✓	✓	RC	

Relinquished By Sampler:
Signature:
Printed Name:
Date/Time:

Received By:
Signature:
Printed Name:
Date/Time:

Relinquished By:
Signature:
Printed Name:
Date/Time:

Received By:
Signature:
Printed Name:
Date/Time:

Relinquished By:
Signature:
Printed Name:
Date/Time:

Received By:
Signature:
Printed Name:
Date/Time:

LABORATORY:
Total # Containers:
Samples Received Chilled? Yes No
Samples in good condition? Yes No

Special Handling
Turnaround: 24 hour 48 hour
72 hour [✓ Regular]
Other:

Comments:

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CORE LABORATORIES

CORE LABORATORIES
ANALYTICAL REPORT

Job Number: 931530
Prepared For:

Cotton and Frazier Consultants, Inc.
Lee Cranmer
P. O. Box 27126
Honolulu, HI 96827

Signature
Date: 8/27/93

Steven A. Hensen
Laboratory Manager

Nick C. Adolfo
Signature
Date: 8/27/93

Nick C. Adolfo
QA/QC Coordinator

Core Laboratories
1250 Gene Autry Way
Anaheim, California 92805
(714) 937-1094

California Environmental Laboratory Accreditation Program Laboratory Number 1174

Los Angeles County Sanitation District Laboratory Number 10146

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CORE LABORATORIES

LABORATORY TESTS RESULTS
08/19/93

IOB NUMBER: 931530 CUSTOMER: Cotton and Frazier Consultants ATTN: Lee Cranmer

CLIENT I.D.........: 93064	LABORATORY I.D...: 931530-0001
IATE SAMPLED.......: 07/26/93	DATE RECEIVED....: 07/27/93
'IME SAMPLED.......: 13:55	TIME RECEIVED....: 10:00
WORK DESCRIPTION...: 64W01	REMARKS..........: 8, VARIOUS-H2O

EST DESCRIPTION	FINAL RESULT	LIMITS/*DILUTION	UNITS OF MEASURE	TEST METHOD	DATE	TECHN
Acid Digestion for GFAA and ICP/MS	COMPLETED	-----	N/A	EPA 3020	07/30/93	LOS
iquid-Liquid Extraction for BNAs	COMPLETED	-----	N/A	EPA 3520	07/28/93	GRP
Semivolatile Organics by GC/MS		*2		EPA 625	08/06/93	ST
Acenaphthene	ND	20	ug/L	EPA 625		
Acenaphthylene	ND	20	ug/L	EPA 625		
Anthracene	ND	20	ug/L	EPA 625		
Benzidine	ND	40	ug/L	EPA 625		
Benzo(a)anthracene	ND	20	ug/L	EPA 625		
Benzo(b)fluoranthene	ND	20	ug/L	EPA 625		
Benzo(k)fluoranthene	ND	20	ug/L	EPA 625		
Benzoic acid	ND	40	ug/L	EPA 625		
Benzo(ghi)perylene	ND	20	ug/L	EPA 625		
Jenzo(a)pyrene	ND	20	ug/L	EPA 625		
Benzyl alcohol	ND	20	ug/L	EPA 625		
Bis(2-chloroethoxy)methane	ND	20	ug/L	EPA 625		
Bis(2-chloroethyl)ether	ND	20	ug/L	EPA 625		
Bis(2-chloroisopropyl)ether	ND	20	ug/L	EPA 625		
Bis(2-ethylhexyl) phthalate	ND	20	ug/L	EPA 625		
4-Bromophenyl phenyl ether	ND	20	ug/L	EPA 625		
Butyl benzyl phthalate	ND	20	ug/L	EPA 625		
4-Chloroaniline	ND	40	ug/L	EPA 625		
4-Chloro-3-methylphenol	ND	20	ug/L	EPA 625		
2-Chloronaphthalene	ND	20	ug/L	EPA 625		
2-Chlorophenol	ND	20	ug/L	EPA 625		
4-Chlorophenyl phenyl ether	ND	20	ug/L	EPA 625		
Chrysene	ND	20	ug/L	EPA 625		
Di-n-butyl phthalate	ND	20	ug/L	EPA 625		
1,2-Dichlorobenzene	ND	20	ug/L	EPA 625		
1,3-Dichlorobenzene	ND	20	ug/L	EPA 625		
1,4-Dichlorobenzene	ND	20	ug/L	EPA 625		
3,3'-Dichlorobenzidine	ND	40	ug/L	EPA 625		
2,4-Dichlorophenol	ND	40	ug/L	EPA 625		
Dibenzo(a,h)anthracene	ND	20	ug/L	EPA 625		
Dibenzofuran	ND	20	ug/L	EPA 625		
Diethyl phthalate	ND	20	ug/L	EPA 625		
2,4-Dimethylphenol	ND	20	ug/L	EPA 625		
Dimethyl phthalate	ND	20	ug/L	EPA 625		
4,6-Dinitro-2-methylphenol	ND	40	ug/L	EPA 625		
2,4-Dinitrophenol	ND	20	ug/L	EPA 625		
2,4-Dinitrotoluene	ND	20	ug/L	EPA 625		
2,6-Dinitrotoluene	ND	20	ug/L	EPA 625		
Di-n-octyl phthalate	ND	20	ug/L	EPA 625		

1250 Gene Autry Way
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CORE LABORATORIES

LABORATORY TESTS RESULTS
08/19/93

JOB NUMBER: 931530 CUSTOMER: Cotton and Frazier Consultants ATTN: Lee Cranmer

CLIENT I.D.........: 93064
DATE SAMPLED.......: 07/26/93
TIME SAMPLED.......: 13:55
WORK DESCRIPTION...: 64W01

LABORATORY I.D...: 931530-0001
DATE RECEIVED....: 07/27/93
TIME RECEIVED....: 10:00
REMARKS..........: 8, VARIOUS-H2O

TEST DESCRIPTION	FINAL RESULT	LIMITS/*DILUTION	UNITS OF MEASURE	TEST METHOD	DATE	TECHN
Fluorene	ND	20	ug/L	EPA 625		
Fluoranthene	ND	20	ug/L	EPA 625		
Hexachlorobenzene	ND	20	ug/L	EPA 625		
Hexachlorobutadiene	ND	20	ug/L	EPA 625		
Hexachlorocyclopentadiene	ND	20	ug/L	EPA 625		
Hexachloroethane	ND	20	ug/L	EPA 625		
Indeno(1,2,3-cd)pyrene	ND	20	ug/L	EPA 625		
Isophorone	ND	20	ug/L	EPA 625		
2-Methylnaphthalene	ND	20	ug/L	EPA 625		
2-Methylphenol	ND	20	ug/L	EPA 625		
4-Methylphenol	ND	20	ug/L	EPA 625		
2-Nitroaniline	ND	20	ug/L	EPA 625		
3-Nitroaniline	ND	100	ug/L	EPA 625		
4-Nitroaniline	ND	100	ug/L	EPA 625		
2-Nitrophenol	ND	20	ug/L	EPA 625		
4-Nitrophenol	ND	20	ug/L	EPA 625		
N-Nitrosodimethylamine	ND	100	ug/L	EPA 625		
N-Nitrosodi-n-propylamine	ND	20	ug/L	EPA 625		
N-Nitrosodiphenylamine	ND	20	ug/L	EPA 625		
Naphthalene	ND	20	ug/L	EPA 625		
Nitrobenzene	ND	20	ug/L	EPA 625		
Pentachlorophenol	ND	40	ug/L	EPA 625		
Phenanthrene	ND	20	ug/L	EPA 625		
Phenol	ND	20	ug/L	EPA 625		
Pyrene	ND	20	ug/L	EPA 625		
1,2,4-Trichlorobenzene	ND	20	ug/L	EPA 625		
2,4,5-Trichlorophenol	ND	20	ug/L	EPA 625		
2,4,6-Trichlorophenol	ND	20	ug/L	EPA 625		
2-Fluorophenol (SURROGATE)	20(a)	0	% Recovery	21-110% QC LIMITS		
d5-Phenol (SURROGATE)	12	0	% Recovery	10-110 QC LIMITS		
d5-Nitrobenzene (SURROGATE)	139(a)	0	% Recovery	34-114% QC LIMITS		
2-Fluorobiphenyl (SURROGATE)	80	0	% Recovery	43-116% QC LIMITS		
2,4,6-Tribromophenol (SURROGATE)	114	0	% Recovery	10-122% QC LIMITS		
d14-Terphenyl (SURROGATE)	90	0	% Recovery	33-141% QC LIMITS		
Alkalinity by Titration		*1		EPA 310.1	08/06/93	CEH
Bicarbonate (as CaCO3), dissolved	460	10	mg/L	EPA 310.1		
Carbonate (as CaCO3), dissolved	ND	10	mg/L	EPA 310.1		
Hydroxide (OH), dissolved	ND	10	mg/L	EPA 310.1		
latile Aromatics by GC/PID		*1		EPA 8020	08/03/93	GDQ
Benzene	ND	0.5	ug/L	EPA 8020		
Toluene	ND	0.5	ug/L	EPA 8020		

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CORE LABORATORIES

LABORATORY TESTS RESULTS
08/19/93

JOB NUMBER: 931530 CUSTOMER: Cotton and Frazier Consultants ATTN: Lee Cranmer

CLIENT I.D.........: 93064
DATE SAMPLED.......: 07/26/93
TIME SAMPLED.......: 13:55
WORK DESCRIPTION...: 64W01

LABORATORY I.D...: 931530-0001
DATE RECEIVED....: 07/27/93
TIME RECEIVED....: 10:00
REMARKS..........: 8, VARIOUS-H2O

TEST DESCRIPTION	FINAL RESULT	LIMITS/*DILUTION	UNITS OF MEASURE	TEST METHOD	DATE	TECHN
Ethylbenzene	ND	0.5	ug/L	EPA 8020		
Xylenes	ND	0.5	ug/L	EPA 8020		
m-Chlorotoluene (SURROGATE)	107	0	% Recovery	64-147% QC LIMITS		
Aluminum (Al)	<0.50	0.50	mg/L	EPA 6020	08/06/93	RVJ
Copper (Cu)	<0.10	0.10	mg/L	EPA 6020	08/03/93	AYJ
Manganese (Mn)	0.14	0.10	mg/L	EPA 6020	08/03/93	AYJ
Zinc (Zn)	0.34	0.20	mg/L	EPA 6020	08/03/93	AYJ
Conductivity	1800	10	umho/cm @77F	EPA 120.1	07/27/93	VB
REDOX Potential	110	1	mv	ASTM D-1498-76	08/19/93	*CC
Total Dissolved Solids (TDS)	1200	10	mg/L	EPA 160.1	07/27/93	VB
Sulfate (SO4), dissolved	150	20	mg/L	EPA 375.3	08/05/93	CEM
Oxygen, dissolved	3	1	mg/L	EPA 360.1	07/27/93	CIS
Chloride (Cl), total	280	5.0	mg/L	EPA 325.3	07/28/93	CEM
Nitrate (NO3-N), total	2.0	0.1	mg/L	EPA 353.1	07/28/93	CEM
Calcium (Ca), total	50	4.0	mg/L	EPA 215.1	08/10/93	RVJ
Iron (Fe), total	3.0	2.0	mg/L	EPA 236.1	08/10/93	RVJ
Magnesium (Mg), total	62	10	mg/L	EPA 242.1	08/10/93	RVJ
Potassium (K), total	39	0.60	mg/L	EPA 258.1	08/10/93	RVJ
Sodium (Na), total	300	30	mg/L	EPA 273.1	08/10/93	RVJ
Hardness(Ca,Mg calculation)	380	1.0	mg/L CaCO3	Std. Method 2340B	08/10/93	RVJ
pH (H2O sample)	7.9		pH units	EPA 150.1	07/27/93	MQ

1250 Gene Autry Way
Anaheim, CA 92805
(714) 937-1094

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CORE LABORATORIES

LABORATORY TESTS RESULTS
08/19/93

OB NUMBER: 931530 CUSTOMER: Cotton and Frazier Consultants ATTN: Lee Cranmer

CLIENT I.D.........: 93064
ATE SAMPLED.......: 07/26/93
IME SAMPLED.......: 14:05
ORK DESCRIPTION...: 64W02

LABORATORY I.D...: 931530-0002
DATE RECEIVED....: 07/27/93
TIME RECEIVED....: 10:00
REMARKS..........: 8, VARIOUS-H2O

EST DESCRIPTION	FINAL RESULT	LIMITS/*DILUTION	UNITS OF MEASURE	TEST METHOD	DATE	TECHN
Acid Digestion for GFAA and ICP/MS	COMPLETED	-----	N/A	EPA 3020	07/30/93	LOS
iquid-Liquid Extraction for BNAs	COMPLETED	-----	N/A	EPA 3520	07/28/93	GRP
Semivolatile Organics by GC/MS		*1		EPA 625	08/09/93	ST
Acenaphthene	ND	10	ug/L	EPA 625		
Acenaphthylene	ND	10	ug/L	EPA 625		
Anthracene	ND	10	ug/L	EPA 625		
Benzidine	ND	20	ug/L	EPA 625		
Benzo(a)anthracene	ND	10	ug/L	EPA 625		
Benzo(b)fluoranthene	ND	10	ug/L	EPA 625		
Benzo(k)fluoranthene	ND	10	ug/L	EPA 625		
Benzoic acid	ND	20	ug/L	EPA 625		
Benzo(ghi)perylene	ND	10	ug/L	EPA 625		
Benzo(a)pyrene	ND	10	ug/L	EPA 625		
Benzyl alcohol	ND	10	ug/L	EPA 625		
Bis(2-chloroethoxy)methane	ND	10	ug/L	EPA 625		
Bis(2-chloroethyl)ether	ND	10	ug/L	EPA 625		
Bis(2-chloroisopropyl)ether	ND	10	ug/L	EPA 625		
Bis(2-ethylhexyl) phthalate	ND	10	ug/L	EPA 625		
4-Bromophenyl phenyl ether	ND	10	ug/L	EPA 625		
Butyl benzyl phthalate	ND	10	ug/L	EPA 625		
4-Chloroaniline	ND	20	ug/L	EPA 625		
4-Chloro-3-methylphenol	ND	10	ug/L	EPA 625		
2-Chloronaphthalene	ND	10	ug/L	EPA 625		
2-Chlorophenol	ND	10	ug/L	EPA 625		
4-Chlorophenyl phenyl ether	ND	10	ug/L	EPA 625		
Chrysene	ND	10	ug/L	EPA 625		
Di-n-butyl phthalate	ND	10	ug/L	EPA 625		
1,2-Dichlorobenzene	ND	10	ug/L	EPA 625		
1,3-Dichlorobenzene	ND	10	ug/L	EPA 625		
1,4-Dichlorobenzene	ND	10	ug/L	EPA 625		
3,3'-Dichlorobenzidine	ND	20	ug/L	EPA 625		
2,4-Dichlorophenol	ND	20	ug/L	EPA 625		
Dibenzo(a,h)anthracene	ND	10	ug/L	EPA 625		
Dibenzofuran	ND	10	ug/L	EPA 625		
Diethyl phthalate	ND	10	ug/L	EPA 625		
2,4-Dimethylphenol	ND	10	ug/L	EPA 625		
Dimethyl phthalate	ND	10	ug/L	EPA 625		
4,6-Dinitro-2-methylphenol	ND	20	ug/L	EPA 625		
2,4-Dinitrophenol	ND	10	ug/L	EPA 625		
2,4-Dinitrotoluene	ND	10	ug/L	EPA 625		
2,6-Dinitrotoluene	ND	10	ug/L	EPA 625		
Di-n-octyl phthalate	ND	10	ug/L	EPA 625		

LABORATORY TESTS RESULTS
08/19/93

JOB NUMBER: 931530 CUSTOMER: Cotton and Frazier Consultants ATTN: Lee Cranmer

CLIENT I.D..........: 93064
DATE SAMPLED........: 07/26/93
TIME SAMPLED........: 14:05
WORK DESCRIPTION...: 64W02

LABORATORY I.D...: 931530-0002
DATE RECEIVED....: 07/27/93
TIME RECEIVED....: 10:00
REMARKS..........: 8, VARIOUS-H2O

TEST DESCRIPTION	FINAL RESULT	LIMITS/*DILUTION	UNITS OF MEASURE	TEST METHOD	DATE	TECHN
Fluorene	ND	10	ug/L	EPA 625		
Fluoranthene	ND	10	ug/L	EPA 625		
Hexachlorobenzene	ND	10	ug/L	EPA 625		
Hexachlorobutadiene	ND	10	ug/L	EPA 625		
Hexachlorocyclopentadiene	ND	10	ug/L	EPA 625		
Hexachloroethane	ND	10	ug/L	EPA 625		
Indeno(1,2,3-cd)pyrene	ND	10	ug/L	EPA 625		
Isophorone	ND	10	ug/L	EPA 625		
2-Methylnaphthalene	ND	10	ug/L	EPA 625		
2-Methylphenol	ND	10	ug/L	EPA 625		
4-Methylphenol	ND	10	ug/L	EPA 625		
2-Nitroaniline	ND	10	ug/L	EPA 625		
3-Nitroaniline	ND	50	ug/L	EPA 625		
4-Nitroaniline	ND	50	ug/L	EPA 625		
2-Nitrophenol	ND	10	ug/L	EPA 625		
4-Nitrophenol	ND	10	ug/L	EPA 625		
N-Nitrosodimethylamine	ND	50	ug/L	EPA 625		
N-Nitrosodi-n-propylamine	ND	10	ug/L	EPA 625		
N-Nitrosodiphenylamine	ND	10	ug/L	EPA 625		
Naphthalene	ND	10	ug/L	EPA 625		
Nitrobenzene	ND	10	ug/L	EPA 625		
Pentachlorophenol	ND	20	ug/L	EPA 625		
Phenanthrene	ND	10	ug/L	EPA 625		
Phenol	ND	10	ug/L	EPA 625		
Pyrene	ND	10	ug/L	EPA 625		
1,2,4-Trichlorobenzene	ND	10	ug/L	EPA 625		
2,4,5-Trichlorophenol	ND	10	ug/L	EPA 625		
2,4,6-Trichlorophenol	ND	10	ug/L	EPA 625		
2-Fluorophenol (SURROGATE)	31	0	% Recovery	21-110% QC LIMITS		
d6-Phenol (SURROGATE)	58	0	% Recovery	10-110 QC LIMITS		
d5-Nitrobenzene (SURROGATE)	124(a)	0	% Recovery	34-114% QC LIMITS		
2-Fluorobiphenyl (SURROGATE)	83	0	% Recovery	43-116% QC LIMITS		
2,4,6-Tribromophenol (SURROGATE)	99	0	% Recovery	10-122% QC LIMITS		
d14-Terphenyl (SURROGATE)	83	0	% Recovery	33-141% QC LIMITS		
Alkalinity by Titration		*1		EPA 310.1	08/06/93	CEM
Bicarbonate (as CaCO3), dissolved	380	10	mg/L	EPA 310.1		
Carbonate (as CaCO3), dissolved	ND	10	mg/L	EPA 310.1		
Hydroxide (OH), dissolved	ND	10	mg/L	EPA 310.1		
Volatile Aromatics by GC/PID		*1		EPA 8020	08/03/93	GDQ
Benzene	ND	0.5	ug/L	EPA 8020		
Toluene	ND	0.5	ug/L	EPA 8020		

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LABORATORY TESTS RESULTS

08/19/93

JOB NUMBER: 931530 CUSTOMER: Cotton and Frazier Consultants ATTN: Lee Cranmer

CLIENT I.D.........: 93064
DATE SAMPLED.......: 07/26/93
TIME SAMPLED.......: 14:05
WORK DESCRIPTION...: 64W02

LABORATORY I.D...: 931530-0002
DATE RECEIVED....: 07/27/93
TIME RECEIVED....: 10:00
REMARKS..........: 8, VARIOUS-H2O

TEST DESCRIPTION	FINAL RESULT	LIMITS/*DILUTION	UNITS OF MEASURE	TEST METHOD	DATE	TECHN
Ethylbenzene	ND	0.5	ug/L	EPA 8020		
Xylenes	ND	0.5	ug/L	EPA 8020		
m-Chlorotoluene (SURROGATE)	108	0	% Recovery	64-147% QC LIMITS		
Aluminum (Al)	0.68	0.50	mg/L	EPA 6020	08/06/93	RVJ
Copper (Cu)	0.12	0.10	mg/L	EPA 6020	08/03/93	AYJ
Manganese (Mn)	0.28	0.10	mg/L	EPA 6020	08/03/93	AYJ
Zinc (Zn)	0.69	0.20	mg/L	EPA 6020	08/03/93	AYJ
Conductivity	1400	10	umho/cm @77F	EPA 120.1	07/27/93	VB
REDOX Potential	155	1	mv	ASTM D-1498-76	08/19/93	*CC
Total Dissolved Solids (TDS)	850	10	mg/L	EPA 160.1	07/27/93	VB
Sulfate (SO4), dissolved	64	20	mg/L	EPA 375.3	08/05/93	CEM
Oxygen, dissolved	3	1	mg/L	EPA 360.1	07/27/93	CIS
Chloride (Cl), total	210	5.0	mg/L	EPA 325.3	07/28/93	CEM
Nitrate (NO3-N), total	2.5	0.1	mg/L	EPA 353.1	07/28/93	CEM
Calcium (Ca), total	59	4.0	mg/L	EPA 215.1	08/10/93	RVJ
Iron (Fe), total	6.6	2.0	mg/L	EPA 236.1	08/10/93	RVJ
Magnesium (Mg), total	44	10	mg/L	EPA 242.1	08/10/93	RVJ
Potassium (K), total	13	0.60	mg/L	EPA 258.1	08/10/93	RVJ
Sodium (Na), total	230	30	mg/L	EPA 273.1	08/10/93	RVJ
Hardness(Ca,Mg calculation)	330	1.0	mg/L CaCO3	Std. Method 2340B	08/10/93	RVJ
pH (H2O sample)	7.8		pH units	EPA 150.1	07/27/93	MQ

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LABORATORY TESTS RESULTS
08/19/93

JOB NUMBER: 931530 CUSTOMER: Cotton and Frazier Consultants ATTN: Lee Cranmer

CLIENT I.D.........: 93064	LABORATORY I.D...: 931530-0003
DATE SAMPLED.......: 07/26/93	DATE RECEIVED....: 07/27/93
TIME SAMPLED.......: 14:15	TIME RECEIVED....: 10:00
WORK DESCRIPTION...: 64W03	REMARKS..........: 8, VARIOUS-H2O

TEST DESCRIPTION	FINAL RESULT	LIMITS/*DILUTION	UNITS OF MEASURE	TEST METHOD	DATE	TECHN
Acid Digestion for GFAA and ICP/MS	COMPLETED	-----	N/A	EPA 3020	07/30/93	LOS
Liquid-Liquid Extraction for BNAs	COMPLETED	-----	N/A	EPA 3520	07/28/93	GRP
Semivolatile Organics by GC/MS		*1		EPA 625	08/09/93	ST
Acenaphthene	ND	10	ug/L	EPA 625		
Acenaphthylene	ND	10	ug/L	EPA 625		
Anthracene	ND	10	ug/L	EPA 625		
Benzidine	ND	20	ug/L	EPA 625		
Benzo(a)anthracene	ND	10	ug/L	EPA 625		
Benzo(b)fluoranthene	ND	10	ug/L	EPA 625		
Benzo(k)fluoranthene	ND	10	ug/L	EPA 625		
Benzoic acid	ND	20	ug/L	EPA 625		
Benzo(ghi)perylene	ND	10	ug/L	EPA 625		
Benzo(a)pyrene	ND	10	ug/L	EPA 625		
Benzyl alcohol	ND	10	ug/L	EPA 625		
Bis(2-chloroethoxy)methane	ND	10	ug/L	EPA 625		
Bis(2-chloroethyl)ether	ND	10	ug/L	EPA 625		
Bis(2-chloroisopropyl)ether	ND	10	ug/L	EPA 625		
Bis(2-ethylhexyl) phthalate	ND	10	ug/L	EPA 625		
4-Bromophenyl phenyl ether	ND	10	ug/L	EPA 625		
Butyl benzyl phthalate	ND	10	ug/L	EPA 625		
4-Chloroaniline	ND	20	ug/L	EPA 625		
4-Chloro-3-methylphenol	ND	10	ug/L	EPA 625		
2-Chloronaphthalene	ND	10	ug/L	EPA 625		
2-Chlorophenol	ND	10	ug/L	EPA 625		
4-Chlorophenyl phenyl ether	ND	10	ug/L	EPA 625		
Chrysene	ND	10	ug/L	EPA 625		
Di-n-butyl phthalate	ND	10	ug/L	EPA 625		
1,2-Dichlorobenzene	ND	10	ug/L	EPA 625		
1,3-Dichlorobenzene	ND	10	ug/L	EPA 625		
1,4-Dichlorobenzene	ND	10	ug/L	EPA 625		
3,3'-Dichlorobenzidine	ND	20	ug/L	EPA 625		
2,4-Dichlorophenol	ND	20	ug/L	EPA 625		
Dibenzo(a,h)anthracene	ND	10	ug/L	EPA 625		
Dibenzofuran	ND	10	ug/L	EPA 625		
Diethyl phthalate	ND	10	ug/L	EPA 625		
2,4-Dimethylphenol	ND	10	ug/L	EPA 625		
Dimethyl phthalate	ND	10	ug/L	EPA 625		
4,6-Dinitro-2-methylphenol	ND	20	ug/L	EPA 625		
2,4-Dinitrophenol	ND	10	ug/L	EPA 625		
2,4-Dinitrotoluene	ND	10	ug/L	EPA 625		
2,6-Dinitrotoluene	ND	10	ug/L	EPA 625		
Di-n-octyl phthalate	ND	10	ug/L	EPA 625		

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LABORATORY TESTS RESULTS
08/19/93

JOB NUMBER: 931530 CUSTOMER: Cotton and Frazier Consultants ATTN: Lee Cranmer

CLIENT I.D.........: 93064
DATE SAMPLED........: 07/26/93
TIME SAMPLED........: 14:15
WORK DESCRIPTION...: 64W03

LABORATORY I.D...: 931530-0003
DATE RECEIVED....: 07/27/93
TIME RECEIVED....: 10:00
REMARKS..........: 8, VARIOUS-H2O

TEST DESCRIPTION	FINAL RESULT	LIMITS/*DILUTION	UNITS OF MEASURE	TEST METHOD	DATE	TECHN
Fluorene	ND	10	ug/L	EPA 625		
Fluoranthene	ND	10	ug/L	EPA 625		
Hexachlorobenzene	ND	10	ug/L	EPA 625		
Hexachlorobutadiene	ND	10	ug/L	EPA 625		
Hexachlorocyclopentadiene	ND	10	ug/L	EPA 625		
Hexachloroethane	ND	10	ug/L	EPA 625		
Indeno(1,2,3-cd)pyrene	ND	10	ug/L	EPA 625		
Isophorone	ND	10	ug/L	EPA 625		
2-Methylnaphthalene	ND	10	ug/L	EPA 625		
2-Methylphenol	ND	10	ug/L	EPA 625		
4-Methylphenol	ND	10	ug/L	EPA 625		
2-Nitroaniline	ND	10	ug/L	EPA 625		
3-Nitroaniline	ND	50	ug/L	EPA 625		
4-Nitroaniline	ND	50	ug/L	EPA 625		
2-Nitrophenol	ND	10	ug/L	EPA 625		
4-Nitrophenol	ND	10	ug/L	EPA 625		
N-Nitrosodimethylamine	ND	50	ug/L	EPA 625		
N-Nitrosodi-n-propylamine	ND	10	ug/L	EPA 625		
N-Nitrosodiphenylamine	ND	10	ug/L	EPA 625		
Naphthalene	ND	10	ug/L	EPA 625		
Nitrobenzene	ND	10	ug/L	EPA 625		
Pentachlorophenol	ND	20	ug/L	EPA 625		
Phenanthrene	ND	10	ug/L	EPA 625		
Phenol	ND	10	ug/L	EPA 625		
Pyrene	ND	10	ug/L	EPA 625		
1,2,4-Trichlorobenzene	ND	10	ug/L	EPA 625		
2,4,5-Trichlorophenol	ND	10	ug/L	EPA 625		
2,4,6-Trichlorophenol	ND	10	ug/L	EPA 625		
2-Fluorophenol (SURROGATE)	25	0	% Recovery	21-110% QC LIMITS		
d6-Phenol (SURROGATE)	47	0	% Recovery	10-110 QC LIMITS		
d5-Nitrobenzene (SURROGATE)	89	0	% Recovery	34-114% QC LIMITS		
2-Fluorobiphenyl (SURROGATE)	98	0	% Recovery	43-116% . QC LIMITS		
2,4,6-Tribromophenol (SURROGATE)	101	0	% Recovery	10-122% QC LIMITS		
d14-Terphenyl (SURROGATE)	86	0	% Recovery	33-141% QC LIMITS		
Alkalinity by Titration		*1		EPA 310.1	08/06/93	CEM
Bicarbonate (as CaCO3), dissolved	520	10	mg/L	EPA 310.1		
Carbonate (as CaCO3), dissolved	ND	10	mg/L	EPA 310.1		
Hydroxide (OH), dissolved	ND	10	mg/L	EPA 310.1		
Volatile Aromatics by GC/PID		*1		EPA 8020	08/03/93	GDQ
Benzene	ND	0.5	ug/L	EPA 8020		
Toluene	ND	0.5	ug/L	EPA 8020		

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LABORATORY TESTS RESULTS
08/19/93

JOB NUMBER: 931530 CUSTOMER: Cotton and Frazier Consultants ATTN: Lee Cranmer

CLIENT I.D.........: 93064
)ATE SAMPLED.......: 07/26/93
TIME SAMPLED.......: 14:15
WORK DESCRIPTION...: 64W03

LABORATORY I.D...: 931530-0003
DATE RECEIVED....: 07/27/93
TIME RECEIVED....: 10:00
REMARKS..........: 8, VARIOUS-H2O

EST DESCRIPTION	FINAL RESULT	LIMITS/*DILUTION	UNITS OF MEASURE	TEST METHOD	DATE	TECHN
Ethylbenzene	ND	0.5	ug/L	EPA 8020		
Xylenes	ND	0.5	ug/L	EPA 8020		
m-Chlorotoluene (SURROGATE)	107	0	% Recovery	64-147% QC LIMITS		
Aluminum (Al)	49	0.50	mg/L	EPA 6020	08/06/93	RVJ
opper (Cu)	0.34	0.10	mg/L	EPA 6020	08/03/93	AYJ
Manganese (Mn)	0.88	0.10	mg/L	EPA 6020	08/03/93	AYJ
inc (Zn)	1.2	0.20	mg/L	EPA 6020	08/03/93	AYJ
Conductivity	1400	10	umho/cm @77F	EPA 120.1	07/27/93	VB
X Potential	108	1	mv	ASTM D-1498-76	08/19/93	*CC
otal Dissolved Solids (TDS)	840	10	mg/L	EPA 160.1	07/27/93	VB
Sulfate (SO4), dissolved	20	20	mg/L	EPA 375.3	08/05/93	CEM
xygen, dissolved	3	1	mg/L	EPA 360.1	07/27/93	CIS
Chloride (Cl), total	190	5.0	mg/L	EPA 325.3	07/28/93	CEM
itrate (NO3-N), total	3.2	0.1	mg/L	EPA 353.1	07/28/93	CEM
Calcium (Ca), total	210	4.0	mg/L	EPA 215.1	08/10/93	RVJ
ron (Fe), total	49	2.0	mg/L	EPA 236.1	08/10/93	RVJ
Magnesium (Mg), total	47	10	mg/L	EPA 242.1	08/10/93	RVJ
otassium (K), total	49	0.60	mg/L	EPA 258.1	08/10/93	RVJ
odium (Na), total	220	30	mg/L	EPA 273.1	08/10/93	RVJ
Hardness(Ca,Mg calculation)	720	1.0	mg/L CaCO3	Std. Method 2340B	08/10/93	RVJ
(H2O sample)	7.8		pH units	EPA 150.1	07/27/93	MQ

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QUALITY ASSURANCE REPORT

08/19/93

IOB NUMBER: 931530 CUSTOMER: Cotton and Frazier Consultants ATTN: Lee Cranmer

ANALYSIS				DUPLICATES		REFERENCE STANDARDS		MATRIX SPIKES		
NALYSIS TYPE	ANALYSIS SUB-TYPE	ANALYSIS I.D.	ANALYZED VALUE (A)	DUPLICATE VALUE (B)	RPD or (|A-B|)	TRUE VALUE	PERCENT RECOVERY	ORIGINAL VALUE	SPIKE ADDED	PERCENT RECOVERY
PARAMETER:Oxygen, dissolved EPORTING LIMIT/DF: 1 UNITS:mg/L				DATE/TIME ANALYZED:07/27/93 16:33 METHOD REFERENCE :EPA 360.1						QC BATCH NUMBER:929151 TECHNICIAN:CIS
LANK	METHOD	072793	<1							
DUPLICATE	MATRIX	931530-3	3	3	0					
ARAMETER:Conductivity EPORTING LIMIT/DF: 10 UNITS:umho/cm @77F				DATE/TIME ANALYZED:07/27/93 17:14 METHOD REFERENCE :EPA 120.1						QC BATCH NUMBER:929153 TECHNICIAN:VB
BLANK	METHOD	072793	<10							
TANDARD	LCS	130061	1400			1400	100			
UPLICATE	MATRIX	931530-3	1400	1400	0					
PARAMETER:Chloride (Cl), total EPORTING LIMIT/DF: 5.0 UNITS:mg/L				DATE/TIME ANALYZED:07/28/93 16:16 METHOD REFERENCE :EPA 325.3						QC BATCH NUMBER:929173 TECHNICIAN:CEM
LANK	METHOD	072893A	<5.0							
STANDARD	REFERENCE	130167	150			150	100			
SPIKE	MATRIX	931530-3	340					190	150	100
ICATE	MATRIX	931530-3	190	180	5					
AMETER:Nitrate (NO3-N), total REPORTING LIMIT/DF: 0.1 UNITS:mg/L				DATE/TIME ANALYZED:07/28/93 17:41 METHOD REFERENCE :EPA 353.1						QC BATCH NUMBER:929177 TECHNICIAN:CEM
LANK	METHOD	072893A	<0.1							
TANDARD	REFERENCE	SI30121	6.0			6.5	92			
STANDARD	CALIB	130072	1.0			1.0	100			
SPIKE	MATRIX	931530-2	3.6					2.5	1.0	110
JPLICATE	MATRIX	931530-2	2.5	2.4	4					
ARAMETER:Total Dissolved Solids (TDS) REPORTING LIMIT/DF: 10 UNITS:mg/L				DATE/TIME ANALYZED:07/27/93 16:09 METHOD REFERENCE :EPA 160.1						QC BATCH NUMBER:929190 TECHNICIAN:VB
LANK	METHOD	072793	<10							
TANDARD	LCS	SI20058	1000			1000	100			
DUPLICATE	MATRIX	931530-1	1200	1200	0					
RAMETER:pH (H2O sample) EPORTING LIMIT/DF: UNITS:pH units				DATE/TIME ANALYZED:07/27/93 09:33 METHOD REFERENCE :EPA 150.1						QC BATCH NUMBER:929201 TECHNICIAN:MQ
STANDARD	LCS	130189	5.1			5.0	102			
TANDARD	LCS	120021	4.1			4.0	102			
IPLICATE	MATRIX	931530-3	7.8	7.8	0					
PARAMETER:Manganese (Mn) REPORTING LIMIT/DF: 0.005 UNITS:mg/L				DATE/TIME ANALYZED:08/03/93 15:33 METHOD REFERENCE :EPA 6020						QC BATCH NUMBER:929371 TECHNICIAN:AYJ
ANK	INSTRUMENT	IB080393	<0.005							
LANK	METHOD	M8073093	<0.005							

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QUALITY ASSURANCE REPORT
08/19/93

JOB NUMBER: 931530 CUSTOMER: Cotton and Frazier Consultants ATTN: Lee Cranmer

ANALYSIS				DUPLICATES		REFERENCE STANDARDS		MATRIX SPIKES		
ANALYSIS TYPE	ANALYSIS SUB-TYPE	ANALYSIS I.D.	ANALYZED VALUE (A)	DUPLICATE VALUE (B)	RPD or (|A-B|)	TRUE VALUE	PERCENT RECOVERY	ORIGINAL VALUE	SPIKE ADDED	PERCENT RECOVERY
PARAMETER:Manganese (Mn) REPORTING LIMIT/DF: 0.005 UNITS:mg/L				DATE/TIME ANALYZED:08/03/93 15:33 METHOD REFERENCE :EPA 6020						QC BATCH NUMBER:929371 TECHNICIAN:AYJ
BLANK	CCB	CB080393	<0.005							
STANDARD	LCS	M93017	0.11			0.10	110			
STANDARD	ICVS	M93087	0.022			0.020	110			
SPIKE	MATRIX	931530-3	0.15					0.044	0.10	106
DUPLICATE	MATRIX	931530-3	0.044	0.047	7					
PARAMETER:Copper (Cu) REPORTING LIMIT/DF: 0.005 UNITS:mg/L				DATE/TIME ANALYZED:08/03/93 15:33 METHOD REFERENCE :EPA 6020						QC BATCH NUMBER:929372 TECHNICIAN:AYJ
BLANK	INSTRUMENT	IB080393	<0.005							
BLANK	METHOD	MB073093	<0.005							
BLANK	CCB	CB080393	<0.005							
STANDARD	LCS	M93017	0.11			0.10	110			
STANDARD	ICVS	M93084	0.020			0.020	100			
SPIKE	MATRIX	931530-1	0.13					0.017	0.10	113
DUPLICATE	MATRIX	931530-3	0.017	0.017	0.000					
METER:Zinc (Zn) REPORTING LIMIT/DF: 0.010 UNITS:mg/L				DATE/TIME ANALYZED:08/03/93 15:33 METHOD REFERENCE :EPA 6020						QC BATCH NUMBER:929373 TECHNICIAN:AYJ
BLANK	INSTRUMENT	IB080393	<0.010							
LANK	METHOD	MB073093	<0.010							
LANK	CCB	CB080393	<0.010							
STANDARD	LCS	M93017	0.10			0.10	100			
STANDARD	ICVS	M93084	0.022			0.020	110			
PIKE	MATRIX	931530-3	0.17					0.060	0.10	110
UPLICATE	MATRIX	931530-3	0.060	0.055	9					
PARAMETER:Sulfate (SO4), dissolved REPORTING LIMIT/DF: 20 UNITS:mg/L				DATE/TIME ANALYZED:08/05/93 14:28 METHOD REFERENCE :EPA 375.3						QC BATCH NUMBER:929382 TECHNICIAN:CEM
LANK	METHOD	080693A	<20							
STANDARD	REFERENCE	I30167	200			200	100			
SPIKE	MATRIX	931530-1	350					150	200	100
UPLICATE	MATRIX	931530-1	150	150	0					
PARAMETER:Aluminum (Al) REPORTING LIMIT/DF: 0.050 UNITS:mg/L				DATE/TIME ANALYZED:08/06/93 17:53 METHOD REFERENCE :EPA 6020						QC BATCH NUMBER:929401 TECHNICIAN:RVJ
LANK	INSTRUMENT	IB080693	<0.050							
LANK	METHOD	MB080693	<0.050							
BLANK	CCB	CB080693	<0.050							
STANDARD	LCS	M93017	0.096			0.10	96			
PIKE	MATRIX	931533-1	0.20					0.12	0.10	80
UPLICATE	MATRIX	931533-1	0.12	0.10	0.020					

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QUALITY ASSURANCE REPORT

08/19/93

JOB NUMBER: 931530 CUSTOMER: Cotton and Frazier Consultants ATTN: Lee Cranmer

ANALYSIS				DUPLICATES		REFERENCE STANDARDS		MATRIX SPIKES		
ANALYSIS TYPE	ANALYSIS SUB-TYPE	ANALYSIS I.D.	ANALYZED VALUE (A)	DUPLICATE VALUE (B)	RPD or (|A-B|)	TRUE VALUE	PERCENT RECOVERY	ORIGINAL VALUE	SPIKE ADDED	PERCENT RECOVERY
PARAMETER:Potassium (K), total REPORTING LIMIT/DF: 0.20 UNITS:mg/L				DATE/TIME ANALYZED:08/10/93 12:11 METHOD REFERENCE :EPA 258.1						QC BATCH NUMBER:929463 TECHNICIAN:RVJ
BLANK	INSTRUMENT	IB081093	<0.20							
BLANK	METHOD	MB081093	<0.20							
BLANK	CCB	CB081093	<0.20							
STANDARD	LCS	I30198	2.5			2.6	96			
STANDARD	ICVS	M93106	1.0			1.0	100			
STANDARD	CCVS	M93107	1.9			2.0	95			
SPIKE	MATRIX	931530-3	4.8					2.4	2.5	96
DUPLICATE	MATRIX	931530-3	4.9	5.0	2					
PARAMETER:Sodium (Na), total REPORTING LIMIT/DF: 0.10 UNITS:mg/L				DATE/TIME ANALYZED:08/10/93 13:27 METHOD REFERENCE :EPA 273.1						QC BATCH NUMBER:929464 TECHNICIAN:RVJ
BLANK	INSTRUMENT	IB081093	<0.10							
BLANK	METHOD	MB081093	<0.10							
BLANK	CCB	CB081093	<0.10							
STANDARD	LCS	I30198	1.5			1.5	100			
DARD	ICVS	M93109	0.52			0.50	104			
DARD	CCVS	M93110	0.96			1.0	96			
SPIKE	MATRIX	931530-3	1.3					0.38	1.0	92
DUPLICATE	MATRIX	931530-3	0.75	0.75	0					
PARAMETER:Magnesium (Mg), total REPORTING LIMIT/DF: 0.10 UNITS:mg/L				DATE/TIME ANALYZED:08/10/93 14:24 METHOD REFERENCE :EPA 242.1						QC BATCH NUMBER:929465 TECHNICIAN:RVJ
BLANK	INSTRUMENT	IB081093	<0.10							
BLANK	METHOD	MB081093	<0.10							
BLANK	CCB	CB081093	<0.10							
STANDARD	LCS	I30159	0.25			0.25	100			
STANDARD	ICVS	M93116	0.98			1.0	98			
STANDARD	CCVS	M93115	0.49			0.50	98			
SPIKE	MATRIX	931530-3	1.2					0.24	1.0	96
DUPLICATE	MATRIX	931530-3	0.47	0.47	0.00					
PARAMETER:Calcium (Ca), total REPORTING LIMIT/DF: 0.20 UNITS:mg/L				DATE/TIME ANALYZED:08/10/93 13:57 METHOD REFERENCE :EPA 215.1						QC BATCH NUMBER:929466 TECHNICIAN:RVJ
BLANK	INSTRUMENT	IB081093	<0.20							
BLANK	METHOD	MB081093	<0.20							
BLANK	CCB	CB081093	<0.20							
STANDARD	LCS	I30159	1.0			1.0	100			
STANDARD	ICVS	M93110	5.1			5.0	102			
STANDARD	CCVS	M93110	5.0			5.0	100			
SPIKE	MATRIX	931530-3	6.0					1.1	5.0	98
DUPLICATE	MATRIX	931530-3	2.1	2.1	0					

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QUALITY ASSURANCE REPORT
08/19/93

IOB NUMBER: 931530 CUSTOMER: Cotton and Frazier Consultants ATTN: Lee Cranmer

ANALYSIS				DUPLICATES		REFERENCE STANDARDS		MATRIX SPIKES		
ANALYSIS TYPE	ANALYSIS SUB-TYPE	ANALYSIS I.D.	ANALYZED VALUE (A)	DUPLICATE VALUE (B)	RPD or (|A-B|)	TRUE VALUE	PERCENT RECOVERY	ORIGINAL VALUE	SPIKE ADDED	PERCENT RECOVERY
PARAMETER:Hardness(Ca,Mg calculation) EPORTING LIMIT/DF: 1.0 UNITS:mg/L CaCO3				DATE/TIME ANALYZED:08/10/93 17:13 METHOD REFERENCE :Std. Method 2340B						QC BATCH NUMBER:929467 TECHNICIAN:RVJ
STANDARD	LCS	I30159	365			361	101			
DUPLICATE	MATRIX	931530-3	720	720	0					
ARAMETER:Iron (Fe), total EPORTING LIMIT/DF: 0.20 UNITS:mg/L				DATE/TIME ANALYZED:08/10/93 17:14 METHOD REFERENCE :EPA 236.1						QC BATCH NUMBER:929468 TECHNICIAN:RVJ
BLANK	INSTRUMENT	IB081093	<0.20							
LANK	METHOD	MB081093	<0.20							
TANDARD	LCS	M93076	1.0			1.0	100			
STANDARD	ICVS	M93064	5.0			5.0	100			
STANDARD	CCVS	M93076	1.1			1.0	110			
PIKE	MATRIX	931530-3	3.4					2.4	1.0	100
UPLICATE	MATRIX	931530-3	4.9	4.6	6					
PARAMETER:REDOX Potential PEPORTING LIMIT/DF: 1 UNITS:mv				DATE/TIME ANALYZED:08/19/93 16:22 METHOD REFERENCE :ASTM D-1498-76						QC BATCH NUMBER:929627 TECHNICIAN:*CC
DARD	LCS	281.97.23	474			475	100			
STANDARD	LCS	281.97.26	93			86	108			
STANDARD	LCS	281.97.25	259			263	98			
UPLICATE	MD	931979-1	110	112	2					

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QUALITY ASSURANCE REPORT
08/19/93

JOB NUMBER: 931530 CUSTOMER: Cotton and Frazier Consultants ATTN: Lee Cranmer

Volatile Aromatics by EPA 602 DATE ANALYZED: 08/03/93 TIME ANALYZED: 00:00 METHOD: EPA 602 QC NUMBER:929357

BLANKS

TEST DESCRIPTION	ANALY SUB-TYPE	ANALYSIS I.D.	DILUTION FACTOR	ANALYZED VALUE	DETECTION LIMIT	UNITS OF MEASURE
Benzene	METHOD	080393	1	<0.5	0.5	ug/L
Ethylbenzene	METHOD	080393	1	<0.5	0.5	ug/L
1,2-Dichlorobenzene	METHOD	080393	1	<0.5	0.5	ug/L
Toluene	METHOD	080393	1	<0.5	0.5	ug/L
Total Xylenes	METHOD	080393	1	<0.5	0.5	ug/L
m-Chlorotoluene (SURROGATE)	METHOD	080393	1	108	0	% Recovery

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QUALITY ASSURANCE REPORT
08/19/93

JOB NUMBER: 931530 CUSTOMER: Cotton and Frazier Consultants ATTN: Lee Cranmer

Volatile Aromatics by EPA 602 DATE ANALYZED: 08/03/93 TIME ANALYZED: 00:00 METHOD: EPA 602 QC NUMBER:929357

MATRIX SPIKES

TEST DESCRIPTION	ANALYSIS SUB-TYPE	ANALYSIS I. D.	DILUTION FACTOR	ANALYZED VALUE	ORIGINAL VALUE	SPIKE ADDED	PERCENT RECOVERY	DETECTION LIMITS	UNITS OF MEASURE
Benzene	MATRIX	931530-3	1	50	0	50	100	0.5	ug/L
	MATRIX DUP	931530-3	1	50	0	50	100	0.5	ug/L
Toluene	MATRIX	931530-3	1	53	0	50	106	0.5	ug/L
	MATRIX DUP	931530-3	1	52	0	50	104	0.5	ug/L
m-Chlorotoluene (SURROGATE)	MATRIX	931530-3	1	55	0	50	110	0	% Recovery
	MATRIX DUP	931530-3	1	51	0	50	102	0	% Recovery

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QUALITY ASSURANCE REPORT

08/19/93

OB NUMBER: 931530 CUSTOMER: Cotton and Frazier Consultants ATTN: Lee Cranmer

Alkalinity by Titration EPA 310.1 DATE ANALYZED: 08/06/93 TIME ANALYZED: 09:57 METHOD: EPA 310.1 QC NUMBER:929370

BLANKS

EST DESCRIPTION	ANALY SUB-TYPE	ANALYSIS I.D.	DILUTION FACTOR	ANALYZED VALUE	DETECTION LIMIT	UNITS OF MEASURE
icarbonate (as CaCO3), dissolved	METHOD	080693A	1	<10	10	mg/L

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QUALITY ASSURANCE REPORT

08/19/93

JOB NUMBER: 931530 CUSTOMER: Cotton and Frazier Consultants ATTN: Lee Cranmer

Alkalinity by Titration EPA 310.1 DATE ANALYZED: 08/06/93 TIME ANALYZED: 09:57 METHOD: EPA 310.1 QC NUMBER:929370

REFERENCE STANDARDS

TEST DESCRIPTION	ANALYSIS SUB-TYPE	ANALYSIS I. D.	DILUTION FACTOR	ANALYZED VALUE	TRUE VALUE	PERCENT RECOVERY	DETECTION LIMITS	UNITS OF MEASURE
Bicarbonate (as CaCO3), dissolved	REFERENCE	I30167A	1	150	150	100	10	mg/L

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QUALITY ASSURANCE REPORT

08/19/93

JOB NUMBER: 931530 CUSTOMER: Cotton and Frazier Consultants ATTN: Lee Cranmer

Alkalinity by Titration EPA 310.1 DATE ANALYZED: 08/06/93 TIME ANALYZED: 09:57 METHOD: EPA 310.1 QC NUMBER:929370

DUPLICATES

TEST DESCRIPTION	ANALYSIS SUB-TYPE	ANALYSIS I. D.	DILUTION FACTOR	ANALYZED VALUE (A)	DUPLICATE VALUE (B)	RPD or (|A-B|)	DETECTION LIMITS	UNITS OF MEASURE
Bicarbonate (as CaCO3), dissolved	MATRIX	931530-1	1	460	460	0	10	mg/L

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QUALITY ASSURANCE REPORT

EPA Method 625

DATE ANALYZED: 08/09/93

METHOD: EPA 625

QC NUMBER:

BLANKS

TEST DESCRIPTION	ANALY SUB-TYPE	ANALYSIS I.D.	DILUTION FACTOR	ANALYZED VALUE	DETECTION LIMIT	UNITS OF MEASURE
Acenaphthene	METHOD	072893	1	ND	10	ug/L
Acenaphthylene	METHOD	072893	1	ND	10	ug/L
Anthracene	METHOD	072893	1	ND	10	ug/L
Benzidine	METHOD	072893	1	ND	20	ug/L
Benzo(a)anthracene	METHOD	072893	1	ND	10	ug/L
Benzo(b)fluoranthene	METHOD	072893	1	ND	10	ug/L
Benzo(k)fluoranthene	METHOD	072893	1	ND	10	ug/L
Benzoic acid	METHOD	072893	1	ND	20	ug/L
Benzo(ghi)perylene	METHOD	072893	1	ND	10	ug/L
Benzo(a)pyrene	METHOD	072893	1	ND	10	ug/L
Benzyl alcohol	METHOD	072893	1	ND	10	ug/L
Bis(2-chloroisopropyl)ether	METHOD	072893	1	ND	10	ug/L
Bis(2-ethylhexyl)phthalate	METHOD	072893	1	ND	10	ug/L
4-Bromophenyl phenyl ether	METHOD	072893	1	ND	10	ug/L
Butyl benzyl phthalate	METHOD	072893	1	ND	10	ug/L
4-Chloroaniline	METHOD	072893	1	ND	20	ug/L
loro-3-methylphenol	METHOD	072893	1	ND	10	ug/L
loronaphthalene	METHOD	072893	1	ND	10	ug/L
2-Chlorophenol	METHOD	072893	1	ND	10	ug/L
4-Chlorophenyl phenyl ether	METHOD	072893	1	ND	10	ug/L
Chrysene	METHOD	072893	1	ND	10	ug/L
Di-n-butyl phthalate	METHOD	072893	1	ND	10	ug/L
1,2-Dichlorobenzene	METHOD	072893	1	ND	10	ug/L
1,3-Dichlorobenzene	METHOD	072893	1	ND	10	ug/L
1,4-Dichlorobenzene	METHOD	072893	1	ND	10	ug/L
3,3'-Dichlorobenzidine	METHOD	072893	1	ND	20	ug/L
2,4-Dichlorophenol	METHOD	072893	1	ND	20	ug/L
Dibenzo(a,h)anthracene	METHOD	072893	1	ND	10	ug/L
Dibenzofuran	METHOD	072893	1	ND	10	ug/L
Diethyl phthalate	METHOD	072893	1	ND	10	ug/L
2,4-Dimethylphenol	METHOD	072893	1	ND	10	ug/L
Dimethyl phthalate	METHOD	072893	1	ND	10	ug/L
4,6-Dinitro-2-methylphenol	METHOD	072893	1	ND	20	ug/L
2,4-Dinitrophenol	METHOD	072893	1	ND	10	ug/L
2,4-Dinitrotoluene	METHOD	072893	1	ND	10	ug/L
2,6-Dinitrotoluene	METHOD	072893	1	ND	10	ug/L
Di-n-octyl phthalate	METHOD	072893	1	ND	10	ug/L
Fluorene	METHOD	072893	1	ND	10	ug/L
luoranthene	METHOD	072893	1	ND	10	ug/L
exachlorobenzene	METHOD	072893	1	ND	10	ug/L
Hexachlorobutadiene	METHOD	072893	1	ND	10	ug/L
Hexachloroethane	METHOD	072893	1	ND	10	ug/L
Indeno(1,2,3-cd)pyrene	METHOD	072893	1	ND	10	ug/L
sophorone	METHOD	072893	1	ND	10	ug/L
-Methylnaphthalene	METHOD	072893	1	ND	10	ug/L
2-Methylphenol	METHOD	072893	1	ND	10	ug/L
4-Methylphenol	METHOD	072893	1	ND	10	ug/L
-Nitroaniline	METHOD	072893	1	ND	10	ug/L

QUALITY ASSURANCE REPORT

EPA Method 625   DATE ANALYZED: 08/09/93   METHOD: EPA 625   QC NUMBER:

BLANKS

TEST DESCRIPTION	ANALY SUB-TYPE	ANALYSIS I.D.	DILUTION FACTOR	ANALYZED VALUE	DETECTION LIMIT	UNITS OF MEASURE
3-Nitroaniline	METHOD	072893	1	ND	50	ug/L
4-Nitroaniline	METHOD	072893	1	ND	50	ug/L
2-Nitrophenol	METHOD	072893	1	ND	10	ug/L
4-Nitrophenol	METHOD	072893	1	ND	10	ug/L
N-Nitrosodimethylamine	METHOD	072893	1	ND	50	ug/L
N-Nitrosodi-n-propylamine	METHOD	072893	1	ND	10	ug/L
N-Nitrosodiphenylamine	METHOD	072893	1	ND	10	ug/L
Naphthalene	METHOD	072893	1	ND	10	ug/L
Nitrobenzene	METHOD	072893	1	ND	10	ug/L
Pentachlorophenol	METHOD	072893	1	ND	20	ug/L
Phenanthrene	METHOD	072893	1	ND	10	ug/L
Phenol	METHOD	072893	1	ND	10	ug/L
Pyrene	METHOD	072893	1	ND	10	ug/L
1,2,4-Trichlorobenzene	METHOD	072893	1	ND	10	ug/L
2,4,5-Trichlorophenol	METHOD	072893	1	ND	10	ug/L
2 ' .6-Trichlorophenol	METHOD	072893	1	61	21-110	% recovery
uorophenol (SURROGATE)	METHOD	072893	1	78	10-110	% recovery
Phenol (SURROGATE)	METHOD	072893	1	76	34-114	% recovery
d5-Nitrobenzene (SURROGATE)	METHOD	072893	1	91	43-116	% recovery
2-Fluorobiphenyl (SURROGATE)	METHOD	072893	1	102	10-123	% recovery
2,4,6-Tribromophenol (SURROGATE)	METHOD	072893	1	84	33-141	% recovery
d14-Terphenyl (SURROGATE)	METHOD	072893				

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Water Semivolatile LCS/LCD Percent Recovery (EPA 625)

Date Analyzed: 8-5-93

Date Extracted : 7-26-93

Compound	Spike Added (ug/l)	LCS Conc. (ug/l)	LCS % Rec	#	LCD Conc. (ug/l)	LCD % Rec	#
S1(P)	100	76	76		77	77	
S2(CP)	100	58	58		60	60	
S3(DCB)	50	34	68		37	74	
S4(NNDP)	50	23	46		34	68	
S5(TCB)	50	40	80		43	86	
S6(CMP)	100	64	64		63	63	
S7(A)	50	37	74		38	76	
S8(NP)	100	86	86		69	69	
S9(DNT)	50	53	106		54	108	
S10(PCP)	100	63	63		72	72	
S11(P)	50	17	34		19	38	

Compound	LCS/LCD RPD	#	QC Limits RPD	% Rec
S1(P)	1		42	12-89
S2(CP)	3		40	27-123
S3(DCB)	8		28	36-97
S4(NNDP)	39		38	41-116
S5(TCB)	7		28	39-98
S6(CMP)	2		42	23-97
S7(A)	3		31	46-118
S8(NP)	22		50	10-80
S9(DNT)	2		38	24-96
S10(PCP)	13		50	9-103
S11(P)	11		31	26-127

S1 = Phenol
S2 = 2-Chlorophenol
S3 = 1,4-Dichlorobenzene
S4 = N-Nitroso-di-n-propylamine
S5 = 1,2,4-Trichlorobenzene

S6 = 4-Chloro-3-methylphenol
S7 = Acenaphthene
S8 = 4-Nitrophenol
S9 = 2,4-Dinitrotoluene
S10 = Pentachlorophenol
S11 = Pyrene

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QUALITY ASSURANCE FOOTER

All methods are taken from one of the following references:

(1) EPA SW-846, Test Methods for Evaluating Solid Waste, Third Edition, November 1990
(2) Standard Methods for the Examination of Water and Wastewater, 17th Edition, 1989
(3) EPA 600/4-79-020, Methods of Chemical Analysis for Waters and Wastes, March 1983
(4) Federal Register, Friday, October 26, 1984 (40 CFR Part 136)
(5) American Society for Testing and Materials, Volumes 5.01, 5.02, 5.03, 1992
(6) EPA 600/4-89-001, *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Fresh Water Organisms*
(7) EPA 600/4-90-027, Methods for Measuring the Acute Toxicity of Effluent and Receiving Waters to Fresh Water and Marine Organisms, Fourth Edition

All methods of chemical analysis have a statistical uncertainty associated with the results. Unless otherwise indicated, the data in this report is within the limits of uncertainty as specified in the referenced method. Quality control acceptance criteria are based either on actual laboratory performance or on limits specified in the referenced method.

Notes: The date and time of analysis indicated on the QA report may not reflect the actual time of analysis for QC samples.
All data reported on an "as received" basis unless otherwise indicated.
Data reported in the QA report may lower than sample data due to dilution of samples into the calibration range of the analysis.
Sample concentrations for solid samples are calculated on an as received basis.

FLAGS, FOOTNOTES, AND ABBREVIATIONS (as needed)

C = Not calculable due to values lower than the detection limit
J = Not detected
NA = Not analyzed
N/A = Not applicable
ug/L = Micrograms per liter
mg/L = Milligrams per liter
N.I. = Not Ignitable
S.I. = Sustains Ignition
I(NS) = Ignites but does not sustain ignition
RPD = Relative Percent Difference
(a) = Surrogate recoveries were outside acceptable ranges due to matrix effects.
(b) = Surrogate recoveries were not calculated due to dilution of the sample below the detectable range for the surrogate.
(c) = Matrix spike recoveries were outside acceptable ranges due to matrix effects.
(d) = Relative Percent Difference (RPD) for duplicate analysis outside acceptance limits due to actual differences in the sample matrix.
(e) = The limit listed for flammability indicates the upper limit for the test. Samples are not tested at temperatures above 140 Fahrenheit since only samples which will sustain ignition at temperatures below 140 are considered flammable.
(f) = Results for this hydrocarbon range did not match a typical hydrocarbon pattern. Results were quantified using a diesel standard, however, the hydrocarbon pattern did not match a diesel pattern.
(g) = Results for this hydrocarbon range did not match a typical hydrocarbon pattern. Results were quantified using a gasoline standard, however, the hydrocarbon pattern did not match a gasoline pattern.
(h) = High dilution due to matrix effects
(i) = Samples with results below 500 mg/L are considered hazardous

SUBCONTRACTED LABORATORY LOCATIONS

Core Laboratories:	Aurora, Colorado	*AU	Other:	Aquatic Testing Laboratories, Ventura, California	*AT
	Casper, Wyoming	*CA		Associated Laboratories, Orange, California	*AL
	Houston, Texas	*HP		Centrum Analytical Laboratories, Redlands, California	*CA
	Long Beach, California	*LB		Pyramid Laboratories, Costa Mesa, California	*PL

931:30

Cotton and Frazier Consultants, Inc.
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Honolulu, Hawaii 96827

Telephone: (808) 599-1993 FAX: (808) 599-1502

Chain of Custody Record/ Analysis Record

PROJECT NAME: FLYNN - LEARNER R/A
LOCATION: SAND ISLAND JOB NUMBER: 9306A
SAMPLER: John Rau + Ken Koga PROJECT MGR: Lee Cranmer

SAMPLE #	LAB SAMPLE ID#	TIME COLLECTED	DATE COLLECTED	MATRIX: S=SOIL W=WATER A=AIR	CONTAINERS 40 ml. VOA	1 L. Plas	125 m Plas	1 L Glass			Analysis Requested 8020 - BTEX +	Major An/Cat & PH	Disolved Oxygen	REDOX Potential	EPA 625 GCMS w/ Forward Search *					Hold for Further Analysis	RUSH (See Below)
64W01		1355	7-26-93	W	3	3	1	1			✓	✓	✓	✓	✓						
64W02		1405	7-26-93	W	3	3	1	1			✓	✓	✓	✓	✓						
64W03		1415	7-26-93	W	3	3	1	1			✓	✓	✓	✓	✓						

Relinquished By Sampler: Signature: John P. Rau Printed Name: John P. Rau Date/Time: 7/26/93 1420	Relinquished By: Signature: Printed Name: Date/Time:	Relinquished By: Signature: Printed Name: Date/Time:
Received By: Signature: Printed Name: ERRIN SIMKINS Date/Time: 7/27/93 1000	Received By: Signature: Printed Name: Date/Time:	Received By: Signature: Printed Name: Date/Time:

LABORATORY:
Total # Containers:
Samples Received Chilled? Yes No
Samples in good condition? Yes No

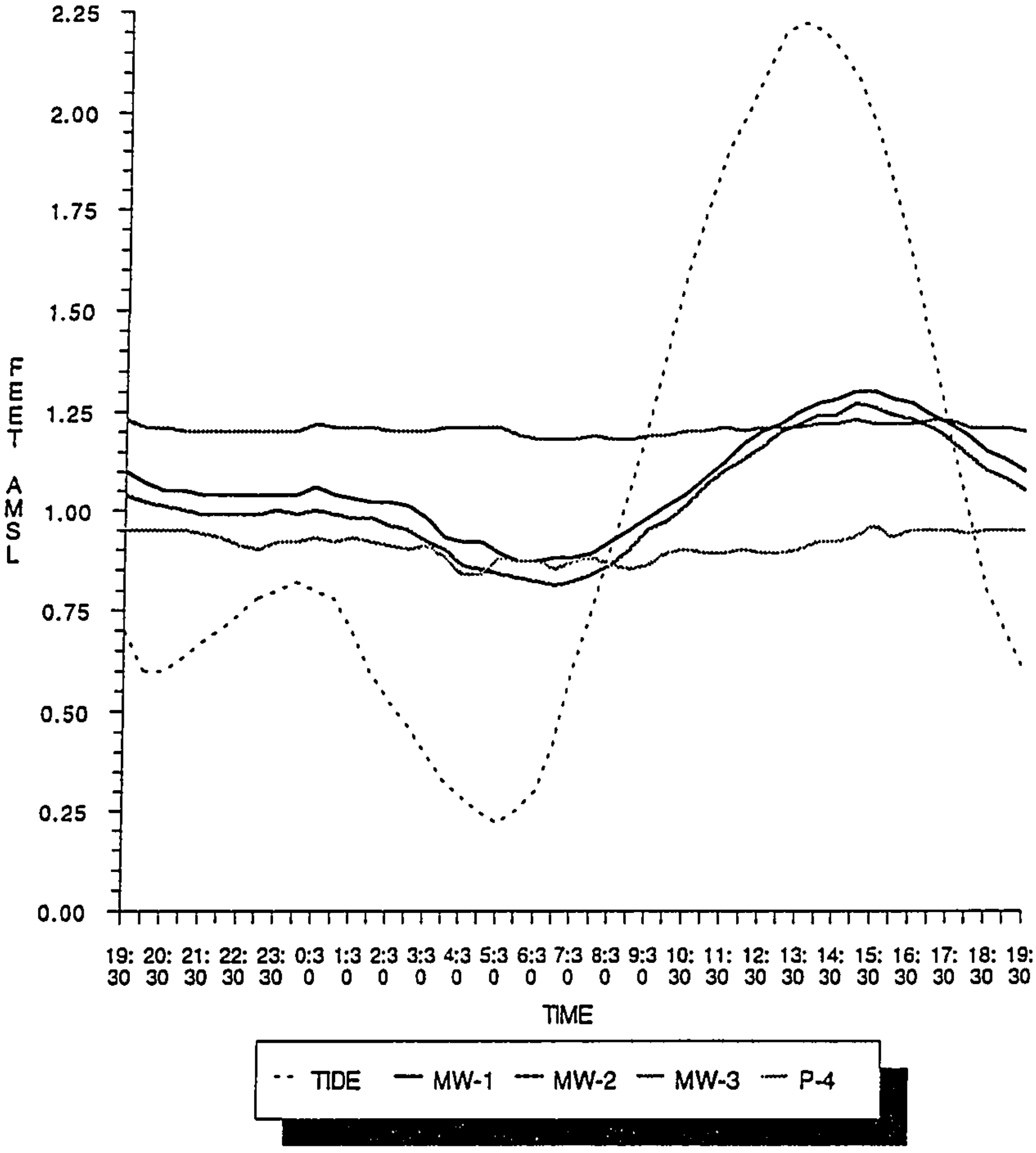
Special Handling
Turnaround:
24 hour 48 hour
72 hour Regular
Other ___________

Comments:
* ADDRESS ANY QUESTIONS ON PROCEDURE TO DONN MARRIN

Page 1 of 1.

APPENDIX F

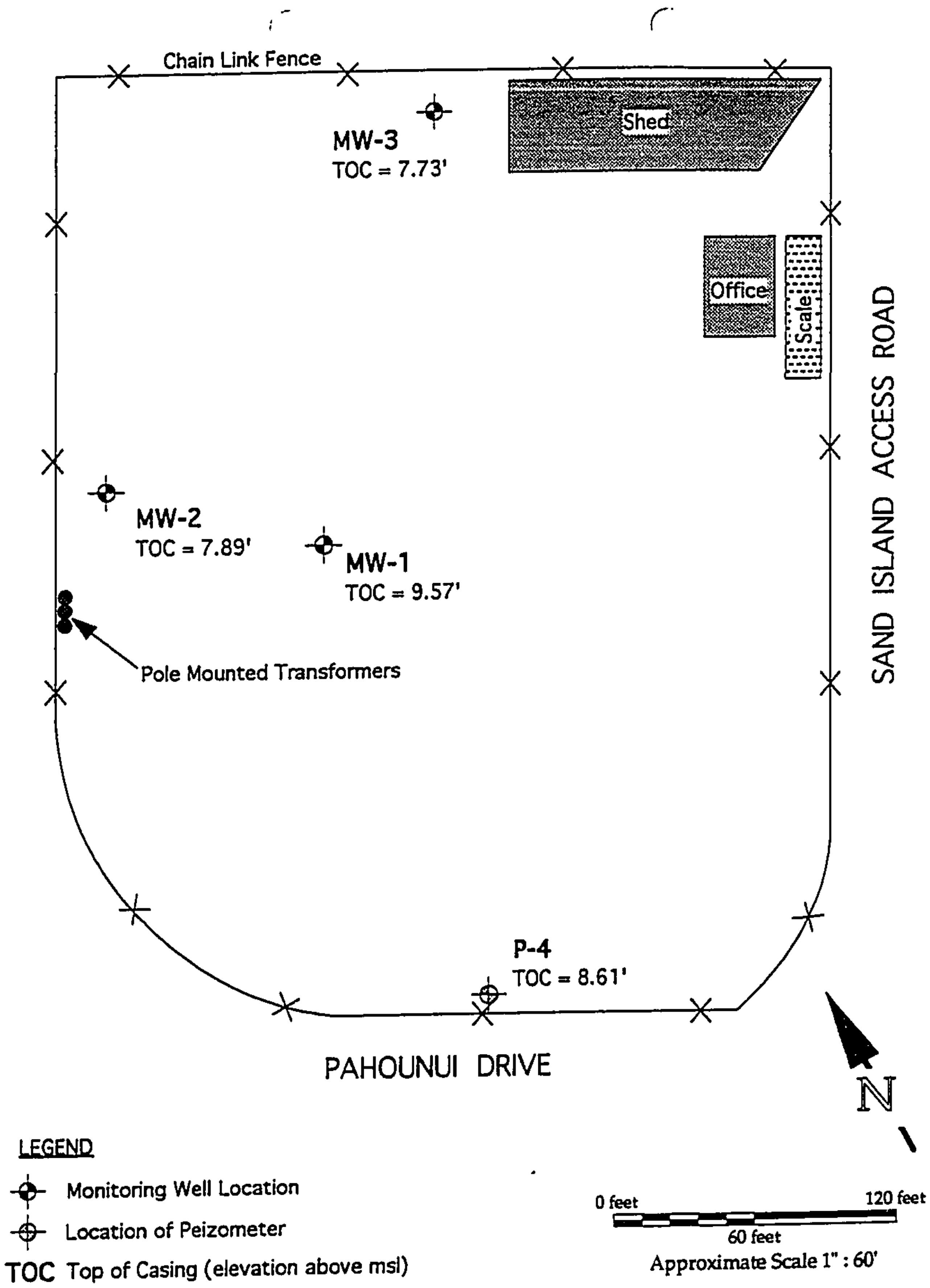
October 22, 1993
CFC Job#93064



COTTON and FRAZIER **Consultants, Inc.** October 22, 1993	**TIDAL INFLUENCE August 12-13, 1993** FLYNN-LEARNER Sand Island, Oahu, Hawaii	Figure F-1

Table F-1 Tidal Influence Data

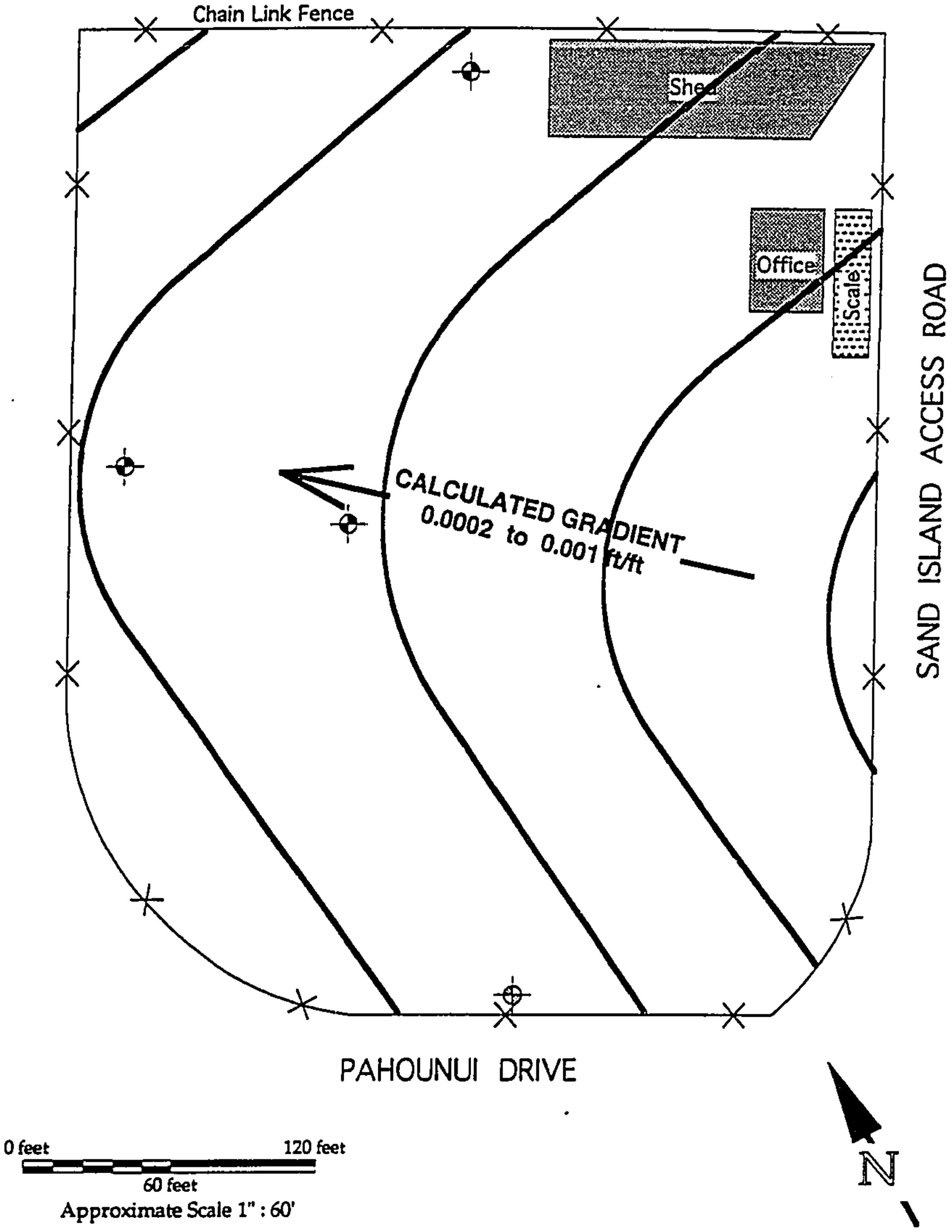
Date	Time	MW-1 Depth	MW-1 Elev	MW-2 Depth	MW-2 Elev	MW-3 Depth	MW-3 Elev	P-4 Depth	P-4 Elev	TIDE ELEV
8/12/93	19:30	8.47	1.10	6.85	1.04	6.50	1.23	7.66	0.95	0.70
	20:00	8.50	1.07	6.87	1.02	6.52	1.21	7.66	0.95	0.60
	20:30	8.52	1.05	6.88	1.01	6.52	1.21	7.66	0.95	0.60
	21:00	8.52	1.05	6.89	1.00	6.53	1.20	7.66	0.95	0.63
	21:30	8.53	1.04	6.90	0.99	6.53	1.20	7.67	0.94	0.67
	22:00	8.53	1.04	6.90	0.99	6.53	1.20	7.68	0.93	0.70
	22:30	8.53	1.04	6.90	0.99	6.53	1.20	7.70	0.91	0.74
	23:00	8.53	1.04	6.90	0.99	6.53	1.20	7.71	0.90	0.78
	23:30	8.53	1.04	6.89	1.00	6.53	1.20	7.69	0.92	0.80
8/13/93	0:00	8.53	1.04	6.90	0.99	6.53	1.20	7.69	0.92	0.82
	0:30	8.51	1.06	6.89	1.00	6.51	1.22	7.68	0.93	0.80
	1:00	8.53	1.04	6.90	0.99	6.52	1.21	7.69	0.92	0.78
	1:30	8.54	1.03	6.91	0.98	6.52	1.21	7.68	0.93	0.70
	2:00	8.55	1.02	6.91	0.98	6.52	1.21	7.69	0.92	0.60
	2:30	8.55	1.02	6.93	0.96	6.53	1.20	7.70	0.91	0.53
	3:00	8.56	1.01	6.94	0.95	6.53	1.20	7.71	0.90	0.47
	3:30	8.59	0.98	6.97	0.92	6.53	1.20	7.70	0.91	0.40
	4:00	8.64	0.93	6.99	0.90	6.52	1.21	7.73	0.88	0.33
	4:30	8.65	0.92	7.03	0.86	6.52	1.21	7.77	0.84	0.29
	5:00	8.65	0.92	7.04	0.85	6.52	1.21	7.77	0.84	0.25
	5:30	8.68	0.89	7.05	0.84	6.52	1.21	7.73	0.88	0.22
	6:00	8.70	0.87	7.06	0.83	6.54	1.19	7.74	0.87	0.25
	6:30	8.70	0.87	7.07	0.82	6.55	1.18	7.74	0.87	0.30
	7:00	8.69	0.88	7.08	0.81	6.55	1.18	7.76	0.85	0.42
	7:30	8.69	0.88	7.07	0.82	6.55	1.18	7.74	0.87	0.60
	8:00	8.68	0.89	7.05	0.84	6.54	1.19	7.73	0.88	0.75
	8:30	8.65	0.92	7.03	0.86	6.55	1.18	7.75	0.86	0.90
	9:00	8.62	0.95	6.99	0.90	6.55	1.18	7.76	0.85	1.05
	9:30	8.59	0.98	6.94	0.95	6.54	1.19	7.75	0.86	1.22
	10:00	8.56	1.01	6.92	0.97	6.54	1.19	7.72	0.89	1.40
	10:30	8.53	1.04	6.88	1.01	6.53	1.20	7.71	0.90	1.60
	11:00	8.49	1.08	6.83	1.06	6.53	1.20	7.72	0.89	1.75
	11:30	8.45	1.12	6.79	1.10	6.52	1.21	7.72	0.89	1.90
	12:00	8.40	1.17	6.76	1.13	6.53	1.20	7.71	0.90	2.00
	12:30	8.37	1.20	6.73	1.16	6.52	1.21	7.72	0.89	2.10
	13:00	8.35	1.22	6.69	1.20	6.52	1.21	7.72	0.89	2.20
	13:30	8.32	1.25	6.67	1.22	6.52	1.21	7.71	0.90	2.22
	14:00	8.30	1.27	6.65	1.24	6.51	1.22	7.69	0.92	2.20
	14:30	8.29	1.28	6.65	1.24	6.51	1.22	7.69	0.92	2.15
	15:00	8.27	1.30	6.62	1.27	6.50	1.23	7.68	0.93	2.08
	15:30	8.27	1.30	6.63	1.26	6.51	1.22	7.65	0.96	1.95
	16:00	8.29	1.28	6.65	1.24	6.51	1.22	7.68	0.93	1.78
	16:30	8.30	1.27	6.66	1.23	6.51	1.22	7.66	0.95	1.60
	17:00	8.33	1.24	6.68	1.21	6.50	1.23	7.66	0.95	1.40
	17:30	8.35	1.22	6.71	1.18	6.50	1.23	7.66	0.95	1.20
	18:00	8.38	1.19	6.75	1.14	6.52	1.21	7.67	0.94	1.00
	18:30	8.42	1.15	6.79	1.10	6.52	1.21	7.66	0.95	0.80
	19:00	8.44	1.13	6.81	1.08	6.52	1.21	7.66	0.95	0.70
	19:30	8.47	1.10	6.84	1.05	6.53	1.20	7.66	0.95	0.60



COTTON and FRAZIER
Consultants, Inc.
October 22, 1993

TIDAL INFLUENCE MEASURING POINTS
FLYNN-LEARNER
Sand Island, Oahu, Hawaii

Figure F-2



COTTON and FRAZIER **Consultants, Inc.** October 22, 1993	CALCULATED HYDRAULIC GRADIENT FLYNN-LEARNER Sand Island, Oahu, Hawaii	Figure F-3

APPENDIX G

BENZO(A)PYRENE

Chemical Properties:	CAS number:	50-32-8
	Molecular weight:	252.3
	Vapor pressure at 25°C:	>1 milligram Hg
	Water solubility at 25°C:	0.0038 mg/L
	Specific gravity:	1.35

Exposure Routes: Inhalation, Ingestion, and dermal absorption

Target Organs: Skin, lungs and bladder.

Acute Toxicity:

Benzo(a)pyrene (BAP) can cause skin irritation with rash, redness and/or burning sensation. Exposure to eyes can irritate or burn on contact.

Chronic Toxicity:

Repeated dermal contact can cause skin changes such as thickening, darkening, and pimples. Later skin changes include loss of color, reddish areas, thinning of the skin, and warts. Repeated inhalation may result in bronchitis.

Carcinogenicity: Classification B2; Probable human carcinogen

Human data specifically linking BAP to a carcinogenic effect are lacking, however, cancers of the lungs, skin, and bladder have all been linked to exposures of compounds containing BAP; including cigarette smoke, roofing tar, and coke oven emissions.

Developmental/Reproductive Toxicity:

There is some evidence that BAP may effect sperm and testes, as well as damage the developing fetus. Exposure may also be transferred to nursing infants through mother's milk.

Standards/Regulations:

Air			
	TLV-TWA	0.2 mg/cu.m	EPA, 1989
	REL	0.1 mg/cu.m	NIOSH, 1981
	STEL	Not available	
	IDLH	Not available	

Benzo(a)Pyrene (cont.)

Water				
	MCLG		0 ug/L	EPA, 1990
	MCL		0.2 ug/L	EPA, 1990
	SMCL		None	
	AWQC (fresh)	Drinking	0.0028 ug/L	EPA, 1980
		Acute	None	
		Chronic	None	
	AWQC (marine)	Fish Consumption	0.03 ug/L	EPA, 1980
		Acute	300 ug/L	EPA, 1980
		Chronic	None	

Drinking Water Health Advisory
None

Slope Factor			
	Oral	7.3 per mg/kg/day	
	Inhalation	Not available	
Risk Level			
	Oral (water)	1:10,000	0.5 ug/L
		1:100,000	0.05 ug/L
		1:1,000,000	0.005 ug/L
	Inhalation	Not available	
RfD			
	Oral	Not available	
RfC			
	Inhalation	Not available	

References:

IRIS database, Micromedex, Inc., Vol. 18, Expires 10/31/93.
Reprotext®, Micromedex, Inc., Vol. 18, Expires 10/31/93.
NIOSH Pocket Guide™, Micromedex, Inc., Vol. 18, Expires 10/31/93.
New Jersey Hazardous Substances Fact Sheets, Micromedex, Inc., Vol. 18, Expires 10/31/93.

POLYCHLORINATED BIPHENYLS

Chemical Properties:	CAS number:	1336-36-3
	Molecular weight:	292.0 to 360.9
	Vapor pressure at 25°C:	<1 milligram Hg
	Water solubility at 25°C:	Extremely low
	Specific gravity:	1.3 to 2.8

Exposure Routes: Inhalation, Ingestion, and dermal absorption.

Target Organs: Skin and liver.

Acute Toxicity:

Exposure to PCB vapor can irritate the eyes, nose and throat. Hig exposures can lead to liver damage.

Chronic Toxicity:

Repeated inhalation can cause liver damage. High level airborne exposure over a period of time can damage the nervous system, causing numbness, weakness, and tingling sensations in the arms and legs. Repeated dermal contact can cause a severe acne-like rash which may persist for years after exposure ceases.

Carcinogenicity: Classification B2; Probable human carcinogen

Limited evidence of dermal exposure causing skin cancer in humans.

Developmental/Reproductive Toxicity:

Animal studies have shown PCBs to be a teratogen. Evidence exists for the passage of PCBs through mothers milk.

Standards/Regulations:

Air

TLV-TWA	0.5 mg/cu. m (54% Chlorine)	ACGIH, 1991
REL	0.001 mg/cu. m	NIOSH, 1981
STEL	Not available	
IDLH	10 mg/cu. m	EPA, 1985

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Polychlorinated Biphenyls (cont.)

Water

MCLG		0 ug/L	EPA, 1991
MCL		0.5 ug/L	EPA, 1991
SMCL		None	
AWQC (fresh)	Drinking	0.000079 ug/L	EPA, 1980
	Acute	2 ug/L	EPA, 1980
	Chronic	0.014 ug/L	EPA, 1980
AWQC (marine)	Acute	10 ug/L	EPA, 1980
	Chronic	0.03 ug/L	EPA, 1980
	Fish Consumption	0.0000079 ug/L	EPA, 1980

Drinking Water Health Advisory

None

Slope Factor

Oral	7.7 per mg/kg/day
Inhalation	Not available

Risk Level

Oral (water)	1:10,000	0.5 ug/L
	1:100,000	0.05 ug/L
	1:1,000,000	0.005 ug/L
Inhalation	Not available	

RfD

Oral	Not available

RfC

Inhalation	Not available

References:

IRIS database, Micromedex, Inc., Vol. 18, Expires 10/31/93.
Reprotext®, Micromedex, Inc., Vol. 18, Expires 10/31/93.
NIOSH Pocket Guide™, Micromedex, Inc., Vol. 18, Expires 10/31/93.
New Jersey Hazardous Substances Fact Sheets, Micromedex, Inc., Vol. 18, Expires 10/31/93.

CADMIUM

Chemical Properties:	CAS number:	7440-43-9
	Molecular weight:	112.4
	Vapor pressure at 25°C:	0 millimeter Hg
	Water solubility at 25°C:	insoluble
	Specific gravity:	8.65

Exposure Routes: Inhalation and Ingestion

Target Organs: Respiratory system, kidneys, prostrate, blood

Acute Toxicity:

Cadmium has a relatively high absorption rate through exposure by inhalation, but is poorly absorbed through ingestion. Most acute intoxications have been caused by inhalation of cadmium fume. Up to several hours after inhaling cadmium, the following symptoms may appear: tracheobronchitis, pneumonitis, and pulmonary edema, with a mortality rate of approximately 20%. Average concentrations causing fatalities are estimated at 40 mg/cu. m. Inhalation of lower concentrations may produce metal fume fever, a flu-like condition involving fever, chills, sweats, aches and pains, cough, and general malaise. Symptoms usually arise within a few hours of exposure and subside within 24 to 48 hours with no permanent effects. While the exact mechanism for metal fume fever is unknown, it is thought to have an allergic basis.

Chronic Toxicity:

Cadmium is eliminated from the body very slowly, causing repeated exposures to be cumulative in effect. Absorbed cadmium is found in nearly all tissue, but is most highly concentrated in the liver, kidney and testes. The kidney cortex is the critical organ for chronic exposure. As kidney function progressively decreases, amino acids, glucose, and minerals are lost in the urine, disturbing bone metabolism and causing kidney stones. Chronic exposures have also been linked to pulmonary emphysema.

Carcinogenicity: Classification B1; Probable Human carcinogen

Evidence exists linking chronic inhalation exposures to respiratory and prostrate cancers. A two-fold excess risk of lung cancer was observed in cadmium smelter workers. There have been inadequate studies of human ingestion of cadmium to assess carcinogenicity.

Developmental/Reproductive Toxicity:

There is a small body of evidence that cadmium can cause testicular damage. Animal studies have linked chronic inhalation exposure to thyroid gland toxicity of the mother during pregnancy, and injection of cadmium during pregnancy has been embryotoxic, fetotoxic, and teratogenic in all animal species studied.

Several occupational studies have reported elevated frequencies of chromosome aberrations in workers with chronic exposures, and a recent study linked poorer performance on intellectual and motor skill tests for 6 year old children whose mothers had been exposed to cadmium during pregnancy.

Cadmium (cont.)

Standards/Regulations:

Air

TLV-TWA	0.005 mg/cu. m	ACGIH, 1990
REL	Not available	
STEL	Not available	
IDLH	50 mg/cu. m	NIOSH, 1993

Water

MCLG		5 ug/L	EPA, 1991
MCL		5 ug/L	EPA, 1991
SMCL		None	
AWQC (fresh)	Drinking	1.0 ug/L	EPA, 1980
	Acute	3.9 ug/L	EPA, 1985
	Chronic	1.1 ug/L	EPA, 1985
AWQC (marine)	Fish Consumption	None	
	Acute	43.0 ug/L	EPA, 1985
	Chronic	9.3 ug/L	EPA, 1985

Drinking Water Health Advisory
None

Slope Factor

Oral	Not available
Inhalation	Not available

Risk Level

Oral	Not available	
Inhalation	1:10,000	0.06 ug/cu. m
	1:100,000	0.006 ug/cu. m
	1:1,000,000	0.0006 ug/cu. m

Cadmium (cont.)

RfD

Oral - Water	0.0005 mg/kg/day	EPA, 1985
Oral - Food	0.001 mg/kg/day	EPA, 1985

RfC

Inhalation	Not available

References:

IRIS database, Micromedex, Inc., Vol. 18, Expires 10/31/93.
Reprotext®, Micromedex, Inc., Vol. 18, Expires 10/31/93.
NIOSH Pocket Guide™, Micromedex, Inc., Vol. 18, Expires 10/31/93.

COPPER

Chemical Properties:	CAS number:	7440-50-8
	Molecular weight:	63.5
	Vapor pressure at 25°C:	0 millimeter Hg
	Water solubility at 25°C:	insoluble
	Specific gravity:	8.94

Exposure Routes: Inhalation; Ingestion; Skin and/or eye contact

Target Organs: Eyes, skin, respiratory system, liver, kidneys

Acute Toxicity:

Inhalation of high levels if copper dust can cause respiratory irritation. Ingested copper salts can cause rapid vomiting, epigastric burning, followed by hemolysis and anemia, then liver and kidney damage.

Chronic Toxicity:

Chronic copper poisoning probably does not occur in man. There is no evidence of lung damage attributed solely to copper inhalation. Chronic exposure to low levels of copper has been reported to induce anemia. Repeated exposure to copper dust is known to cause metal fume fever, a flu-like condition involving fever, chills, sweats, aches and pains, cough, and general malaise. Symptoms usually arise within a few hours of exposure and subside within 24 to 48 hours with no permanent effects. While the exact mechanism for metal fume fever is unknown, it is thought to have an allergic basis.

Carcinogenicity: Classification D; not classified

At the present time, neither copper nor its inorganic salts are regarded as human carcinogens.

Developmental/Reproductive Toxicity:

There is a possible link between occupational exposure to copper and miscarriages in women. Metallic copper can inhibit the motility of human sperm and is used as a material for contraceptive devices. The possible role of copper in neurological diseases bears further study.

Copper (cont.)

Standards/Regulations:

Air				
	TLV-TWA	1 mg/cu.m		ACGIH, 1990
	REL	1 mg/cu.m		NIOSH, 1993
	STEL	Not available		
	IDLH	Not available		
Water				
	MCLG		1.3 mg/L	EPA, 1991
	MCL		None	
	SMCL		1 mg/L	EPA, 1991
	AWQC (fresh)	Drinking	None	
		Acute	9.2 ug/L	EPA, 1985
		Chronic	6.5 ug/L	EPA, 1985
	AWQC (marine)	Fish Consumption	None	
		Acute	2.9 ug/L	EPA, 1985
		Chronic	None	

Drinking Water Health Advisory
None

Slope Factor		
	Oral	Not applicable
	Inhalation	Not applicable
Risk Level		
	Oral	Not applicable
	Inhalation	Not applicable
RfD		
	Oral	Not available
RfC		
	Inhalation	Not available

References:

IRIS database, Micromedex, Inc., Vol. 18, Expires 10/31/93.
Reprotext®, Micromedex, Inc., Vol. 18, Expires 10/31/93.
NIOSH Pocket Guide™, Micromedex, Inc., Vol. 18, Expires 10/31/93.

LEAD

Chemical Properties:	CAS number:	7439-92-1
	Molecular weight:	207.2
	Vapor pressure at 25°C:	0 millimeter Hg
	Water solubility at 25°C:	insoluble
	Specific gravity:	11.34

Exposure Routes: Inhalation; Ingestion; Skin and/or eye contact.

Target Organs: Eyes, gastrointestinal tract, central nervous system, kidneys, blood, gingival tissue.

Acute Toxicity:

Extremely high exposures could cause seizures, however, usually lead toxicity is brought on by chronic exposures.

Chronic Toxicity:

Lead toxicity is both cumulative and irreversible. Most lead exposure is by ingestion. Inhaled lead does not accumulate in the lungs, but is eventually absorbed or transferred to the gastrointestinal tract. Earliest effects are in the blood forming system leading to anemia. Early outward symptoms are; fatigue, sleep disorders, aches and pains, and digestive problems. As poisoning progresses, there are typically episodes of lead colic and later peripheral neuropathy involving the motor nerves. Hypertension and irreversible kidney damage are less frequently reported.

Carcinogenicity: Classification B2; Probable Human carcinogen

Although its carcinogency is debated by the International Agency for Research on Cancer, the EPA has classified lead as a possible human carcinogen based on animal research findings.

Developmental/Reproductive Toxicity:

Lead can inhibit production of sperm and has been reported to cause birth defects through paternal exposures. Lead oxide has been used as an abortifacient and women exposed to high levels of lead had increased miscarriages, stillbirths, and birth defects. Prenatal exposures may affect postnatal mental development, imparing motor skills and suppressing IQs.

Lead (cont.)

<u>Standards/Regulations</u>:

Air				
	TLV-TWA	0.15 mg/cu. m		ACGIH, 1991
	REL	0.10 mr/cu. m		NIOSH, 1993
	STEL	Not available		
	IDLH	700 mg/cu. m		NIOSH, 1993
Water				
	MCLG		0 ug/L	EPA, 1991
	MCL		None	
	SMCL		None	
	AWQC (fresh)	Drinking	50 ug/L	EPA, 1980
		Acute	82 ug/L	EPA, 1985
		Chronic	3.2 ug/L	EPA, 1985
	AWQC (marine)	*Fish Consumption*	None	
		Acute	140 ug/L	EPA, 1985
		Chronic	5.6 ug/L	EPA, 1985
Drinking Water Health Advisory				
	None			
Slope Factor				
	Oral	Not available		
	Inhalation	Not available		
Risk Level				
	Oral	Not available		
	Inhalation	Not available		
RfD				
	Oral	0.006 mg/kg/day		World Health, 1985
RfC				
	Inhalation	Not available		

<u>References</u>:

IRIS database, Micromedex, Inc., Vol. 18, Expires 10/31/93.
Reprotext®, Micromedex, Inc., Vol. 18, Expires 10/31/93.
NIOSH Pocket Guide™, Micromedex, Inc., Vol. 18, Expires 10/31/93.
New Jersey Hazardous Substances Fact Sheets, Micromedex, Inc., Vol. 18, Expires 10/31/93.

ZINC

Chemical Properties:	CAS number:	1314-13-2
	Molecular weight:	81.4
	Vapor pressure at 25°C:	0 millimeter Hg
	Water solubility at 25°C:	insoluble
	Specific gravity:	5.61

Exposure Routes: Inhalation

Target Organs: Respiratory system

Acute Toxicity:

There are no known cases of toxicity in humans through ingestion of zinc metal or its salts.

Metallic zinc probably does not exist as such when fine particles are suspended in air, because it readily oxidizes to form zinc oxide. Inhalation zinc dust is well known to cause metal fume fever, a flu-like condition involving fever, chills, sweats, aches and pains, cough, and general malaise. Symptoms usually arise within a few hours of exposure and subside within 24 to 48 hours with no permanent effects. While the exact mechanism for metal fume fever is unknown, it is thought to have an allergic basis.

Chronic Toxicity:

Chronic zinc poisoning has not been seen in humans, on the contrary, zinc deficiency toxicity is well documented.

Carcinogenicity: Classification D; not classified

Zinc compounds are not regarded to be carcinogenic.

Developmental/Reproductive Toxicity:

Since zinc is an essential element to life, reasonable doses are not considered to be genotoxic, to the contrary, zinc deficiencies have been linked to delayed development and reproductive disorders.

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Zinc (cont.)

Standards/Regulations:

Air				
	TLV-TWA	10 mg/cu.m		ACGIH, 1990
	REL	5 mg/cu.m		NIOSH, 1993
	STEL	10 mg/cu.m		NIOSH, 1993
	IDLH	600 mg/cu.m		NIOSH, 1993
Water				
	MCLG		Not available	
	MCL		Not available	
	SMCL		5 mg/L	EPA, 1989
	AWQC (fresh)	Drinking	None	
		Acute	120 ug/L	EPA, 1987
		Chronic	110 ug/L	EPA, 1987
	AWQC (marine)	Acute	95 ug/L	EPA, 1987
		Chronic	86 ug/L	EPA, 1987
		Fish Consumption	None	
Drinking Water Health Advisory				
	None			
Slope Factor				
	Oral	Not applicable		
Risk Level				
	Oral	Not applicable		
	Inhalation	Not applicable		
RfD				
	Oral	1.7 mg/kg/day		EPA, 1990
RfC				
	Inhalation	Not available		

References:

IRIS database, Micromedex, Inc., Vol. 18, Expires 10/31/93.
Reprotext®, Micromedex, Inc., Vol. 18, Expires 10/31/93.
NIOSH Pocket Guide™, Micromedex, Inc., Vol. 18, Expires 10/31/93.

Remedial Alternatives Analysis

For:
Flynn Learner
91-056 Hana Street
Ewa Beach, Hawaii 96707

Location:
120 Sand Island Access Road
Honolulu, Oahu, Hawaii

January 25, 1995

CF Job #93064

COTTON and FRAZIER Consultants, Inc.

Environmental Solutions

P.O. BOX 27126
Honolulu, Hawaii 96827

PHONE (808) 599-1993
FAX (808) 599-1502

FLYNN LEARNER SAND ISLAND SITE
REMEDIAL ALTERNATIVES ANALYSIS
CF Job #93064

Prepared for:
Flynn-Learner
91-056 Hana Street
Ewa Beach, Hawaii 96707

Location:
120 Sand Island Access Road
Honolulu, Hawaii 96819

Prepared by:

Lee R. Cranmer, PE
Project Manager

Approved by:

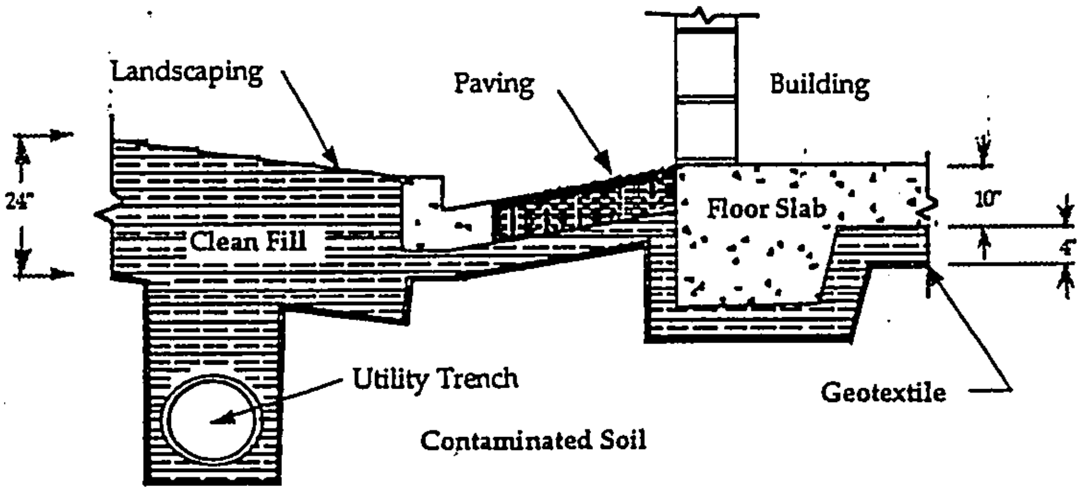
W. Mark Frazier
Vice President

EXECUTIVE SUMMARY

COTTON and FRAZIER Consultants, Inc. (CF) was retained by Flynn-Learner to perform an analysis of remediation alternatives for the property located at 120 Sand Island Access Road (TMK 1-2-23, parcels 9 through 12). Flynn-Learner operated a metals recycling facility at the site from 1951 to 1991. This alternatives analysis was initiated subsequent to CF's Risk Assessment Report for 120 Sand Island Access Road, dated October 22, 1993.

The objective of this analysis was the selection of the most appropriate remedial action to mitigate environmental risks at the site. The criteria and format used for this analysis were those outlined in the Environmental Protection Agency, Superfund, *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA, October 1988).

Based on a systematic review of available options and a comparative analysis of remedial action alternatives, COTTON and FRAZIER Consultants, Inc. recommends pursuing the integration of a permanent site cap into redevelopment of the site. We further recommend that all contaminated soils be impounded on site, including soils disturbed by site improvement construction. To facilitate this, we recommend that a qualified engineering firm design an integrated site cap into redevelopment of the site. The following is provided as a recommended design basis.



Recommended Integrated Cap Design Basis

Furthermore, we recommend that the selected designer specify adequate management practices to be used by the general contractor to ensure the health and safety of their workers and workers on neighboring properties during construction. We anticipate that periodic inspection of the cap system and effectiveness reviews will be required by the Hawaii Department of Health.

TABLE OF CONTENTS

1.0 INTRODUCTION

COTTON and FRAZIER Consultants, Inc. (CF) was retained by Flynn-Learner to perform an analysis of remediation alternatives for the property located at 120 Sand Island Access Road (TMK 1-2-23, parcels 9 through 12). Flynn-Learner operated a metals recycling facility at the site from 1951 to 1991. This alternatives analysis was initiated subsequent to CF's Risk Assessment Report for 120 Sand Island Access Road, dated October 22, 1993.

1.1 Purpose and Organization of Report

The objective of this analysis was the selection of the most appropriate remedial action to mitigate environmental risks at the site. The criteria and format used for this analysis were those outlined in the Environmental Protection Agency, Superfund, *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA, October 1988). Based upon discussions with the Hawaii Department of Health, relative weight given to specific evaluation criteria were modified to be consistent with the proposed Superfund Reform Act of 1994. Please refer to Section 4.1, Evaluation Criteria, for a discussion of specific criteria used for evaluation.

The following activities were performed under the scope of this analysis: review of site characterization and baseline risk assessment; identification and screening of available remedial action technologies; selection of representative process options; development and screening of remedial action alternatives; and comparative analysis of the three most promising alternatives. Please refer to the table of contents for an outline of the structure of this report.

1.2 Limitations

This analysis is limited to the area of, and contaminants associated with, the former metals recycling facility components known to exist at the site. This analysis has been performed in accordance with sound engineering practices and the best current industry standards.

1.3 Background Information

1.3.1 Site Description

The site is located at 120 Sand Island Access Road in Honolulu, Hawaii (TMK 1-2-23, Parcels 9 through 12). It is bounded on the south and west by Pahounui Drive, on the east by Sand Island Access Road, and on the north by Kilgo's (a building supply store). The property is located within the Kalihi Kai Area.

The property and surrounding parcels are zoned I2, Intense Industrial. The remaining area within a half-mile radius of the site is zoned either Light, Intense, or Waterfront Industrial. Keehi Lagoon is the nearest surface body of water and is located approximately 620 feet west of the site.

The 400 feet by 335 feet site is topographically flat and lies at an elevation of approximately 8 feet above mean sea level. Groundwater is present at a depth of approximately 7 feet below ground surface (bgs) and shows signs of tidal influence. Soils from the surface to first encountered groundwater (approximately 7 feet bgs) generally consist of a mixed fill material largely made up of a dark brown silty sand with gravel and debris. Underlying soils generally consist of a dark gray lagoonal clay.

Structures existing on site include: a single-story office building, a metal shed, and a truck scale. Structures and equipment formerly located at the site include: an incinerator, metal shearing equipment, a crane, an underground storage tank, a battery casing storage area, and an engine block storage area.

1.3.2 Site History

Flynn-Learner operated a metal recycling facility at the site from October 1951 to October 1991, under a lease from the Samuel M. Damon Trust. Since October 1991, the property has been intermittently used for parking trucks and equipment.

1.3.3 Nature and Extent of Contamination

The nature and extent of contaminants present in site soils and groundwaters were characterized by eight separate sampling events conducted between August 1991 and July 1993. Results of these eight events are summarized in CF, October 1993.

Compounds detected in soils at concentrations above potentially applicable or relevant and appropriate requirements (ARARs) were: benzo(a)pyrene (B(a)P); polychlorinated biphenyls (PCBs); cadmium (Cd); and lead (Pb). These compounds were detected in soils sampled throughout the site, with maximum concentrations generally present in the vicinity of the former battery casing and engine block storage areas. Detected concentrations diminished with depth, indicating that the majority of impacted soils are found within five feet of the ground surface.

Arsenic, copper, and zinc were the only compounds detected in groundwater samples[1] . However, none were indicated by laboratory analysis to be present at concentrations above ARARs.

1.3.4 Contaminant Fate and Transport

Fate and transport modeling of petroleum contaminants considered migration through soil via unsaturated flow, non-aqueous phase liquid (NAPL) flow, and gas-phase diffusion. Transport via saturated flow through groundwater was also considered. Modeling predicted: maximum groundwater loading via unsaturated flow of B(a)P to be 0.004 parts per million (ppm) and of PCBs to be 0.100 ppm; NAPL flow would not occur in soils; diffusion of vapor-phase B(a)P and PCB to the surface would be negligible; and predicted arrival times of NAPL or groundwater saturated with B(a)P and PCB at the nearest surface water (Keehi Lagoon) would range from 460 thousand to 50 million years (CF, October 1993).

Metal contaminants do not exist as a vapor or liquid-phase. Modeling of fate and transport of metal contaminants considered migration in soils via free metal ion and complexed speciation. Due to the proximity of metal contaminants to groundwater, it was assumed that loading to groundwater would occur at limits of saturation. Modeling predicted that arrival times of groundwater saturated with metals at the nearest surface water (Keehi Lagoon) would range between 780 thousand and 180 million years (CF, October 1993).

Based on the above, modeling effectively eliminated vapor-phase or groundwater pathway exposures, leaving direct contact with contaminants sorbed to soil as the only likely pathway of concern.

1.3.5 Baseline Risk Assessment

Populations potentially exposed to site contaminants through dermal contact, inhalation or incidental ingestion were identified as: permanent site employees and transient site construction workers.

Calculation of excess lifetime cancer risks and hazard indexes using average concentrations of compounds encountered at the surface revealed that the only human health risks associated with the site are dermal contact with and incidental ingestion of soil containing elevated metal concentrations. An unacceptable risk (Hazard Index > 1) was calculated for remaining lead concentrations (CF, October 1993).

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[1] Additional grab samples were collected from open trenches on August 12, 1993, but were not filtered prior to analysis. Although other compounds and high concentrations were detected in these samples, they are not considered representative of groundwater conditions due to interference from suspended solids.

2.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

2.1 Remedial Action Objectives

EPA guidance (EPA, October 1988) calls for identifying remedial action objectives in order to evaluate potential technologies. Remedial action objectives are site specific goals developed for the protection of human health and the environment, and should specify the contaminant(s) of concern, exposure route(s) and receptor(s), and an acceptable contaminant level or range of levels for each exposure route.

2.1.1 Contaminants of Concern

As summarized in the previous section, the baseline risk assessment (CF, October 1993) identified *remaining* lead and cadmium concentrations as the contaminants of concern for the site. Furthermore, fate and transport modeling predicted that these compounds are for all practical purposes immobile.

2.1.2 Exposure Routes and Receptors

Guidance promulgated with EPA Region IX's *Preliminary Remediation Goals* (EPA, August 1994), defines typical exposure pathways at residential and industrial sites. At industrial sites with soils containing elevated levels of immobile metals, typical exposure pathways are: dermal absorption, inhalation of particulates, and incidental ingestion. These are in agreement with the baseline risk assessment, which as summarized previously, defined receptors as: permanent site employees and transient site construction workers.

2.1.3 Acceptable Contaminant Levels

There are no legally applicable or relevant and appropriate regulations (ARARs) regarding cleanup levels for lead and/or cadmium contaminated soils. However, screening levels have been identified by the Hawaii Department of Health and EPA Region IX and guidance from both of these offices recommends determining acceptable contaminant levels for cadmium and lead on a case by case basis.

The Hawaii Department of Health has published recommended clean-up criteria for soil and water in their *Technical Guidance Manual for Underground Storage Tank Closure and Release Response* (DOH, August 1992). The goal for lead is 400 ppm in soil and for cadmium is 2 ppm or natural background in soil, regardless of the land use at the site. The recommended clean-up criteria for lead and cadmium were "based on direct exposure to human and ecological receptors" (DOH, August 1992).

Because the Hawaii Department of Health established uniform goals for State wide use, they based the goals on worst case scenarios representative of risks to children in residential areas. Therefore, for industrial areas, these goals are useful only as screening levels for further investigation.

EPA Region IX has calculated Preliminary Remediation Goals (PRGs) from EPA toxicity values and health-protective exposure assumptions. The published PRGs represent "safe" contaminant levels in environmental media and are meant to be used as "triggers" for further investigation (EPA, August 1994). EPA Region IX used EPA's Integrated Exposure Uptake Biokinetic Model (IEUBK) to calculate lead PRGs. The IEUBK calculated a "trigger" of 400 ppm for lead in residential soils and a "trigger" of 1,200 ppm for lead in industrial soils (EPA August 1994). Using standard exposure hazard equations based on reference doses, EPA Region IX establish a PRG of 850 ppm for cadmium in soil at industrial sites (EPA, August 1994).

In July 1994, EPA's Office of Solid Waste and Emergency Response [OSWER] issued revised guidance for soil lead at Comprehensive Environmental Response Cleanup and Liabilities Act (CERCLA) sites and Resourse Conservation and Recovery Act (RCRA) facilities (OSWER Directive # 9355.4-12, dated, July 14, 1994). This guidance replaces all previous directives and recommended a screening level of 400 ppm for lead in soil at sites with residential land use. The OSWER used the IEUBK model to arrive at the residential screening level, but noted that this value is not appropriate for sites with non-residential land use because the IEUBK is specifically designed to evaluate lead exposures of children. Further, it was noted that although several models which approximate adult exposures are now available, EPA has not yet reached a consensus on non-residential screening levels.

OSWER Directive # 9355.4-12 also provides a summary of guidance contained in Section 403 of the Toxic Substances Control Act (TSCA) for lead contaminated sites. Section 403 "identifies ranges over which various types of responses are appropriate, commensurate with the level of potential risk reduction, and cost incurred to achieve such risk reduction...in the range of 400 to 5,000 ppm, limited interim controls are recommended...while above 5,000 ppm, soil abatement is recommended." Finally, OWSER also recommends the site-specific modeling of exposure risks to establish site-specific media cleanup standards (OSWER, July 1994).

In an effort to identify an accepted model for calculating a site-specific clean-up goal for lead, both the Hawaii Department of Health (DOH) and EPA Region IX were consulted.

Ms. Barbara Brooks, Toxicologist with DOH's office of Hazard Evaluation and Emergency Response, indicated that in the past the IEUBK has been the model of choice for quantifying lead risks, but that since the model is specifically designed to assess risks to children that it is not appropriate for use at this site. Ms. Brooks recommended the use of the California Lead Risk Assessment Spreadsheet (developed and distributed by the California Department of Toxic Substances Control) to calculate an acceptable lead concentration for soils at this site (Brooks, January 1995).

Mr. Dan Stralka, EPA Region IX Superfund Regional Toxics Integration Coordinator, and Dr. Stanford Smucker, EPA Region IX Regional Toxicologist, agreed with Ms. Brook's comments (Stralka, January 1995) (Smucker, January 1995). Dr. Jim Carlisle, Toxicologist with the California Department of Toxic Substances Control, provided a copy of the model and documentation for our use. Dr. Carlisle also indicated that the model has a track record for acceptance with California regulators for establishing cleanup goals at industrial sites (Stralka, January 1995).

Table 2.1 Observed Contaminant Concentrations vs. Screening Levels

Cadmium

Average Concentration Detected(b)	20 ppm
Maximum Concentration Detected(c)	124 ppm
DOH, UST Cleanup Goal, Regardless of Land Use	3 ppm (a)
EPA Region IX PRG, Residential Areas	38 ppm
EPA Region IX PRG for Industrial Areas	850 ppm

Lead

Average Concentration Detected(b)	2,430 ppm
Average Concentration Detected in Surface Soils Smaller than 500 microns(c)	3,660 ppm
Maximum Concentration Detected(d)	14,000 ppm
DOH, UST Cleanup Goal, Regardless of Land Use	400 ppm
EPA OSWER, Residential Screening Level	400 ppm
EPA Region IX PRG, Industrial Areas	1,200 ppm
CA Lead Risk Spreadsheet, Construction Conditions	1,480 ppm
CA Lead Risk Spreadsheet, Industrial Use	4,260 ppm
TSCA Section 403, Limited Interim Controls Recommended	400 - 5,000 ppm
TSCA Section 403, Soil Abatement Recommended	> 5,000 ppm

Notes:
(a) Natural background level established during investigation by CF on October 15, 1992.
(b) All soils sampled.
(c) From CF, March 1994.
(d) From CF, October 1993.

The California Lead Risk Assessment Spreadsheet was used to calculate an average soil lead concentration at which 99% of an exposed adult population would not result in a blood lead level in excess of 10 micrograms per deciliter (µg/dL). The resulting allowable average concentration of lead in soil was calculated to be 4,260 ppm for conditions of industrial use at the site (respirable dust = 50 µg/m^3). For conditions during construction operations (respirable dust = 1,000 µg/m^3), the resulting allowable average concentration of lead in soil was calculated to be 1,480 ppm (see Appendix A for calculation sheets).

The data in this section (summarized in Table 2.1) provides an acceptable cadmium in soil concentration of 850 ppm (EPA Region IX PRG). Depending on the source, data in this section also provides a range of acceptable lead in site soil concentrations from 1,200 ppm (EPA Region IX PRG) up to 4,260 ppm (industrial use scenario calculated by California Lead Risk Assessment Spreadsheet). Faced with such divergent numbers, we have decided to be conservative and select 1,480 ppm as the concentration of lead in soil at this site for which the evaluation of remedial alternatives is appropriate. This value is selected as protective of both the short-term (risks to construction workers) and long-term (risks to permanent employees) risks identified in the baseline risk assessment.

2.1.4 Site Specific Remedial Action Objectives

In the previous section, an acceptable cadmium in soil concentration of 850 ppm was identified. This concentration is above the highest detected on site (124 ppm), eliminating the need to establish cadmium based remedial action objectives. The previous section also identified an acceptable lead in soil concentration of 1,480 ppm. Since the average concentration of lead detected in site soils (2,430 ppm) exceeds the acceptable level, remedial action objectives are driven by the requirement to address lead exposure risks at the site. Remedial action objectives proposed for the site are:

a. Prevent physical contact with soil having a concentration of lead greater than or equal to 1,480 ppm.

b. Prevent inhalation or dermal absorption of airborne particulates from soil having a concentration of lead greater than or equal to 1,480 ppm.

c. Reduce the toxicity of metals in soils which cannot be effectively isolated from human contact and have a concentration of lead greater than or equal to 1,480 ppm.

2.1.5 "Hot Spots"

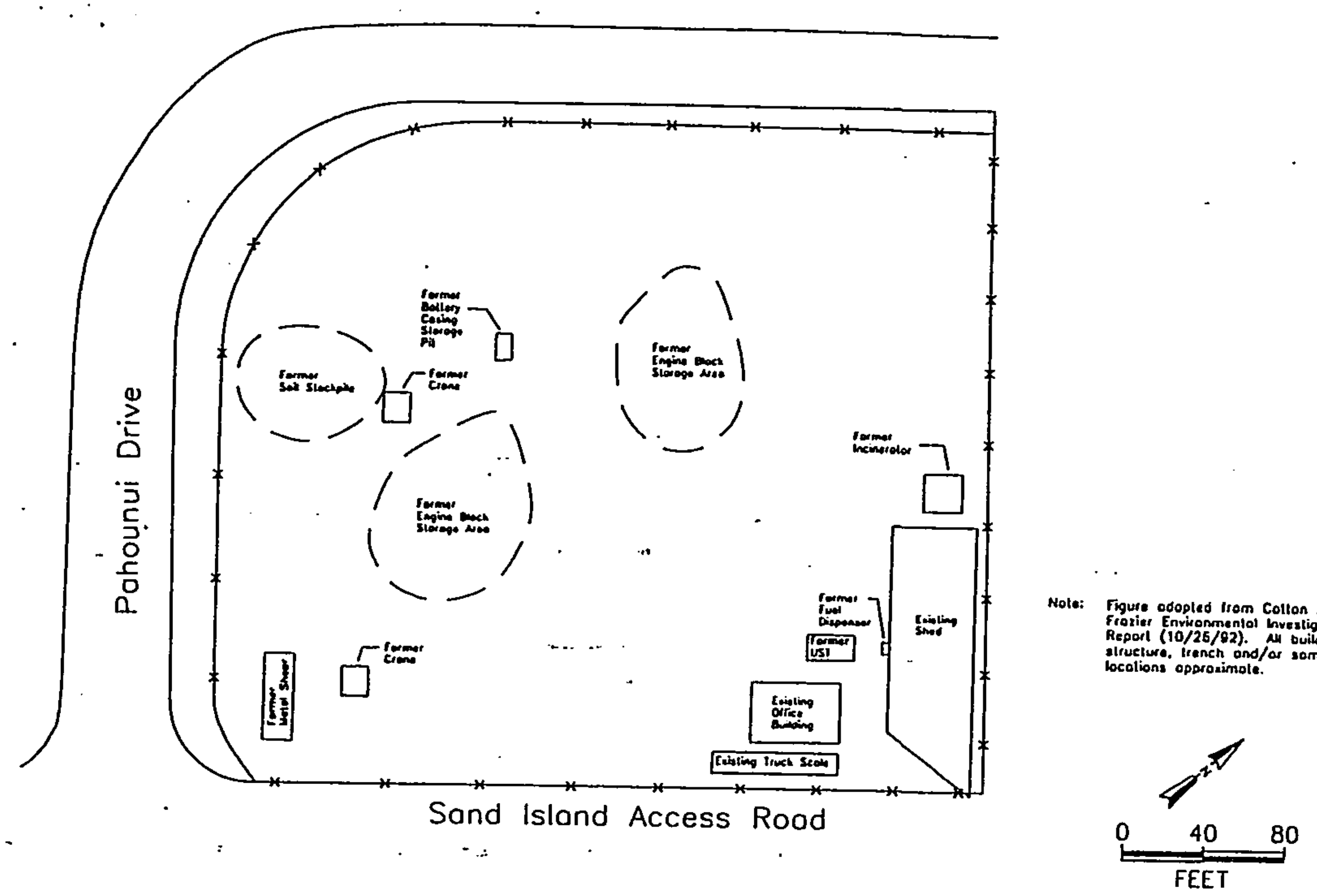
Section 2.1.3 summarized TSCA guidance which recommends "abatement" of soils with lead levels above 5,000 ppm.

Analysis of surface soil samples collected September 6, 1991 (Weiss, October 1991) indicated lead concentrations in 3 of 16 composite samples in excess of 5,000 ppm (5,250 ppm, 8,500 ppm, and 9,570 ppm), while the average of all composite samples collected that day yielded an average lead concentration of 3,160 ppm in surface soils. Sometime between September 1991 and March 1994, surface soils (0 to 6 inches bgs) were scraped and segregated in an effort to retrieve recyclable metals. Screened soils were then spread uniformly back across the surface of the site. On March 15, 1994, 13 composite samples were collected from surface soils. To represent lead concentrations in potential airborne particles, samples were first passed through a 500 micron wet sieve and only the fraction 500 microns or smaller was analyzed. Only 1 screened composite sample indicated a lead concentration above 5,000 ppm (5,100 ppm in a composite collected near the former metal sheer location shown on Figure 2.1). Lead concentrations of the 13 screened composites ranged from 2,500 ppm to 5,100 ppm with an average concentration of 3,660 ppm, indicating a fairly homogeneous distribution of lead in surface soils (CF, March 1994).

Discrete sampling of soils from the 3, 5, and 7 feet bgs intervals was conducted on August 12, 1992. Of the 28 samples collected, only 1 sample indicated a lead concentration above 5,000 ppm (14,000 ppm in a discrete sample collected from 3 feet bgs near the former battery casing storage area location (see Figure 2.1). An additional sample was collected from the soil underlying this (5 feet bgs), resulting in a lead concentration of just 180 ppm (CF, October 1992).

From this discussion, two areas have been identified with lead levels above 5,000 ppm, a discrete 3 feet location near the former battery casing storage area (14,000 ppm) and a composite of surface soils near the former metal sheer (5,100 ppm).

"Hot spots" are defined by the proposed Superfund Reform Act as "A discrete area within a facility that contains hazardous substances, pollutants or contaminants that are present in high concentrations, are highly mobile, or cannot be reliably contained, and that would present a significant risk to human health or the environment should exposure occur."



Note: Figure adopted from Cotton & Frazier Environmental Investigation Report (10/25/92). All building, structure, trench and/or sample locations approximate.

Cotton and Frazier Consultants, Inc.
Environmental Solutions

TITLE:
SITE LAYOUT
Flynn-Learner Site
Honolulu, Hawaii

DWN: GAM	DES.:	PROJECT NO.: 93064
CHKD: LRC	APPD: WMF	
DATE: 1-20-95	REV.: 1	FIGURE NO.: 2.1

Although the two identified areas exceed the TSCA threshold of 5,000 ppm, they are not "hot spots" which require specific measures (as defined by the proposed Superfund Reform Act). First, the sample collected from near the former metal sheer is not representative of a discrete location, but a composited sample representative of lead content slightly higher than homogeneous conditions across the site. Furthermore, as summarized in Section 1.3.4, the baseline risk assessment determined that the metal contaminants are effectively immobile at this site. Finally, nothing is unique about these two areas which would preclude reliably mitigating exposure risks in the same manner as the rest of the site. Therefore, specific mitigative measures for discrete areas are not recommended and we have chosen to view the site as homogeneous for the evaluation of response alternatives.

2.2 General Response Actions and Their Technical Feasibility at the Site

EPA remedial investigation guidance (EPA, October 1988) recommends developing general response alternatives that allow decision-makers to make informed selections from a wide range of options. EPA organizes general response actions into the following categories:

a. No Action - EPA CERCLA guidance recommends that the "no action" alternative be considered as a baseline for comparison. If selected, no further remedial activities would be implemented at the site.

b. Institutional Controls - Include deed restrictions or access control to limit the potential for human exposures and are typically used in conjunction with other measures.

c. Containment - Protects human health and the environment by preventing potential exposure through the construction of a barrier over or around the contaminated media.

d. Removal - Eliminates risks by removing the contaminant from site media. After removal, the media requires treatment or disposal to eliminate risks.

e. Disposal - Removes risks from the site by moving the contaminated media to a controlled impoundment or treatment facility.

f. Treatment - Reduce volume or toxicity of contaminant through physical, biological, chemical, or thermal processes.

While specific characteristics of the site, the contaminated media, predicted exposure scenarios, available remediation technologies and associated costs may make one option more desirable than another, no technical barriers exist for the use of any of these general response actions at the site.

2.3 Identification and Screening of Technology Types and Process Options

2.3.1 Identification and Screening of Technologies

The first step in selecting a remediation alternative is to examine remedial technology types and process options available for each general response action. Table 2.2 summarizes potentially applicable technology types and process options for use in meeting the three remedial action objectives defined for the site. Included are brief descriptions of each process option and a comment on its technical feasibility for the site.

Technology types and process options for each of the six general response actions (no action, institutional controls, containment, removal, disposal, and treatment) were identified from various sources, including: EPA's *Remediation Technologies Screening Matrix and Reference Guide* (EPA, July 1993), EPA's *Superfund Innovative Technology Evaluation Program* (EPA, November 1993), and EPA's *Vendor Information System for Innovative Treatment Technologies* (EPA, July 1994).

Since the baseline risk assessment eliminated concern over risks from a groundwater exposure route or due to contaminant migration, process options for remediating groundwater or controlling contaminant mobility are not included for consideration in Table 2.2.

The first remedial action objective, preventing physical contact, can be accomplished by institutional controls, containment, removal or disposal response actions. Containment, removal, and disposal would also satisfy the second objective of preventing inhalation or dermal absorption of contaminated particulates.

Three types of institutional controls were identified: access restrictions, land use restrictions, and monitoring. Access restrictions (such as fencing) and monitoring (such as medical surveillance) were screened from further consideration because they will not control airborne particulates or guard against exposures.

Containment can be accomplished through dust controls, such as wetting and revegetation, or capping using clean fill, clay, asphalt, concrete, or a synthetic membrane. All were found to be potentially applicable at the site.

Removal of lead and cadmium contaminated soils can only be accomplished by conventional excavation processes employing scrapers, graders, and excavator/loaders.

Table 2.2 Identification and Screening of Technology Types and Process Options for Soils

Remedial Action Objective	General Response Action	Remedial Technology Type	Process Options	Description	Screening Comment
	No action	n/a	n/a	No action	Considered as baseline
Prevent physical contact with soil having a concentration of lead ≥ 1,480 ppm	Institutional controls	Access restrictions	Fencing	Access controlled by security fence	Does not control airborne particulates
		Land use restrictions	Deed restrictions	Restriction on subsurface improvements	Potentially applicable
		Monitoring	Medical surveillance	Monitor blood levels of Lead	Does not guard against exposure
Prevent inhalation or dermal absorption of airborne particulates from soil having a concentration of lead ≥ 1,480 ppm	Containment	Dust controls	Wetting	Control dust with wetting agent	Potentially applicable during site improvement construction
			Revegetation	Vegetation as a barrier	Potentially applicable
		Capping	Clean fill	Clean fill as a barrier	Potentially applicable
			Clay	Clay as a barrier	Potentially applicable
			Asphalt	Asphalt paving as a barrier	Potentially applicable
			Concrete	Concrete slab as a barrier	Potentially applicable
			Synthetic membrane	Synthetic membrane as a barrier	Potentially applicable
	Removal	Excavation	Scraper/Grader	Physically remove contaminated soils	Potentially applicable
	Disposal	Impoundment	On site	On-site impoundment of removed soils	Potentially applicable
			Off site	Landfilling of removed soils	Potentially applicable
Reduce the toxicity of soils which cannot be effectively isolated from human contact and have a concentration of lead ≥ 1,480 ppm	Treatment	Physical treatment	Soil washing	Heavy metals removed from excavated soils using a liquid rinse	Potentially applicable
			Magnetic segregation	Magnetic separation of heavy metals combined with other mineral processing techniques such as scrubbing, classifying, and cycloning	Not feasible for Lead sorbed to soil particles

Table 2.2 Identification and Screening of Technology Types and Process Options for Soils (cont.)

Remedial Action Objective	General Response Action	Remedial Technology Type	Process Options	Description	Screening Comment
	Treatment (cont.)	Chemical treatment	Chemical Reduction/ Oxidation	Converts heavy metals into less toxic compounds using a reducing/oxidizing agent	Potentially applicable
			Chemical leaching	Leaching heavy metals from soils using a sulfuric acid bath	Potentially applicable
		Thermal treatment	Smelting	Metals reclaimed using a flash-smelting flame reactor	Not feasible for soil particles larger than 0.033 inches in diameter
		In-situ treatment	Soil flushing	Heavy metal removal from soils using a solvent and traditional pump-and-treat methods	Potentially applicable
			Solidification	In-situ soil-cement mixing using multi-axis overlapping augers	Potentially applicable
			Electrokinetics	Ionic separation and removal of heavy metals by induced electrical current	Technology not proven in unsaturated soils
			Vitrification	Thermal conversion of contaminants to a non-hazardous silicate	Technology not proven in clays, basalts, and corals

Disposal of the solid wastes generated by removal can be accomplished by on-site impoundment or off-site landfilling.

The third remedial action objective, reducing the toxicity of soils which cannot be effectively isolated from contact, can only be accomplished by ex-situ or in-situ treatment.

Treatment technology types and processes identified include ex-situ physical treatment by soil washing or magnetic segregation, ex-situ chemical treatment by chemical reduction/oxidation or chemical leaching, and ex-situ thermal treatment by smelting.
Available in-situ treatment processes identified are soil flushing, solidification, electrokinetics, or vitrification. Only ex-situ smelting, ex-situ magnetic segregation, and in-situ electrokinetics and in-situ vitrification were found to be unsuitable for the site.

2.3.2 Evaluation and Selection of Representative Technologies

EPA guidance (EPA, October 1988) recommends evaluating in greater detail the processes considered to be potentially implementable prior to selecting one process to represent each technology type. Table 2.3 presents an evaluation of effectiveness, implementability, and cost of each process option.

The "no action" alternative was found to be ineffective in achieving remedial action objectives and is not recommended for further consideration.

Deed restrictions were found to be effective only if used in conjunction with a containment alternative. Implementation requires authority beyond Flynn-Learner's.

Wetting of soils for dust control is considered an effective means of limiting exposures during construction as part of a comprehensive health and safety program.

Revegetation and the capping options of clean fill, clay, asphalt, concrete, and synthetic membranes were all found to be effective as part of integrated caps. All were found to be easily implementable and of low to moderate cost. However, the permeability reducing capacities of clays and synthetic membranes are not required to meet remediation objectives due to the non-mobile nature of contaminants.

Excavation was found to be required for any alternative which alters site configuration.

Table 2.3 Evaluation of Process Options

General Response Action	Remedial Technology Type	Process Options	Effectiveness	Implementability	Cost
No action	n/a	n/a	Does not achieve remedial action objectives.	Not acceptable to regulatory agency.	None.
Institutional controls	Land use restrictions	Deed restrictions	Effective with future enforcement as part of a containment alternative.	Requires consent of property owner. Restrictions on future land use.	Negligible.
Containment	Dust controls	Wetting	Effective as part of a comprehensive health and safety program for limiting airborne particulates during construction operations.	Easily implemented.	Negligible.
		Revegetation	Effective in controlling erosion in non-paved areas as part of an integrated site cap.	Easily implemented. Restrictions on future land use.	Low capital, moderate maintenance.
	Capping	Clean fill	Effective as part of an integrated cap. Requires erosion control.	Easily implemented. Restrictions on future land use.	Low capital, low maintenance.
		Clay	Effective as part of an integrated cap. Requires erosion control. Reduction of permeability not required for site.	Easily implemented. Restrictions on future land use.	Low capital, low maintenance.
		Asphalt	Effective as part of an integrated cap.	Easily implemented. Restrictions on future land use.	Low capital, moderate maintenance.
		Concrete	Effective as part of an integrated cap.	Easily implemented. Restrictions on future land use.	Moderate capital, moderate maintenance.
		Synthetic membrane	Effective as part of an integrated cap. Reduction of permeability not required for site.	Easily implemented. Restrictions on future land use.	Moderate capital, moderate maintenance.
Removal	Excavation	Scraper/Grader	Not an effective solution. Integral part of implementing other remedial alternatives.	Required for any alternative which alters site configuration.	High capital.
Disposal	Impoundment	On site	Effective as part of an overall containment approach.	Easily implemented. Restrictions on future land use.	Low capital, moderate maintenance.
		Off site	Effective, uses conventional technology.	Difficult to implement, no receiving landfill available in Hawaii. Hazards from excavation, transfer, and shipping.	Very high capital. Moderate potential for retained liability.

Table 2.3 Evaluation of Process Options (cont.)

General Response Action	Remedial Technology Type	Process Options	Effectiveness	Implementability	Cost
Treatment	Physical treatment	Soil washing	Effective in reducing volume of hazardous contaminants as part of a removal, segregation, and treatment approach.	Produces undesirable liquid waste which requires further treatment. End result may be hazardous waste requiring disposal outside of Hawaii.	High capital, high operations and maintenance.
	Chemical treatment	Chemical Reduction/ Oxidation	Effective in reducing toxicity as part of a removal, segregation, and treatment approach.	Requires material processing and large quantities of reducing/ oxidizing agents. End product may still be considered hazardous.	High capital, high operations and maintenance.
		Chemical leaching	Effective in reducing volume of hazardous contaminants as part of a removal, segregation, and treatment approach.	Produces undesirable liquid waste which requires further treatment. End result may be hazardous waste requiring disposal outside of Hawaii.	High capital, high operations and maintenance
	In-situ treatment	Soil flushing	Effective in reducing volume of hazardous contaminants as part of a removal, treatment, and disposal approach.	Produces undesirable liquid waste which requires further treatment. End result may be hazardous waste requiring disposal outside of Hawaii.	High capital, high operations and maintenance.
		Solidification	Effective in reducing toxicity of contaminated media.	Soil mixing increases volume of media and produces a cemented formation restricting future land use.	High capital.

Impounding soils on site was found to be a low cost, easily implementable disposal option, while off-site disposal would be costly and difficult to implement because of the lack of a suitable waste disposal facility in Hawaii.

All ex-situ treatment options were found to be high cost solutions. Implementation of all ex-situ treatment methods, except chemical reduction/oxidation, causes the generation of undesirable waste streams. In-situ soil flushing raised the same cost and waste stream concerns.

In-situ solidification was found to be the most promising available treatment option. Solidification by soil mixing uses conventional construction equipment and is effective in reducing the toxicity of soils contaminated with heavy metals. The end product is a cemented mass which could restrict future land use.

3.0 DEVELOPMENT AND SCREENING OF ALTERNATIVES

3.1 Development of Alternatives

Six remedial action alternatives were assembled from the remedial technologies and process options which were evaluated to be effective in meeting remedial action objectives and to be implementable at the site, they are:

Alternative 1 - RCRA Cap
Alternative 2 - Modified Cap
Alternative 3 - Integrated Structures and Modified Cap w/o Treatment
Alternative 4 - Integrated Structures and Modified Cap w/ Treatment
Alternative 5 - Ex-situ Treatment and Disposal
Alternative 6 - In-situ Treatment

The proposed alternatives represent a range of distinct strategies in addressing the concerns associated with the site. Options ranging from the most intrusive to the least intrusive are presented. The "no action" baseline alternative is absent from further consideration due to its inability to achieve remedial action objectives.

Section 3.2 discusses criteria used for screening these alternatives, while section 3.3 presents a discussion of screening comments. Screening comments are summarized in Table 3.1.

Table 3.1 Screening of Remedial Alternatives

Remedial Alternative	Components	Effectiveness	Implementability	Cost
RCRA Cap	Asphalt Clean fill Geotextile Sand Synthetic membrane Clay. On-site impoundment of contaminated soils	Effective in limiting human exposures. Requires inspection and maintenance to remain effective with time. Does not reduce volume or toxicity of contaminants. Since contaminants remain on site, may require five year reviews.	Requires substantial regrading of the site. Bulk materials available locally, geotextile and synthetic membrane must be imported from the mainland. Worker exposures must be managed during implementation. Nullifies future construction of site structures.	Estimated capital = $1,500,000. Estimated annual O&M = $14,000.
Modified Cap.	Asphalt Clean fill Geotextile On-site impoundment of contaminated soils	Effective in limiting human exposures. Requires inspection and maintenance to remain effective with time. Does not reduce volume or toxicity of contaminants. Since contaminants remain on site, may require five year reviews.	Requires regrading of the site. Bulk materials available locally, geotextile must be imported from the mainland. Worker exposures must be managed during implementation. Nullifies future construction of site structures.	Estimated capital = $550,000. Estimated annual O&M = $14,000.
Integrated Structures and Modified Cap without Treatment	Floor slab, paving or landscaped surface. Clean fill. Geotextile. On-site impoundment of contaminated soils	Effective in limiting human exposures. Requires inspection and maintenance to remain effective with time. Does not reduce volume or toxicity of contaminants. Since contaminants remain on site, may require five year reviews.	Allows flexibility in site configuration. Bulk materials available locally, geotextile must be imported from the mainland. Worker exposures must be managed during implementation. Allows full development of site. Restricts future construction of sub-grade structures.	Estimated capital expense over redevelopment = $185,000. Estimated annual O&M = $3,000.
Integrated Structures and Modified Cap with Treatment	Floor slab, paving or landscaped surface. Clean fill. Geotextile. On-site impoundment of contaminated soils. Soil washing, Chemical reduction/oxidation Treated soils returned to the site Waste products disposed of off-site	Effective in limiting human exposures. Requires inspection and maintenance to remain effective with time. Some reduction in volume of contaminants. Since contaminants remain on site, may require five year reviews.	Allows flexibility in site configuration. Bulk materials available locally, geotextile must be imported from the mainland. Worker exposures must be managed during implementation. Allows full development of site. Restricts future construction of sub-grade structures.	Estimated capital expense over redevelopment = $800,000. Estimated annual O&M = $3,000.
Ex-situ Treatment and Disposal	Excavation Soil washing, Chemical reduction/ oxidation. Treated soils returned to the site. Waste products disposed of off-site	Effective in limiting human exposures. Reduces volume and toxicity of contaminants.	Requires substantial disturbance of contaminated soils. Requires large quantities of reducing/oxidizing agents. End product may still need to be disposed of as hazardous material. Worker exposures must be managed during implementation. Additional risks generated by the shipping of hazardous reducing/oxidizing agents and wastes.	Estimated capital = $6,150,000. No annual O&M.
In-situ Treatment	Solidification	Effective in limiting human exposures. Reduces toxicity of contaminants by encapsulation.	Requires substantial disturbance of contaminated soils. Worker exposures must be managed during implementation.	Estimated capital = $970,000. No annual O&M.

3.2 Criteria for Screening Alternatives

The same criteria used to evaluate process options - effectiveness, implementability, and cost - are used to screen the six alternatives prior to further evaluation.

Effectiveness is judged based on the ability of the alternative to be protective of human health and the environment through either reductions in toxicity, mobility, or volume or through elimination of exposure pathways. Short-term and long-term effectiveness are both considered; short-term referring to the construction and implementation period, and long-term referring to the period after the remedial action is complete.

Implementability is a measure of both the technical and administrative feasibility of constructing, operating, and maintaining the alternative. Technical feasibility refers to the ability to construct and reliably operate the process. Administrative feasibility refers to the ability to obtain regulatory approvals for the treatment, storage, disposal, and construction services required by the alternative.

Cost evaluation is based on estimates of capital and operating expenditures. Capital costs should take into account equipment, site-development, buildings, services, treatment, disposal, design, licensing, startup, and shakedown expenses. Annual operation and maintenance costs should consider labor, materials, utilities, disposal, administration, maintenance, and repair.

An initial determination of areas and volumes of soil to which alternatives will be applied is necessary to define relative costs of associated processes. Applicable areas, volumes, and quantities of materials were calculated for the six alternatives. Quantities are summarized below, while original calculation sheets can be found at Appendix A.

<u>General Site Dimensions</u>			
Gross site dimensions	=	400 x 335	feet
Depth of affected soil	=	5	feet
Total site area	=	130,568	square feet
<u>RCRA Cap</u>			
Asphalt	=	14,500	square yards
Base course	=	2,420	cubic yards
Clean fill	=	7,260	cubic yards
Geotextile	=	14,500	square yards
Sand	=	4,840	cubic yards
20 mil flexible membrane liner	=	14,500	square yards
Clay	=	9,680	cubic yards
<u>Modified Cap</u>			
Asphalt	=	14,500	square yards
Base course	=	2,420	cubic yards
Clean fill	=	1,600	cubic yards
Geotextile	=	14,500	square yards

Integrated Structures and Modified Cap			
Estimated volume of soil excavated to construct a multi-story building with landscaping and below grade features	=	2,400	cubic yards
Imported fill requirements	=	2,800	cubic yards
Geotextile	=	17,500	square yards
Ex-Situ Treatment			
Total volume of affected soil	=	24,180	cubic yards
Total weight of affected soil	=	41,000	tons
In-Situ Treatment			
Total volume of affected soil	=	24,180	cubic yards

3.3 Screening of Alternatives

3.3.1 Alternative 1 - RCRA Cap

The first alternative generated is a permanent site cap constructed to RCRA specifications as detailed in EPA's *Technical Guidance Document: Final Covers on Hazardous Waste Landfills and Surface Impoundments* (EPA, July 1989). The cap would be continuous across the entire site and would prohibit the future subsurface use of the site.

A RCRA cap is judged to be effective and implementable. Since contaminants remain on site with a RCRA cap, periodic inspection and maintenance of the cap is required with effectiveness reviews every five years. Substantial regrading of the site is required to meet the specified 3 to 5 percent surface drainage slope and worker exposures to airborne particulates must be managed during construction. A RCRA cap would prohibit the future construction of subsurface structures, severely limiting future site use. The RCRA cap is specifically designed to prohibit the percolation of water from the surface through contaminated soils, a feature which is not required for this site since contaminants are considered immobile. The estimated capital cost of a RCRA cap would be $1,500,000 with an annual operations and maintenance (O&M) cost of $14,000. Detailed cost estimates can be found at Appendix A.

3.3.2 Alternative 2 - Modified Cap

The second alternative considered is a permanent site cap modified to eliminate features of the RCRA cap which inhibit percolation of surface water or migration of groundwaters. The cap would be continuous across the entire site and would prohibit the future subsurface use of the site.

A modified cap is judged to be effective and implementable. Since contaminants remain on site with a modified cap, periodic inspection and maintenance of the cap may be required with effectiveness reviews every five years. A modified cap would prohibit the future construction of subsurface structures, severely limiting future site use. The modified cap eliminates the layers of the RCRA cap which are designed to prohibit the perculation of water from the surface through contaminated soils and reduces surface slopes to the minimum required for drainage. These modifications reduce the estimated capital cost of a modified cap to $550,000 with an annual O&M cost of $14,000.

3.3.3 Alternative 3 - Integrated Structures and Modified Cap w/o Treatment

A third alternative is a permanent site cap integrated with future site improvements to provide continuous containment across the site and allow the installation of subsurface utilities. All disturbed soils would be managed on site without treatment.

An integrated cap is judged to be effective and implementable. Since contaminants remain on site with an integrated cap, periodic inspection and maintenance of the cap may be required with effectiveness reviews every five years. An integrated cap allows full site redevelopment and flexibility in site layout. After construction however, future construction of subsurface structures would be restricted. In this option, any contaminated soils excavated for subsurface features would be impounded on-site. The capital cost of integrating a cap into redevelopment of the site is estimated to increase site development costs by $185,000. Annual O&M costs of the cap are estimated to be $3,000.

3.3.4 Alternative 4 - Integrated Structures and Modified Cap w/ Treatment

The fourth alternative considered is a permanent site cap integrated with future site improvements to provide continuous containment across the site and allow the installation of subsurface utilities. Disturbed soils would be subjected to ex-situ treatment on-site.

Again this option is judged to be effective and implementable, with the same characteristics of Alternative 3. However, in this option, any contaminated soils excavated for subsurface features would be treated on-site by soil washing and chemical reduction/oxidation, with wastes disposed of at a mainland facility.

The capital cost of an integrated cap with treatment of excavated soils is estimated to increase site development costs by $800,000. Annual O&M costs of the cap are estimated to be $3,000.

3.3.5 Alternative 5 - Ex-situ Treatment and Disposal

The fifth alternative is removal of all soils which exceed remediation goals and treatment on site by a combination of volume reducing processes and chemical reduction/oxidation. By products would be disposed of off site and clean-fill would be imported to compensate for any overall volume reduction.

Removal and ex-situ treatment is judged to be effective and implementable. It eliminates exposure risks by reducing the volume and toxicity of contaminants. However, this option requires substantial disturbance of the site, causing construction and neighboring site worker exposure hazards. The end product may still be hazardous and need to be shipped to the mainland for disposal and additional risks are associated with shipping of hazardous reagents and wastes. The estimated capital cost of total treatment and disposal is $6,150,000 with no annual O&M cost.

3.3.6 Alternative 6 - In-situ Treatment

The final alternative considered is in-situ solidification of soils exceeding remediation goals using a soil-cement mixing rig with multi-axis overlapping augers.

In-situ treatment by solidification is judged to be effective and implementable. It eliminates exposure risks by immobilizing contaminants sorbed to soil particles. However, this option requires substantial disturbance of the site, causing construction and neighboring site worker exposure hazards. The estimated capital cost of in-situ treatment by solidification is $970,000 with no annual O&M cost.

4.0 ANALYSIS OF ALTERNATIVES

Three alternatives which provide a range of distinct strategies in addressing the concerns associated with the site were selected for more detailed analysis, they are:

Alternative 2 - Modified Cap
Alternative 3 - Integrated Structures and Modified Cap w/o Treatment
Alternative 6 - In-situ Treatment

Alternative 1 - RCRA cap was dropped from consideration because it does not provide any benefits above a modified cap which is significantly less expensive to implement. Alternative 4 - Integrated Structures and Modified Cap with Treatment was dropped from consideration because it provides no advantages over an integrated cap without treatment which is significantly less expensive. Alternative 5 - Ex-situ Treatment and Disposal was dropped from further consideration because of the additional short-term risks associated with this option over in-situ treatment without a corresponding benefit.

4.1 Evaluation Criteria

The criteria selected for detailed individual and comparative analysis of the screened alternatives were taken from the approach set forth in the proposed Superfund Reauthorization Act. The Act proposes to make four major changes to the remedy decision process, namely: a.) containment would be explicitly endorsed as a legitimate remediation alternative, b.) consideration of future land uses would be explicitly required in formulating remedy decisions, c.) consideration of cost would be equally weighted with the other balancing criteria, and d.) the preference for treatment would be eliminated except with respect to "hot spots".

The proposed reform modifies the organization of the NCP's nine evaluation criteria into the single threshold criteria and five balancing criteria listed below:

4.1.1 Threshold Criteria

- Overall Protection of Human Health and the Environment - Before an alternative can be considered for further evaluation, it must be judged to pass the minimum requirement of being protective of human health and the environment. This criteria is used to assesses the overall ability of the alternative to comply with ARARs and meet remedial action objectives.

4.1.2 Balancing Criteria

- Effectiveness and Implementability - This criteria is used to assess the effectiveness of the alternative in achieving remedial objectives and examines the technical and administrative feasibility of the specified process options.

- Long-Term Reliability - This criteria judges the alternatives ability to maintain protection of human health and the environment after response objectives have been met.

- Short-Term Risks - This criteria examines the impacts of construction and implementation of the alternative. Specifically, risks to the environment, community, and workers are considered.

- Cost - The focus of this criteria is to make comparative estimates between the alternatives. Due to remaining uncertainties which will be address during remedial design, costs generated at this point may vary widely from actual costs of implementation. However, the same relative level of accuracy is achieved for each alternative, making cost comparisons between alternatives meaningful.

- Community Acceptance - This criteria attempts to assess the community's apparent preferences among or concerns about each alternative.

4.2 Individual Analysis of Alternatives

The three alternatives carried forward all pass the threshold criteria of being adequately protective of human health and the environment. The following sub-sections 4.2.1 through 4.2.3 provide a discussion of individual analysis of each alternative against the five balancing criteria (summarized in Table 4.1). The alternatives are comparatively analyzed in the following section.

4.2.1 Alternative 2 - Modified Cap

The modified cap is judged effective in limiting lead exposures risks by isolating the contaminated soil. However, installation of a modified cap which covers the entire site would prohibit future construction of sub-grade structures, limiting any redevelopment of the site. A properly maintained cap is judged to have long-term effectiveness in limiting exposures, but would require periodic inspection, routine maintenance, and eventual replacement of the wearing surface. During construction, short-term risks are posed to construction workers and potentially workers on adjacent properties. The cost of installing a modified cap over the entire site is estimated to be $550,000, with an annual O&M cost of $14,000. The community is unlikely to be affected by this type of remedy and is accepting of capped lead contaminated sites nearby (namely the Kakaako Waterfront Park). Acceptance of this type of remedy is anticipated by the property owner and regulatory agency.

4.2.2 Alternative 3 - Integrated Structures and Modified Cap w/o Treatment

The integrated cap is judged effective in limiting lead exposures risks by isolating the contaminated soil. Installation of an integrated cap would allow full site redevelopment and flexibility in site configuration.

Table 4.1 Detailed Analysis of Remedial Alternatives

Remedial Alternative	Modified Cap	Integrated Structures and Modified Cap w/o Treatment	In-situ Solidification
Overall Protection	Adequately protective of human health and the environment	Adequately protective of human health and the environment	Adequately protective of human health and the environment
Effectiveness and Implementability	Effective in limiting exposure risks through isolation of contaminants. Implementation requires regrading of site. Prohibits future construction of permanent site structures.	Effective in limiting exposure risks through isolation of contaminants. Implementation allows full site development and flexible site configuration.	Effective in limiting exposure risks by immobilizing contaminants. Implementation requires substantial disturbance of contaminated soils. Typically, volume of media increases 20-30 percent.
Long-term Reliability	A properly maintained cap can isolate contaminants indefinitely. May require periodic inspection and maintenance. Requires five year reviews of effectiveness.	A properly maintained cap can isolate contaminants indefinitely. May require periodic inspection and maintenance. Requires five year reviews of effectiveness.	Exposure to elements and future material handling may affect the ability of the stabilized mass to maintain immobilization of contaminants.
Short-term Risks	Inhalation, ingestion, and dermal contact risks to workers during regrading and placement of cap's lower layers. Inhalation risks to adjacent property workers during regrading operations.	Inhalation, ingestion, and dermal. contact risks to workers during regrading and placement of cap's lower layers. Inhalation risks to adjacent property workers during regrading operations.	Inhalation, ingestion, and dermal.. contact risks to workers during soil mixing operations. Inhalation risks to adjacent property workers during soil mixing operations.
ost	Capital: $550,000 Annual O&M: $14,000	Capital $185,000 Annual O&M: $3,000	Capital: $970,000 Annual O&M: $0
Community Acceptance	Community unlikely to be affected by remedy and is accepting of capped sites nearby. Property owner and regulator acceptance is anticipated.	Community unlikely to be affected by remedy and is accepting of capped sites nearby. Property owner and regulator acceptance is anticipated.	Community unlikely to be affected by remedy. Neighboring businesses may accept remedy if air emissions are controlled during implementation. Property owner and regulator acceptance is anticipated.

A properly maintained cap is judged to have long-term effectiveness in limiting exposures, but would require periodic inspection. Routine maintenance and repair of the surface elements of an integrated cap (the pavement asphalt, the building floor, the landscaping features) are judged to be no greater than the costs which would be normally encountered during the life of these standard site development features. During construction, short-term risks are posed to construction workers and potentially workers on adjacent properties. The additional cost of installing an integrated cap during the redevelopment of the site is estimated to be $185,000. Increased annual O&M costs due to periodic inspection and effectiveness reviews is estimated to be $3,000. The community is unlikely to be affected by this type of remedy and is accepting of capped lead contaminated sites nearby (namely the Kakaako Waterfront Park). Acceptance of this type of remedy is anticipated by the property owner and regulatory agency.

4.2.3 Alternative 6 - In-situ Treatment

In-situ treatment by solidification is judged effective in limiting lead exposures risks by immobilizing contaminants sorbed to soil particles. However, implementation of soil solidification requires substantial disturbance of contaminated soils and will probably cause a total increase in the volume of soils by 20-30 percent. Long-term reliability may be affected by exposure to the elements and any future excavation or material handling. Short-term risks are posed to construction and neighboring site workers due to possible exposure to airborne contaminated soil particles. The estimated capital cost of in-situ treatment by solidification is $970,000 with no annual O&M cost. The community is unlikely to be affected by this type of remedy. Neighboring businesses may be accepting if air emissions are controlled during implementation. Acceptance of this type of remedy is anticipated by the property owner and regulatory agency.

4.3 Comparative Analysis

All three alternatives (modified cap, integrated cap, and in-situ solidification) are judged to be adequately protective of human health and the environment. The modified cap and the integrated cap achieve protectiveness through isolation of contaminants, while solidification immobilizes contaminated soil to eliminate potential airborne particles.

The modified and integrated caps have long-term effectiveness if they are properly maintained through time. Solidification is effective over time if the solidified soils are not subjected to forces which would cause them to be pulverized into dust sized particles.

Implementation of all three options would pose short-term risk to construction workers and potentially off-site workers at adjacent facilities. Due to the intrusive nature of soil mixing, solidification may pose addition risks of generating airborne contaminated soil particles.

Capital costs range from a low of $185,000 for an integrated cap to a high of $970,00 for solidification. Annual O&M costs range from none for solidification to $14,000 for a modified cap. If lifecycle costs are considered, the total cost of a modified cap is estimated to be $1,250,000, the total cost of an integrated cap is estimated to be $335,000, and the total cost of solidification is estimated to be $970,000.

The community is unlikely to be affected by the implementation of any of the proposed alternatives. However, the community has accepted capping of lead contaminated soils at the nearby Kakaako Waterfront Park. Solidification may have a slight edge in acceptance due to the perception that it would provide a more permanent solution to exposure risks.

Property owner and regulatory acceptance of the protectiveness of any of the three options is anticipated. However, the property owner would most likely be adverse to the modified cap because it would prohibit construction of subsurface features and greatly restrict redevelopment of the site. The property owner may also have concerns over the annual operations and maintenance costs associated with impounding contaminated soils on site under either of the capping options. Solidification may be of concern to the owner due to the increase in volume of soils associated with the process and the resulting cementatous mass left behind by the process.

5.0 RECOMMENDATIONS

Based on a systematic review of available options and a comparative analysis of remedial action alternatives, COTTON and FRAZIER Consultants, Inc. recommends pursuing the integration of a permanent site cap into redevelopment of the site. We further recommend that all contaminated soils be impounded on site, including soils disturbed by site improvement construction.

To facilitate this action, we recommend that a qualified engineering firm design an integrated site cap into redevelopment of the site. Figure 4.1 provides a recommended basis for design.

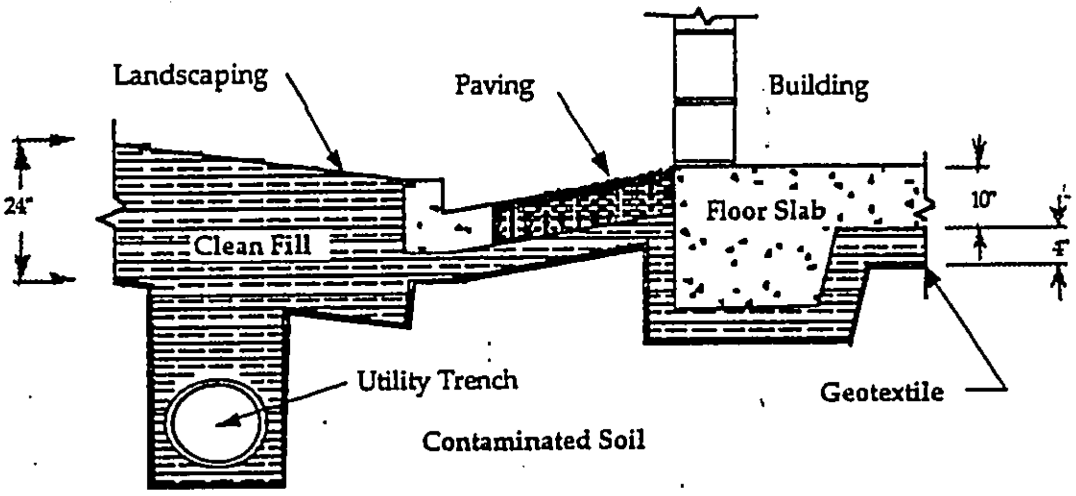


Figure 5.1 Recommended Integrated Cap Design Basis

Furthermore, we recommend that the selected designer specify adequate management practices to be used by the general contractor to ensure the health and safety of their workers and workers on neighboring properties during construction. We anticipate that periodic inspection of the cap system and effectiveness reviews will be required by the Hawaii Department of Health.

6.0 REFERENCES

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Appendix A

Engineering Calculations and Cost Estimates

LEAD RISK ASSESSMEI SPREADSHEET - Constructi Conditions

CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL

INPUT		OUTPUT							
MEDIUM	LEVEL		percentiles					PRG-99	PRG-95
			50th	90th	95th	98th	99th	(ug/g)	(ug/g)
LEAD IN AIR (ug/m^3)	0.15								
LEAD IN SOIL (ug/g)	130.0	BLOOD Pb, ADULT (ug/dl)	2.5	3.9	4.4	5.1	5.7	561.3	832.9
LEAD IN WATER (ug/l)	15	BLOOD Pb, CHILD (ug/dl)	4.7	7.3	8.3	9.6	10.5	108.6	217.6
PLANT UPTAKE? 1=YES 0=NO	1	BLOOD Pb, PICA CHILD (ug	11.4	17.8	20.2	23.4	25.8	19.2	38.4
RESPIRABLE DUST (ug/m^3)	1000	BLOOD Pb, INDUSTRIAL (u	2.1	3.3	3.8	4.4	4.8	1479.5	2188.9

EXPOSURE PARAMETERS

	units	residential			industrial
		adults	children	children with pica	adults
General					
Days per week	days/wk	7	7	7	5
Dermal Contact					
Skin area	cm^2	3700	2800	2800	5800
Soil adherence	mg/cm^2	0.5	0.5	0.5	0.5
Route-specific constant	(ug/dl)/(ug/day)	0.00011	0.00011	0.00011	0.00011
Soil ingestion					
Soil ingestion	mg/day	25	55	790	25
Route-specific constant	(ug/dl)/(ug/day)	0.0176	0.0704	0.0704	0.0176
Inhalation					
Breathing rate	m^3/day	20	10	10	20
Route-specific constant	(ug/dl)/(ug/day)	0.082	0.192	0.192	0.082
Water ingestion					
Water ingestion	l/day	1.4	0.4	0.4	1.4
Route-specific constant	(ug/dl)/(ug/day)	0.04	0.16	0.16	0.04
Food ingestion					
Food ingestion	kg/day	2.2	1.3	1.3	2.2
Route-specific constant	(ug/dl)/(ug/day)	0.04	0.16	0.16	0.04
Dietary concentration	ug/kg	12.7	12.7	12.7	10.0
Lead in produce	ug/kg	58.5	58.5	58.5	

PATHWAYS, ADULTS

Pathway	Residential		Industrial		Concentration in medium
	Blood Pb ug/dl	percent of total	Blood Pb ug/dl	percent of total	
SOIL CONTACT:	0.03	1%	0.03	1%	130 ug/g
SOIL INGESTION:	0.06	2%	0.04	2%	130 ug/g
INHALATION:	0.46	18%	0.33	15%	0.28 ug/m^3
WATER INGESTION:	0.84	34%	0.84	40%	15 ug/l
FOOD INGESTION:	1.11	45%	0.88	42%	12.7 ug Pb/kg diet

PATHWAYS, CHILDREN

Pathway	Typical		with pica		concentration in medium
	Blood Pb ug/dl	percent of total	Blood Pb ug/dl	percent of total	
SOIL CONTACT:	0.02	0%	0.02	0%	130 ug/g
SOIL INGESTION:	0.50	11%	7.23	64%	130 ug/g
INHALATION:	0.54	12%	0.54	5%	0.28 ug/m^3
WATER INGESTION:	0.96	21%	0.96	8%	15 ug/l
FOOD INGESTION:	2.63	57%	2.63	23%	12.7 ug Pb/kg diet

LEAD RISK ASSESSMENT SPREADSHEET - Industrial Us

CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL

INPUT		OUTPUT							
			percentiles					PRG-99	PRG-95
MEDIUM	LEVEL		50th	90th	95th	98th	99th	(ug/g)	(ug/g)
LEAD IN AIR (ug/m^3)	0.15								
LEAD IN SOIL (ug/g)	130.0	BLOOD Pb. ADULT (ug/dl)	2.3	3.6	4.1	4.7	5.2	863.4	1281.0
LEAD IN WATER (ug/l)	15	BLOOD Pb. CHILD (ug/dl)	4.4	6.9	7.9	9.1	10.0	129.9	260.5
PLANT UPTAKE? 1=YES 0=NO	1	BLOOD Pb. PICA CHILD (ug	11.1	17.5	19.8	22.9	25.2	19.7	39.6
RESPIRABLE DUST (ug/m^3)	50	BLOOD Pb. INDUSTRIAL (u	2.0	3.1	3.5	4.1	4.5	4262.5	6306.5

EXPOSURE PARAMETERS

		residential			industrial
	units	adults	children	children with pica	adults
General					
Days per week	days/wk	7	7	7	5
Dermal Contact					
Skin area	cm^2	3700	2800	2800	5800
Soil adherence	mg/cm^2	0.5	0.5	0.5	0.5
Route-specific constant	(ug/dl)/(ug/day)	0.00011	0.00011	0.00011	0.00011
Soil ingestion					
Soil ingestion	mg/day	25	55	790	25
Route-specific constant	(ug/dl)/(ug/day)	0.0176	0.0704	0.0704	0.0176
Inhalation					
Breathing rate	m^3/day	20	10	10	20
Route-specific constant	(ug/dl)/(ug/day)	0.082	0.192	0.192	0.082
Water ingestion					
Water ingestion	l/day	1.4	0.4	0.4	1.4
Route-specific constant	(ug/dl)/(ug/day)	0.04	0.16	0.16	0.04
Food ingestion					
Food ingestion	kg/day	2.2	1.3	1.3	2.2
Route-specific constant	(ug/dl)/(ug/day)	0.04	0.16	0.16	0.04
Dietary concentration	ug/kg	12.7	12.7	12.7	10.0
Lead in produce	ug/kg	58.5	58.5	58.5	

PATHWAYS, ADULTS

	Residential		Industrial		
Pathway	Blood Pb ug/dl	percent of total	Blood Pb ug/dl	percent of total	Concentration in medium
SOIL CONTACT:	0.03	1%	0.03	1%	130 ug/g
SOIL INGESTION:	0.06	2%	0.04	2%	130 ug/g
INHALATION:	0.26	11%	0.18	9%	0.16 ug/m^3
WATER INGESTION:	0.84	37%	0.84	43%	15 ug/l
FOOD INGESTION:	1.11	49%	0.88	45%	12.7 ug Pb/kg diet

PATHWAYS, CHILDREN

	Typical		with pica		
Pathway	Blood Pb ug/dl	percent of total	Blood Pb ug/dl	percent of total	concentration in medium
SOIL CONTACT:	0.02	0%	0.02	0%	130 ug/g
SOIL INGESTION:	0.50	11%	7.23	65%	130 ug/g
INHALATION:	0.30	7%	0.30	3%	0.16 ug/m^3
WATER INGESTION:	0.96	22%	0.96	9%	15 ug/l
FOOD INGESTION:	2.63	60%	2.63	24%	12.7 ug Pb/kg diet

PROJECT FLYNN - LEARNER — Computed LRC — Date 12-22-94 — Sheet 1 of 7

ITEM — Checked GAM — Date 1-12-95

GIVEN: SITE AREA = 130,568 ft² (from Tax Map)

Ave depth of effected soils = 5 ft bgs (from investigations)

- CALCULATED Volume of effected soils

$130,563\ ft^2 \times 5\ ft \times \frac{1\ C.Y.}{27\ ft^3} = 24,180\ C.Y.$

ASSUME: THREE - STORY BUILDING w/ BELOW GRADE FEATURES

BUILDING FOOTPRINT = 75% OF SITE
PAVED AREA = 15% OF SITE
LANDSCAPED AREA = 10% OF SITE

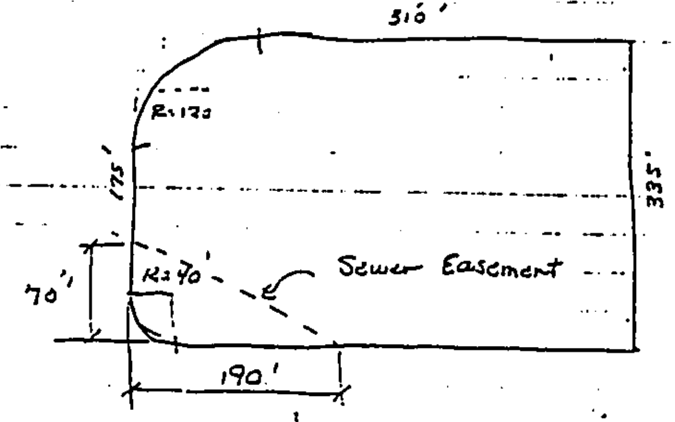
- BUILDING FOOTPRINT

$0.75 \times 130,563\ ft^2 = 98,000\ ft^2$

- Check Floor Area Ratio

$\frac{3\ floors \times 98,000\ ft^2}{130,568\ ft^2} = 2.25 < 2.5$ O.K.

- LANDSCAPE AREA = $0.10 \times 130,568\ ft^2 = 13,100\ ft^2$



- ASSUME S.W. CORNER REMAINS LANDSCAPED TO EDGE OF SEWER EASEMENT.

- AREA OF S.W.:

$A = 0.5 \cdot (190\ ft \times 70\ ft) - 0.215(40\ ft)^2$

$= 6650\ ft^2 - 344\ ft^2 = 6,300\ ft^2$

Sheet 2 of 7

PROJECT FLYNN - LEANER Computed LRC Date 12-22-94

ITEM Checked GAM Date 1-12-95

- REMAINING LANDSCAPED AREA

$13,100 \text{ ft}^2 - 6,300 \text{ ft}^2 = 6,800 \text{ ft}^2$

- ASSUME UNIFORM BELT ALONG PAHOUNUI DRIVE & SAND ISLAND ACCESS ROAD

- WIDTH = AREA ÷ LENGTH

$$= 6,800 \text{ ft}^2 \div ((400 \text{ ft} - 190 \text{ ft}) + 310' + (175 \text{ ft} - 30 \text{ ft}) + (\tfrac{1}{4} \times 2\pi \times 120 \text{ ft}))$$

$$= 6,800 \text{ ft}^2 \div (210 \text{ ft} + 145 \text{ ft} + 188 \text{ ft})$$

$$= 8.0 \text{ ft}$$

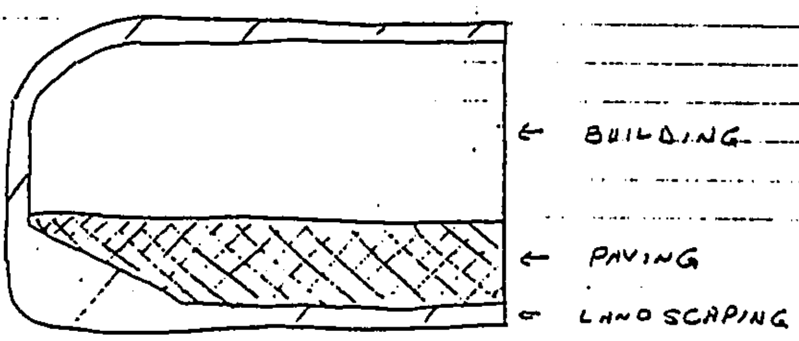
- PAVED AREA $= 0.15 \times 130,568 \text{ ft}^2 \cong 19,600 \text{ ft}^2$

  - ASSUME SINGLE PARKING AREA ON SAND ISLAND ACCESS ROAD SIDE
  - ASSUME LENGTH 290 ft

- DEPTH $= 19,600 \text{ ft}^2 \div 325 \text{ ft}$

$$= 60 \text{ ft}$$

- BUILDING DIMENSIONS



- DEPTH $= 335 \text{ ft} - (2(12.5 \text{ ft}) + 60 \text{ ft}) = 250 \text{ ft}$
- LENGTH $= 98,000 \text{ ft}^2 \div 250 \text{ ft} = 390 \text{ ft}$

Sheet 3 of 7

PROJECT FLYNN - LEARNER Computed LRC Date 12-22-94

ITEM Checked GAM Date 1-12-95

BUILDING: 390 ft × 250 ft = 97,500 ft²

• COLUMN SPACING ≈ 40 ft

390' → 10 @ 39.00' } 9 × 5 = 45 pile groups

250' → 6 @ 41.67' }

• COLUMN LOADS

ROOF @ 15 psf × 39 ft × 42 ft = 24.5 K

2 FLOORS @ 60 p.s.f × 39 ft × 42 ft = 196.0 K
(4" conc.)

1 SLAB @ 150 p.s.f. × 37 ft × 42 ft = 239.0 K
(10" conc.)

460 K

• NUMBER OF PILES / COLUMN

@ 40 T / PILE 460 K ÷ 80 K = 6 pile/cap

• CAP SIZE (2 ROWS OF 3)

0.25 + 1' + 2 + 1 + 2 + 1 + 0.25 = 7.5 ft

0.25 + 1 + 2 + 1 + 0.25 = 4.5 ft

- ASSUME 2 ft Depth

∴ 7.5 ft × 4.5 ft × 2.0 ft ⇒ 2.5 C.Y. each

• SOIL DISPLACED BY PILE CAPS

$2.5 \frac{C.Y}{CAP} \times 45$ caps = 113 C.Y.

• WALL LOADS

35 ft × 0.5 ft × 160 p.c.f. = 2.8 KLF

- ASSUME 2 ft × 2 ft grade beam 0.7 KLF

3.5 KLF

PROJECT FLYNN - LEARNER

Sheet 4 of 7

ITEM

Computed LRC Date 12-22-94

Checked GAM Date 1-12-95

- SOIL DISPLACED BY GRADE BEAMS

PERIMETER 2 (390 ft + 250 ft) × 4 ft² ⇒ 190 C.Y.

INTERIOR WALLS (3 @ 250 ft) × 4 ft² ⇒ 111 C.Y.

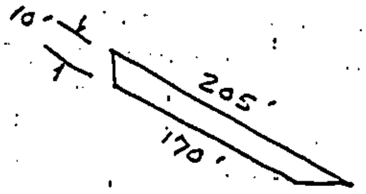
301 C.Y.

- SOIL DISPLACED BY BUILDING

PILE CAPS	113 C.Y.
GRADE BEAMS	301 C.Y.
	415 C.Y.

UTILITIES

SEWER EASEMENT - ASSUME CONSTRUCTION OF "CLEAN" CORRIDOR FOR EASEMENT



A = 170 ft × 10 ft

+ ½ × 35 ft × 10 ft

A = 1,900 ft²

- VOLUME = AREA × DEPTH

V = 1,900 ft² × 5 ft ⇒ 350 C.Y.

UTILITY CORRIDOR

- ASSUME CONSTRUCTION OF "CLEAN" UTILITY CORRIDOR FOR BUILDING SERVICE

V = 400 ft L × 5' W × 5' D ⇒ 370 C.Y.

DOCUMENT CAPTURED AS RECEIVED

PROJECT FLYNN – LEARNER
Computed LRC Date 12-22-94
ITEM
Checked GAM Date 1-12-95
Sheet 5 of 7

LOADING DOCK

- ASSUME: 4 BAYS @ 40 ft / BAY
  40 ft RAMP to
  5 ft Below T.O.S.

• VOLUME = 4 × 40 ft × ½ (5 ft × 40 ft) => 595 C.Y.

ELEVATOR SHAFTS

- ASSUME: 3 elevators @ 12 ft × 12 ft
  to 5' Below Grade

• VOLUME = 3 × 12 ft × 12 ft × 5 ft => 80 C.Y.

LANDSCAPING

- ASSUME EXCAVATION TO 2 ft & BACKFILL
  WITH CLEAN FILL

V = (9,800 ft² – 1,900 ft²) × 2 ft => 585 C.Y.

TOTAL BUILDING w/ LANDSCAPING & SUB-GRADE FEATURES

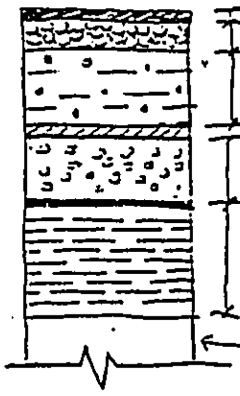
STRUCTURE	415 CY
LOADING DOCK	595
ELEVATORS	80
UTILITIES	370
LANDSCAPING	585
C&C EASEMENT	350.
	2,400 C.Y.

Sheet 6 of 7

PROJECT FLYNN - LEARNER Computed LRC Date 12-22-94

ITEM Checked GAM Date 1-12-95

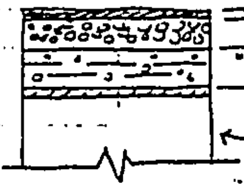
RCRA CAP



2"	ASPHALT	→	14,500	S.Y.
6"	BASE COARSE	→	7,250	C.Y.
18"	CLEAN FILL	→	21,750	C.Y.
	GEOTEXTILE	→	14,500	S.Y.
12"	SAND	→	14,500	C.Y.
	20 mil FML	→	14,500	S.Y.
24"	CLAY	→	29,000	C.Y.

EFFECTED SOILS

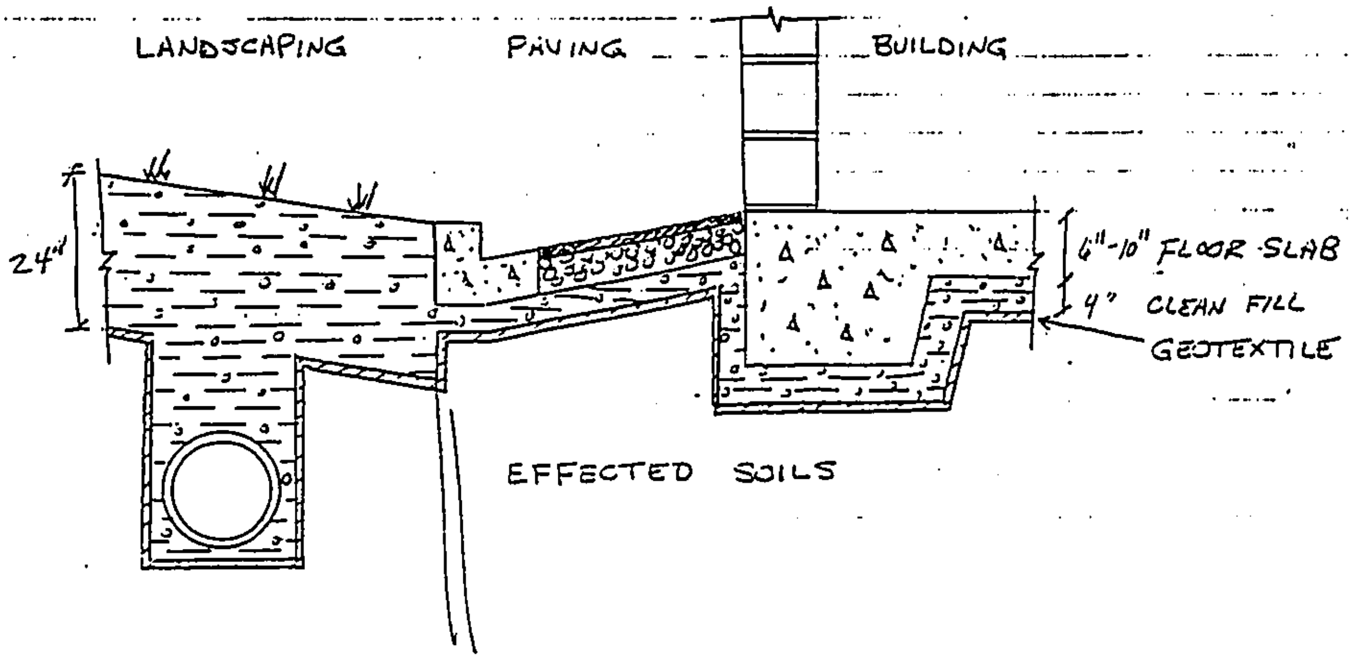
MODIFIED CAP



2"	ASPHALT	→	14,500	S.Y.
6"	BASE COURSE	→	7,250	C.Y.
4"	CLEAN FILL	→	4,830	C.Y.
	GEOTEXTILE	→	14,500	S.Y.

EFFECTED SOILS

INTEGRATED STRUCTURES & MODIFIED CAP



PROJECT FLYNN - LEARNER Computed LRC Sheet 7 of 7 Date 12-22-94

ITEM Checked GAM Date 1-12-95

- IMPORTED CLEAN FILL

LANDSCAPED AREAS 535 CY (See Sheet #5)

UTILITY CORRIDOR 370

C & C EASEMENT 350

PAVED AREAS

V = 19,600 ft² × 4 in ⇒ 250

BUILDING

V = 98,300 ft² × 4 in ⇒ 1,210

2,800 CY

- GEOTEXTILE

A = 130,568 ft² × 1.20 (OVERLAPS AND SIDES OF EXCAVATIONS)

⇒ 17,500 S.Y.

EX-SITU TREATMENT

- VOLUME OF SOIL

V = 130,568 ft² × 5 ft ⇒ 24,179 C.Y.

- WEIGHT OF SOIL

$W = 24,179 \text{ C.Y.} \times \frac{1.7 \text{ TONS}}{\text{C.Y.}} = 41,000 \text{ TONS}$

Sheet 1 of 4

PROJECT FLYNN - LEARNER
Computed LRC Date 12-23-94

ITEM
Checked GAM Date 1-19-95

COST ESTIMATES - CAPITAL COSTS

RCRA CAP - CAPITAL

ASPHALT	14,500	SY	@	9.00 /SY	$ 130,600
BASE COURSE	2,420	CY		62.64	151,500
CLEAN FILL	7,255	CY		22.00	159,600
GEOTEXTILE	14,500	SY		1.80	26,100
SAND	4,840	CY		20.00	96,700
30 mil FML	14,500	SY		15.00	217,500
CLAY	9,680	CY		20.00	193,600
					975,600
Grading	12,100	CY		5.00	60,500
Mob/Demob	1	LS		5,000	5,000
Drainage	1	LS		35,000	35,000
Add'l mgmt, H&S	1	LS		20,000	20,000
					1,096,100
Engr	8%				87,700
CM	8%				87,700
Permits	5%				54,800
					1,326,300
Contingency	10%				132,600
					$ 1,459,000

PROJECT FLYNN - LEARNER
Computed LRC Date 12-23-94
Sheet 2 of 4
ITEM
Checked GAM Date 1-19-95

MODIFIED CAP

ASPHALT	14,500	SY	@	9.00	SY	$ 130,600
BASE COURSE	2,420	CY		62.64		151,500
CLEAN FILL	1,500	CY		22.00		35,100
GEOTEXTILE	14,500	SY		1.80		26,100
GRADING	2,400	CY		5.00		12,000
MOB / DEMOB	1	LS		5000.00		5,000
DRAINAGE	1	LS		35,000.00		35,000
HDDNL H & S	1	LS		20,000.00		20,000
						415,300
ENG'G 8 %						33,200
CM 8 %						33,200
Permit 5 %						20,300
						502,500
Contingency 10%						50,300
						$ 552,800

Sheet 3 of 4

PROJECT FLYNN - LEARNER Computed LRC Date 12-23-94

ITEM Checked GAM Date 1-19-95

INTEGRATED STRUCTURES (Cap costs in excess of site improvements)

- W/O TREATMENT:

CLEAN FILL	2,800 CY	@ 22.00 /CY		$ 61,600
GEOTEXTILE	17,500 SY	1.80		31,500
GRADING	3,500 CY	5.00		17,500
TRENCHING	720 CY	12.00		8,600
				119,200
ADDL H&S				20,000
				139,200
ENGR	8 %			11,100
CM	8 %			11,100
PERMITS	5 %			7,000
				168,400
CONTINGENCY	10%			16,800
				$ 185,200

- WITH TREATMENT

VOLUME OF SOIL EXCAVATED FOR SITE IMPROVEMENTS = 2,400 C.Y.
2,400 CY x 1.7 TONS/CY = 4,080 TONS

ADD:	MATERIAL HANDLING	4080 TONS	$ 20 / TON	$ 81,600
	SOIL WASHING	4080 TONS	$ 100 / TON	408,000
	WASTE TREATMENT/ DISPOSAL	408 TONS	$ 300/TON	122,400
			Add	$ 612,000
			CAPITAL	$ 797,200
			O&M	10,000 /yr

PROJECT FLYNN - LEARNER
Sheet 4 of 4
ITEM
Computed LRC Date 12-23-94
Checked GAM Date 1-19-95

EX-SITU TREATMENT

Volume of affected Soil 24,200 C.Y. = 41,000 TONS.

MATERIAL HANDLING	41,000 TONS	$20/TON	$820,000
SOIL WASHING	41,000 TONS	100/TON	4,100,000
WASTE TREATMENT/ DISPOSAL	4,130 TONS	300/TON	1,230,000
			$6,150,000

IN-SITU SOLIDIFICATION

Volume of affected soil 24,200 C.Y.

SOIL STABILIZATION BY OVERLAPPING AUGERS	24,200 C.Y.	$40/CY	$968,000

Sheet 1 of 2

PROJECT FLYNN - LEARNER Computed LRC Date 1-20-95

ITEM Checked GAM Date 1-20-95

COST ESTIMATES - O & M COSTS

RCRA CAP

- ASSUME PAVEMENT SURFACE SERVICABLE LIFE OF 20 yrs

→ FULL REPLACEMENT OF ASPHALT EVERY 20 yrs	$ 150,000
→ REPAIR OF SUBGRADE AT TIME OF REPLACEMENT	25,000
→ AFTER 5 yrs ANNUAL REPAIR OF DEFECTS EQUAL TO 2% OF REPLACEMENT COST	3,000
○ ASSUME ANNUAL INSPECTION & DOCUMENTATION	1,000
○ ASSUME FULL EFFECTIVENESS REVIEW EVERY 5 YRS	10,000

○ ASSUME INFLATION RATE = EFFECTIVE RATE OF RETURN

ANNUALIZED COST =	150,000 ÷ 20 →	7,500
	25,000 ÷ 20 →	1,250
	3,000 × 15 ÷ 20 →	2,250
	1,000 × 1 →	1,000
	10,000 × 4 ÷ 20 →	2,000
	ANNUAL O & M	$ 14,000

MODIFIED CAP

- ASSUME SAME SURFACE PAVEMENT AS RCRA CAP

ANNUAL O & M $ 14,000

INTEGRATED CAP

- ASSUME PAVEMENT, BUILDING, AND LANDSCAPING MAINTENANCE & REPAIR COSTS ARE NOT AFFECTED BY CAP.

→ ANNUALIZED COSTS DUE TO CAP ARE THOSE FOR

INSPECTION & DOCUMENTATION	1,000 ÷ 1	1,000
EFFECTIVENESS REVIEW / 5 YRS	10,000 ÷ 5	2,000
	ANNUAL O & M	$ 3,000

Sheet 2 of 2

PROJECT FLYNN - LEARNER Computed LRC Date 1-20-95

ITEM Checked GAM Date 1-20-95

LIFE - CYCLE COSTS

- Assume a design life of 50 years
- Assume cost of money, inflation, and rate-of-return are all equal

o MODIFIED CHP

550,000 + 50 × 14,000 = $1,250,000

o INTEGRATED CHP

185,000 + 50 × 3,000 = $335,000

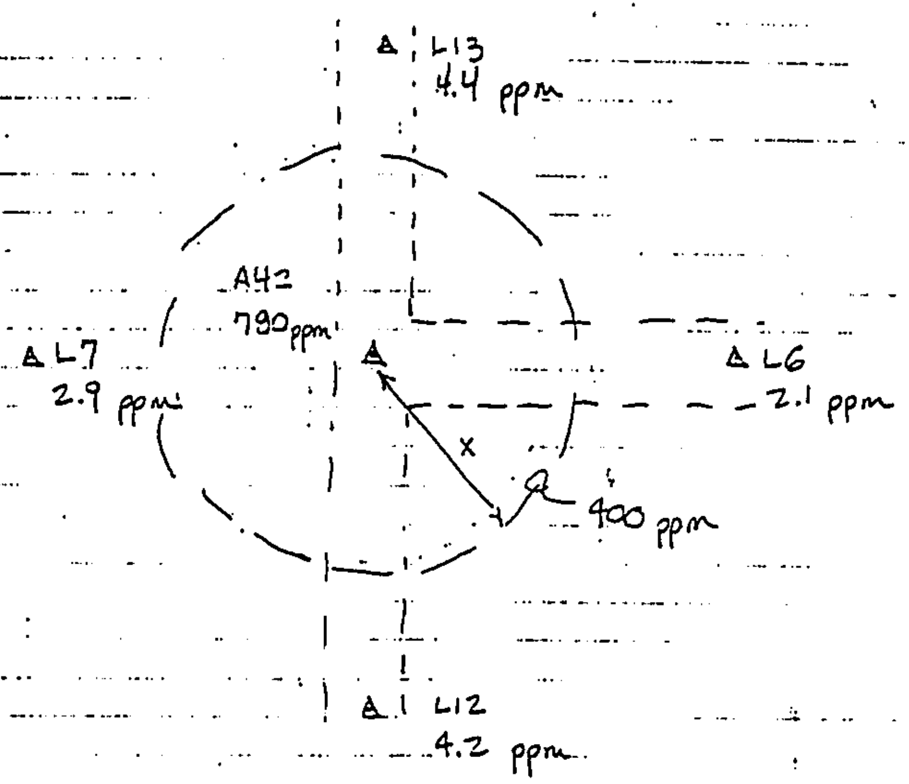
o SOLIDIFICATION

970,000 + 0 = $970,000

Sheet 1 of 1

PROJECT 94200 - AAFES FOUR SEASONS Computed LRC Date 1-23-95

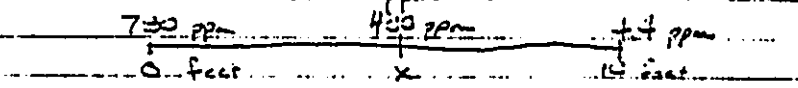
ITEM LEAD IN SOIL Checked GAM Date 1-24-95



ASSUME - CONCENTRATION DEMINISHES LINEARLY

- CALCULATE AREA WITH LEAD ELEVATED ABOVE 400 ppm.

DISTANCE TO 400 ppm isobar



$$780 - 4.4 = \frac{775.6}{10} = 77.6 \text{ ppm/ft}$$

$$\frac{400}{77.6} = 5.2 \text{ ft}$$ $\therefore$ 400 ppm isobar at 5 ft from A42

$$A = \pi 5^2 = 78.5 \text{ ft}^2$$

- CALCULATE VOLUME OF SOIL > 400 ppm

Ave thickness = 3 ft

$$V = 78.5 \text{ ft}^2 \times 3 \text{ ft} = 235 \text{ ft}^3 = 9 \text{ C.Y.}$$

$$9 \text{ CY} \times 1.7 = 15 \text{ TON} \times 450/\text{TON} = \$6,750^{\underline{00}}$$

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

LAWRENCE MIIKE
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HAWAII 96801

In reply, please refer to:
HEER OFFICE

June 15, 1995

95-160-MM

Mr. James C. Banigan
Flynn-Learner
91-056 Hanua Street
Ewa Beach, Hawaii 96707

Dear Mr. Banigan:

The Department of Health Hazard Evaluation and Emergency Response Office (HEER) has reviewed the Remedial Alternatives Analysis for the Flynn Learner site located at 120 Sand Island Access Road. The HEER Office concurs with the use of the remedial alternative of the integrated structures and modified cap over the site to protect human health and the environment. In general, we concur with your proposal to eliminate the risk caused by the lead by capping the contaminated soil.

We are requesting that you submit to us the design and construction plans for the integrated cap, which shall include the installation of groundwater monitoring wells, along with a management plan for the cap and an operations and maintenance plan for the monitoring wells. A health and safety plan for construction workers installing the cap or any structures built on the site should also be submitted. We are also requesting that a time schedule be submitted on the installation of the integrated cap.

The HEER Office feels that the investigation that was done to locate and remove the free floating oils on the site was not sufficient or fully completed. Before the integrated cap can be installed, we are requesting you to further investigate the areas where free floating oils were found and determine the extent of the free floating oil, to include offsite areas if required, and to remove as much of the oil as possible. We ask that you submit to us for review your plans for the investigation and for the removal of the free floating oil.

<u>We are also requesting that you:</u>

1. Remove all vehicles that are on the site and insure that no lead contaminated soil is tracked off the site on the vehicle tires.

2. Repair the fencing and gates on the site to provide proper security which will prevent people from going onto the site.

3. Post warning signs every 100 feet around the perimeter fencing to inform the public of the hazard posed by the lead contaminated soil on site.

4. Install a temporary cap on the site to prevent the lead contaminated soil from getting airborne and blowing off the site. Also submit the design plans for the temporary cap to to our office for review prior to installation.

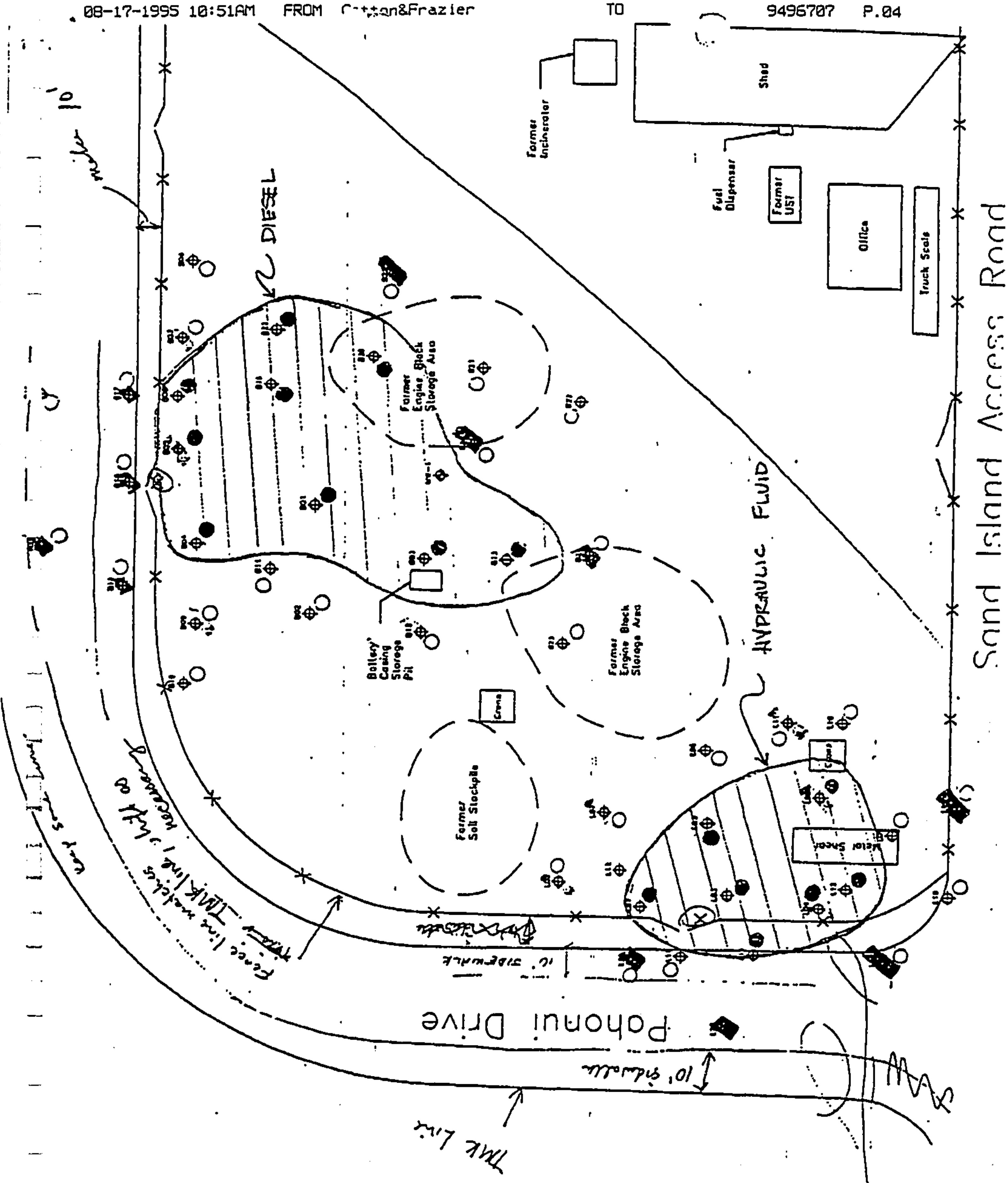
Since hazardous lead contaminated soil will be left in place on the site, we are investigating the need for a deed restriction to be placed on the property identifying the presence of hazardous lead contaminated soil and the requirement to have a properly maintained cap over the contaminated site.

Should you have any questions on the information covered in this letter, please contact Mr. Michael Miyasaka at 586-4698.

Sincerely,

Steven S. Armann, Acting Manager
Hazard Evaluation and Emergency Response Office

c: James Whitman, Damon Estate
Cotton and Frazier Consultants, Inc.


Shed
Former Incinerator
Fuel Dispenser
Former UST
Office
Truck Scale
Sand Island Access Road
DIESEL
HYDRAULIC FLUID
Former Engine Block Storage Area
Former Engine Block Storage Area
Battery Casing Storage Pit
Crane
Former Soil Stockpile
Metal Shear
Crane
Pahonui Drive
10' sidewalk
10' sidewalk
TMK Line
make 10'
Fence line matches TMK line

COTTON and FRAZIER Consultants, Inc.
P.O. Box 27126 Honolulu, Hawaii 96827
Phone: (808) 599-1993 Fax: (808) 599-1502

FAX-MEMO

DATE: Aug. 17, 1995

FAX NO: 949-6707

To : Robert S. Nitta - Sueda & Assoc.

From : Lee Cranmer

RE : 120 Sand Island Access Rd.

We are transmitting 4 page (s), including this cover sheet. If you experience any difficulty with this transmission, please call (808) 599-1993.

Original copy ______ *will* be sent. Original copy x *will not* be sent.

COMMENTS:

Robert:

It was a pleasure meeting with you this morning. Forwarded are copies of the DOH letter I referenced and field notes indicating the extents of free product remaining on site. Call me at 599-1993 with any questions which arise.

Lee

Free Product Delineation Report

Location:
Flynn-Learner
120 Sand Island Access Road
Honolulu, HI

August 29, 1995

CF Job #93064.1

COTTON and FRAZIER Consultants, Inc.

Environmental Solutions

P.O. BOX 27126
Honolulu, Hawaii 96827

PHONE (808) 599-1993
FAX (808) 599-1502

FREE PRODUCT DELINEATION REPORT
CF Job #93064.1

Prepared for:
Flynn-Learner

Location:
120 Sand Island Access Road
Honolulu, HI 96819

Prepared by:

Robert W. Rooks, PE
Project Engineer

Approved by:

W. Mark Frazier
Vice President

August 29, 1995

EXECUTIVE SUMMARY

COTTON and FRAZIER Consultants, Inc. (CF) was retained by Hawaii Metals Recycling to perform subsurface characterization work at the former Flynn-Learner metals recycling site at 120 Sand Island Access Road in Honolulu, Hawaii. Initial site investigation work in 1992 showed the presence of free phase petroleum product in two distinct areas on the site. Field observations indicated an area near the southwestern corner of the site where a "clear oil" was seen on the groundwater and a larger area extending from the center of the site to the northwestern property boundary where a "heavy black oil" was seen. The objective of the current investigation was to determine the lateral extents of these two contaminant plumes.

In July and August of 1995, soil samples were collected from the water table depth at 21 locations in and around the area formerly observed to contain the "clear oil" and at 26 locations in and around the area seen to be contaminated with the "heavy black oil." Samples were collected from discrete depth intervals using Direct Push Sampling (DPS) techniques and Geoprobe sampling equipment. Samples were collected in clear polyethylene sample sleeves, opened, and observed for evidence of soil saturation, visible petroleum product, and discernible petroleum odors.

Visible free product in the form of hydraulic oil was observed in 7 of the 21 samples collected from the "clear oil" area, yielding a contaminated area of approximately 6,000 square feet. Product in 1 of 8 probe locations outside the property boundary indicated that the observed plume extended slightly off site to the southwest. It was not seen to extend across Pahounui Street. Vertically, the product appeared to be confined to the zone of tidal fluctuation.

Product as a mixture of diesel fuel and motor oil was observed at the water table depth in 9 of the 26 locations sampled in the "heavy black oil" area, yielding an affected area of approximately 13,500 square feet. The plume did not extend to probe locations just outside the property boundary to the northwest. The product appears to be bound in the soil and fill materials under capillary pressure and is not easily released from the formation.

Laboratory analysis of soil samples surrounding both plumes for Total Petroleum Hydrocarbons as both diesel and as motor oil showed that soil contamination levels decreased significantly outside the free product areas. Based on these findings, we conclude that petroleum contamination in soils is generally limited to the areas where free product was observed.

COTTON and FRAZIER recommends removal of the hydraulic oil product impacted soils by excavation. Unimpacted surface soils down to approximately four feet should be excavated and set aside. The discrete zone of product contaminated soils can then be excavated and transported for proper disposal, followed by returning the clean surface soils to the excavation. Such work should consider the previously-identified hazards posed by other contaminants in the surface materials.

Further, we recommend regular monitoring of the diesel and motor oil plume to assess its migration and natural attenuation by biologic activity. This can be accomplished by a series of permanent groundwater and soil gas monitoring points to be installed in conjunction with the site cap.

TABLE OF CONTENTS

1.0 INTRODUCTION

The Flynn-Learner site is located at 120 Sand Island Access Road in Honolulu, Hawaii (see Site Location Map, Figure A-1, Appendix A). From 1976 to 1991, Flynn-Learner operated a scrap metal recycling facility on the property, dismantling automobiles and other metal products for eventual recycling. Prior to this time, the site was owned and operated by others performing the same type of recycling business since the 1940s.

In October of 1991, Weiss Associates presented a letter summarizing the results of surface soil sampling at the site. The results presented several concerns, including petroleum contamination of soils and groundwater, heavy metals contamination in soils, and other potential contaminants associated with former use of the property.

In October of 1992, COTTON and FRAZIER Consultants, Inc. (CF) presented the results of site characterization work in a report entitled "Flynn-Learner Sand Island Site - Environmental Investigation Report." In that investigation, CF collected soils and groundwater from 16 test pits performed on the site. Field observations indicated an area near the southwestern corner of the site where a "clear oil" was seen on the groundwater and a larger area extending from the center of the site to the northwestern property boundary where a "heavy black oil" was seen.

Laboratory analysis of soil and groundwater samples yielded elevated levels of lead, copper, and zinc in site soils. Low levels of polynuclear aromatic hydrocarbons (PAHs) and polychlorinated biphenyl (PCB) compounds were seen in soils at limited locations, but not in groundwater. Chlorinated organics were not detected in soil or groundwater at the site.

1.1 Purpose and Scope

The objective of the current investigation was to determine the lateral extents of the "clear oil" and the "heavy black oil" petroleum products identified previously. Specifically, it was desired to determine whether free product contamination had migrated outside the site boundaries.

Also included in the present study was laboratory analysis of selected soil samples from within and outside of the free product plumes to determine the extent of sorbed phase petroleum contaminants. Analysis for constituents other than PAHs and Total Petroleum Hydrocarbons in the diesel and oil ranges is beyond the scope of the investigation, but was completed during previous investigations at the site.

2.0 SITE DESCRIPTION

2.1 Present Site

The former Flynn-Learner metal recycling site consists of a flat 300 by 300 foot property located on the west side of the Sand Island area adjacent to Keehi Lagoon. The site is bound on three sides by Sand Island Access Road and Pahounui Drive. Structures on the site consist of a single-story scale house and a large maintenance shed in the eastern corner of the property.

Structures formerly on the property, according to historic maps and and conversations with past employees during previous investigations, consisted of an incinerator, metal shear equipment, a battery casing storage sump, and an engine block sump. The locations of these items are shown on the Sample Location Map presented in Appendix A (Figure A-2). We understand that a single underground storage tank was formerly located near the buildings in the eastern corner of the site.

2.2 Neighboring Properties

Adjoining properties include a large building supply business (Kilgo's) immediately adjacent to the northeast. Ameron HC&D, a cement facility, is located across Pahounui street to the west, separating the subject site from Keehi Lagoon. The US post Office maintenance facility and Kapalama Military Reserve are located south of the site. Various other retail and industrial businesses occupy the other adjoining properties.

2.3 Topography, Physiography, and Hydrogeologic Setting

The site is located on the western side of Honolulu on a small peninsula of reclaimed land. Topographic coverage of the vicinity is provided by the US Geologic Survey, 7.5 minute series, Island of Oahu, Honolulu quadrangle. A portion of the topographic map has been reproduced as Figure A-1 in Appendix A.

The elevation of the site varies between approximately 5 and 7 feet above mean sea level. The site is nearly flat but has a slight topographic gradient downward to the northwest. The nearest surface water body is Keehi Lagoon approximately 200 feet to the west.

Geologically, the site is located on the western flank of the Koolau sheild volcano on the Honolulu plain, an elevate coral reef. The site itself is apparently underlain by coralline fill material and lagoon sediments, which are in turn underlain by coralline reefal materials with alluvial soils, and, with depth, by volcanic rock.

Groundwater near the center of the site was measured at 5.8 feet to 6.2 feet below ground surface (bgs) in monitor wells MW-2 and MW-1, respectively, during the site investigation (mid to high tide cycle). First-encountered groundwater beneath the site is brackish and is not considered a potential source of drinking water. The prevailing direction of local groundwater flow has been shown during previous work to be very shallow (<0.001 ft/ft) and in a westerly direction. The site is situated below the State of Hawaii's Underground Injection Control (UIC) line.

3.0 FIELD SAMPLING

In July and August of 1995, soil samples were collected from the water table depth at 21 locations in and around the area formerly observed to contain the "clear oil" and at 26 locations in and around the area seen to be contaminated with the "heavy black oil."

Sample locations, shown on Figure A-2 in Appendix A, were selected in the field based on real time information from previous probe locations. Initially, probe locations were selected in the suspected center of each plume. After demonstrating the effectiveness of the screening method, sampling proceeded outward in each direction until no further product was observed in soil samples collected from the water table elevation.

The Geoprobe sampling methodology is described in detail in Appendix B. One inch diameter by 22 inch long soil cores were removed from each location in clear polyethylene sleeves. Soils were described according to the Unified Soil Classification System (USCS) and visually observed for free phase petroleum product. Each core was assessed for evidence of soil saturation to indicate that the water table depth was encountered and recovered. After initial observation, the liners were cut open and checked for discernible petroleum odors. When neither visible product nor odors were readily detected, a small subsample was placed in clean water, agitated, and observed for presence of a sheen or floating separate phase product. Samples with either visible product, discernible petroleum odor, or sheen upon immersion in water were classified as containing product.

Each sample collected was placed in a laboratory jar, labeled, and preserved on ice for future laboratory analysis if necessary.

4.0 FIELD OBSERVATIONS

Soils on the site were found to be consistent with those encountered during previous investigations. At the southwestern corner of the property, soils consisted of generally fine-grained sediments interlayered with coarse sands and coralline gravels at the water table. Probe locations at the northern boundary of the "clear oil" plume encountered man-made fill materials in the form of glass shards and other debris from the surface to the maximum depth of probing. Soil description logs and observations are documented in Appendix B.

From the center of the site to the northwestern property boundary miscellaneous fills, including clayey gravels, glass shards, and metal (auto parts) were encountered. Several locations presented refusal on metal at depths of 2 to 4 feet after numerous probing attempts.

4.1 "Clear Oil" Area

Product in the form of a yellowish fluid, similar in appearance and odor to hydraulic oil, was observed in 7 of the 21 samples collected from the "clear oil" area, yielding a contaminated area of approximately 6,000 square feet. The observed plume extended slightly outside the property boundary to the southwest. It was not seen to extend across Pahounui Street. Vertically, the product appeared to be confined to the zone of tidal fluctuation (0.5 to 1 ft). Product was physically observed in a band approximately 6 inches thick near the center of the product plume. Based on previous work at the site, the product may be in an "available" state, that is, it will freely flow from the soil formation. The lateral extent of observed free product is shown on Figure A-3 in Appendix A.

4.2 "Heavy Black Oil" Area

Petroleum product was observed at the water table depth in 9 of the 26 locations sampled in the "heavy black oil" area, yielding an affected area of approximately 13,500 square feet. Field observations and odors were described variably as either "degraded" diesel or as motor oil. The plume did not extend to probe locations just outside the property boundary to the northwest. The product appears to be bound in the soil and fill materials under negative capillary pressure and is not easily released from the formation. Consequently, the vertical extent of product contamination was not readily apparent in the field. The lateral extent of observed free product is shown on Figure A-3 in Appendix A.

5.0 LABORATORY RESULTS

After the extents of free product were plotted on a map, samples from outside the perimeter of each area were selected and submitted for laboratory analysis. All samples were analyzed for Total Petroleum Hydrocarbons as Diesel (TPH-D) and for Total Petroleum Hydrocarbons as 30W Motor Oil (TPH-O). Both analyses were performed by EPA Method 8015M. Also, four samples from within and outside of the "heavy black oil" plume were analyzed for Polynuclear Aromatic Hydrocarbons (PAHs) by EPA Method 8310. Analytical results are summarized in Table 1 below and are discussed further in the sections which follow.

One product-containing sample from each plume, along with a sample of virgin hydraulic oil provided by the former site operator, was used to produce a simulated distillation curve for the the product present. The distillation curves and all other analytical results are presented in Appendix C.

5.1 "Clear Oil" Area

Analysis for TPH-Diesel in soils surrounding the "clear oil" plume produced low to non-detect results. Sample 64S-L8-6, collected inside the product plume, showed a result of 640 milligrams per kilogram (mg/kg), indicating that there may be a diesel range component to the contaminant present. Results are shown on Figure A-4 in Appendix A.

Analysis for TPH as 30W Motor Oil showed results up to 6,300 mg/kg inside the product plume. Samples surrounding the plume showed results from non-detect (less than 20 mg/kg) to approximately 200 mg/kg. Results generally indicated that contamination is limited to the area of observed free product.

Sample 64S-L4-6, from location L4, was used to produce a simulated distillation curve for the product. The curve, presented in Appendix C, indicates compounds in the carbon range generally consistent with hydraulic oil and containing a small amount of diesel range organics, however, a characteristic hydraulic oil pattern was not revealed. The laboratory quantified the sample as TPH-D at 0.51 mg/kg.

A virgin hydraulic oil sample was provided by the former site operator. The oil was reported to be the same type as that formerly used in the metal shear at this location. A simulated distillation curve for the product sample, sample 64.1P-HO, showed a pattern consistent with hydraulic oil containing approximately 14 percent diesel range organics. The simulated distillation curve can be found in Appendix C.

Table 1. Summary of Analytical Results

(all results in mg/kg)

Sample Location	Sample Number	TPH-Diesel	TPH-30W Oil	PAHs			
				Benzo(a)pyrene	Acenaphthene	Fluoranthene	Naphthalene
B05	64S-B5-5	4698	†	< 0.017	< 0.17	< 0.017	< 0.083
B07	64S-B7-5	< 5.0	46	< 0.017	< 0.17	< 0.017	< 0.083
B09	64S-B9-5	< 5.0	< 20	-		-	
B12	64S-B12-6	190	3000	-	-	-	-
B14	64S-B14-5	< 5.0	< 20	-	-	-	-
B15	64S-B15-5	< 5.0	< 20	-	-	-	-
B17	4W-B17-5	< 5.0	< 20	-	-	-	-
B18	64S-B18-5	< 5.0	< 20	< 0.017	< 0.17	< 0.017	< 0.083
B22	64S-B22-6	< 5.0	< 20	0.086	< 0.17	0.024	< 0.083
B24	64S-B24-6	< 5.0	< 20	-	-	-	-
B26	64S-B26-6	< 5.0	< 20	-	-	-	-
B27	64S-B27-6	180	610	-	-	-	-
L02	64S-L2-6	< 5.0	100	-	-	-	-
L04	64S-L4-6	< 5.0	†	-	-	-	-
L07	64S-L7-6	8.6	110	-	-	-	-
L08	64S-L8-6	640	6300	-	-	-	-
L11	64S-L11-6	< 5.0	< 20	-	-	-	-
L17	64S-L17-5	6.3	< 20	-	-	-	-
L19	64S-L19-5	< 5.0	190	-	-	-	-
L20	64S-L20-5	7.6	28	-	-	-	-
L21	64S-L21-5	< 5.0	< 20	-	-	-	-
DOH Criteria		NS	NS	1	100	500	100

PAHs	Polynuclear Aromatic Hydrocarbons (EPA Method 8310)
TPH-Diesel	Total Petroleum Hydrocarbons as Diesel Fuel (EPA Method 8015M)
TPH-30W Oil	Total Petroleum Hydrocarbons as 30W Motor Oil (EPA Method 8015M)
NS	No DOH criteria published
<	Result less than indicated detection limit reported by laboratory
-	Not analyzed
†	value not quantified separately from TPH-D by laboratory

5.2 "Heavy Black Oil" Area

Analysis for TPH-Diesel in soils surrounding the "heavy black oil" plume produced results ranging from non-detect to approximately 200 mg/kg. Sample 64S-B5-5, collected inside the product plume, showed a result of 4,200 mg/kg, indicating the presence of diesel range organics in the plume. Results are shown on Figure A-4 in Appendix A.

For TPH as motor oil, samples surrounding the plume generally showed low to non-detect results (less than 20 mg/kg), with the exception of samples 64S-B12-6 (3,000 mg/kg) and 64S-B27-6 (610 mg/kg). With these exceptions, the results again generally indicate that contamination is limited to the area of observed free product.

Sample 64S-B5-5, from location B5, was used to produce a simulated distillation curve for the product. The curve, presented in Appendix C, indicates a carbon range pattern spanning both the diesel and motor oil ranges, possibly indicating a mixture of the two types of contaminants. However, the laboratory reported that the pattern produced was most consistent with diesel and reported a total TPH-D concentration in the C7 to C30 range of 4,698 mg/kg.

Samples from four locations within and outside of the plume were further analyzed for PAHs. Sample 64S-B5-5, which contained free product, produced non-detect results for each of the PAHs. Similarly, samples from locations B7 and B18, located north and northwest, respectively, of the product plume showed non-detect results. A sample from location B22, outside the plume to the east, revealed low levels of several of the PAH constituents. However, all detected concentrations were well below the applicable Department of Health (DOH) criteria.

6.0 SUMMARY AND CONCLUSIONS

Soil samples were collected from the water table depth at 21 locations in and around the area formerly observed to contain a "clear oil" and at 26 locations in and around the area seen to be contaminated with a "heavy black oil." Samples were collected from discrete depth intervals using Direct Push Sampling (DPS) techniques and Geoprobe sampling equipment. Samples were collected in clear polyethylene sample sleeves, opened, and observed for evidence of soil saturation, visible petroleum product, and discernible petroleum odors.

Product in the form of hydraulic oil was observed in 7 of the 21 samples collected from the "clear oil" area, yielding a contaminated area of approximately 6,000 square feet. The observed plume extended slightly outside the property boundary to the southwest. It was not seen to extend across Pahounui Street. Vertically, the product appeared to be confined to the zone of tidal fluctuation. Further, based on previous work at the site, the product may be in an "available" state, that is, it will freely flow from the soil formation.

Product as a mixture of diesel fuel and motor oil was observed at the water table depth in 9 of the 26 locations sampled in the "heavy black oil" area, yielding an affected area of approximately 13,500 square feet. The plume did not extend to probe locations just outside the property boundary to the northwest. The product appears to be bound in the soil and fill materials under negative capillary pressure and is not easily released from the formation.

Laboratory analysis of selected soil samples for Total Petroleum Hydrocarbons as both diesel and as motor oil showed that soil contamination levels decreased significantly outside the free product area. Based on these findings, we conclude that petroleum contamination in soils is generally limited to the areas where free product was observed.

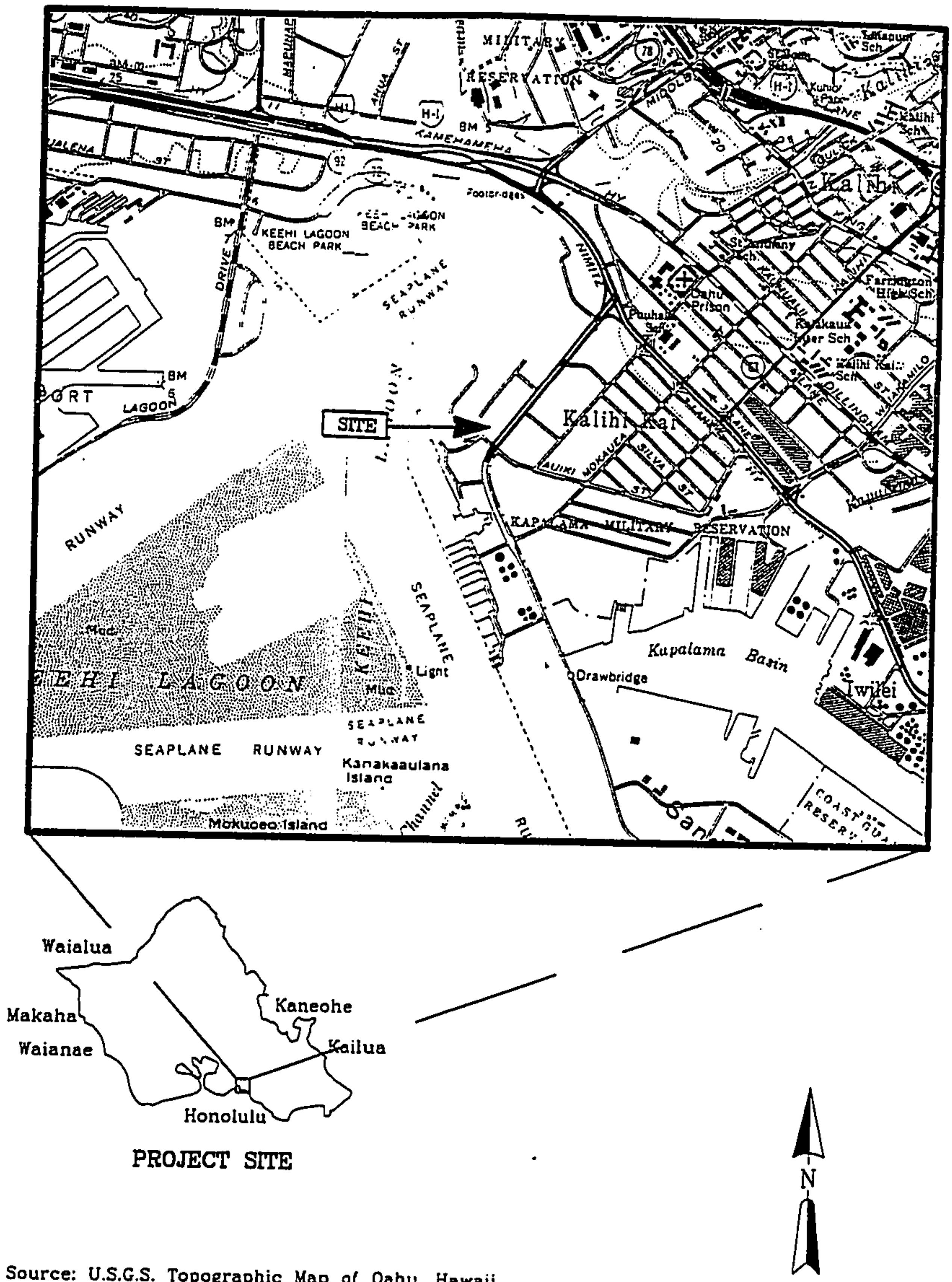
7.0 RECOMMENDATIONS

COTTON and FRAZIER recommends removal of the hydraulic oil impacted soils by excavation. Unimpacted surface soils down to approximately four feet should be excavated and set aside. The discrete zone of product contaminated soils can then be excavated and transported for proper disposal, followed by returning the clean surface soils to the excavation. Such work should consider the previously-identified hazards posed by other contaminants in the surface materials.

Further, we recommend regular monitoring of the diesel and motor oil plume to assess its migration and natural attenuation by biologic activity. This can be accomplished by a series of permanent groundwater and soil gas monitoring points to be installed in conjunction with the site cap.

Appendix A

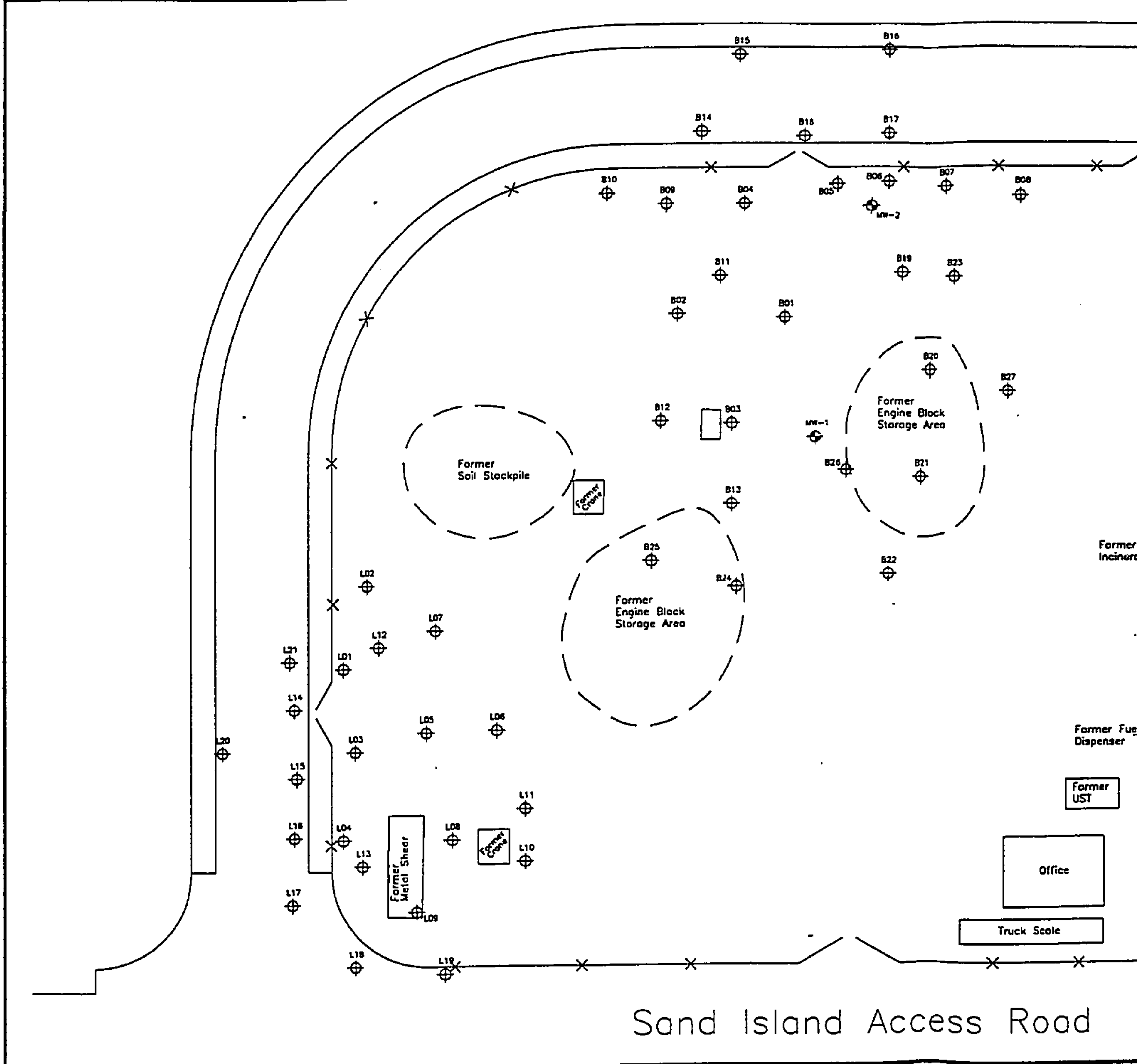
Figures



Source: U.S.G.S. Topographic Map of Oahu, Hawaii. 7.5 minute series, Honolulu Quadrangle

Scale 1:24,000

COTTON and FRAZIER Consultants, Inc.	**SITE LOCATION MAP** FLYNN-LEARNER 120 SAND ISLAND ACCESS RD., HONOLULU	FIGURE A-1



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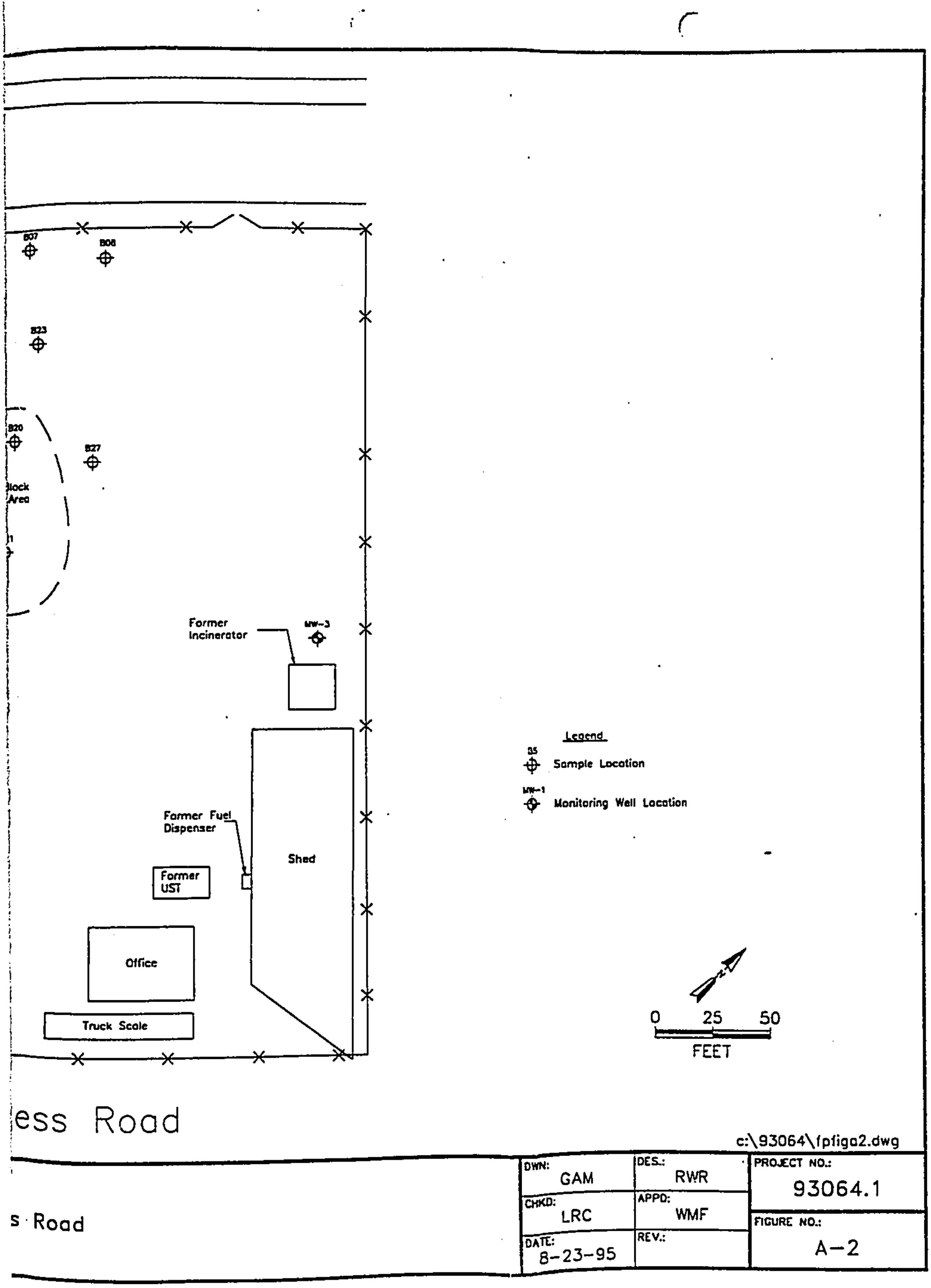
Consultants, Inc.

Environmental Solutions

TITLE:

SAMPLE LOCATION MAP
Flynn—Learner – 120 Sand Island Access Road
Honolulu, Hawaiai



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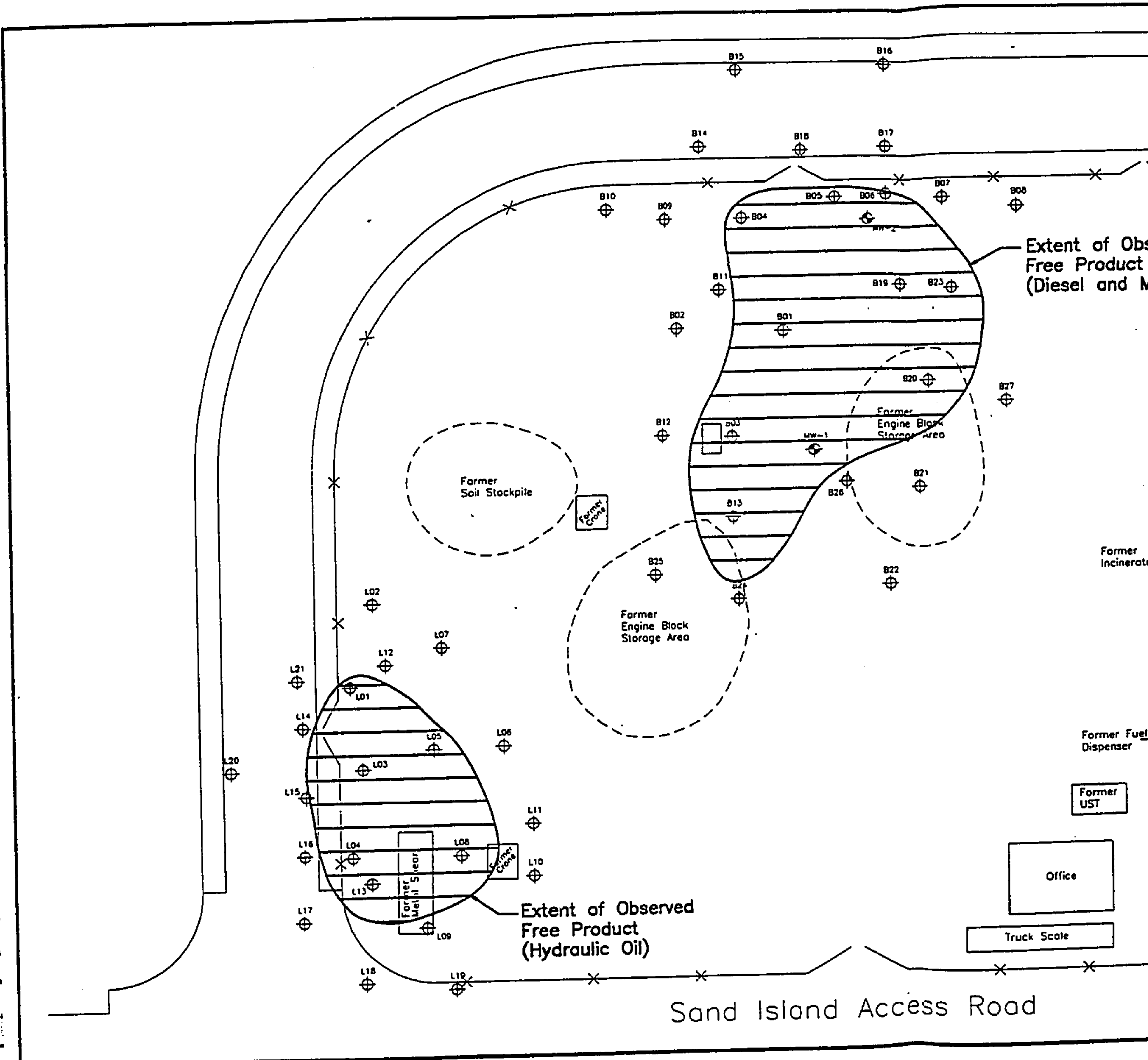
CHKD: LRC	APPD: WMF	FIGURE NO.: A-2
DATE: 8-23-95	REV.:	

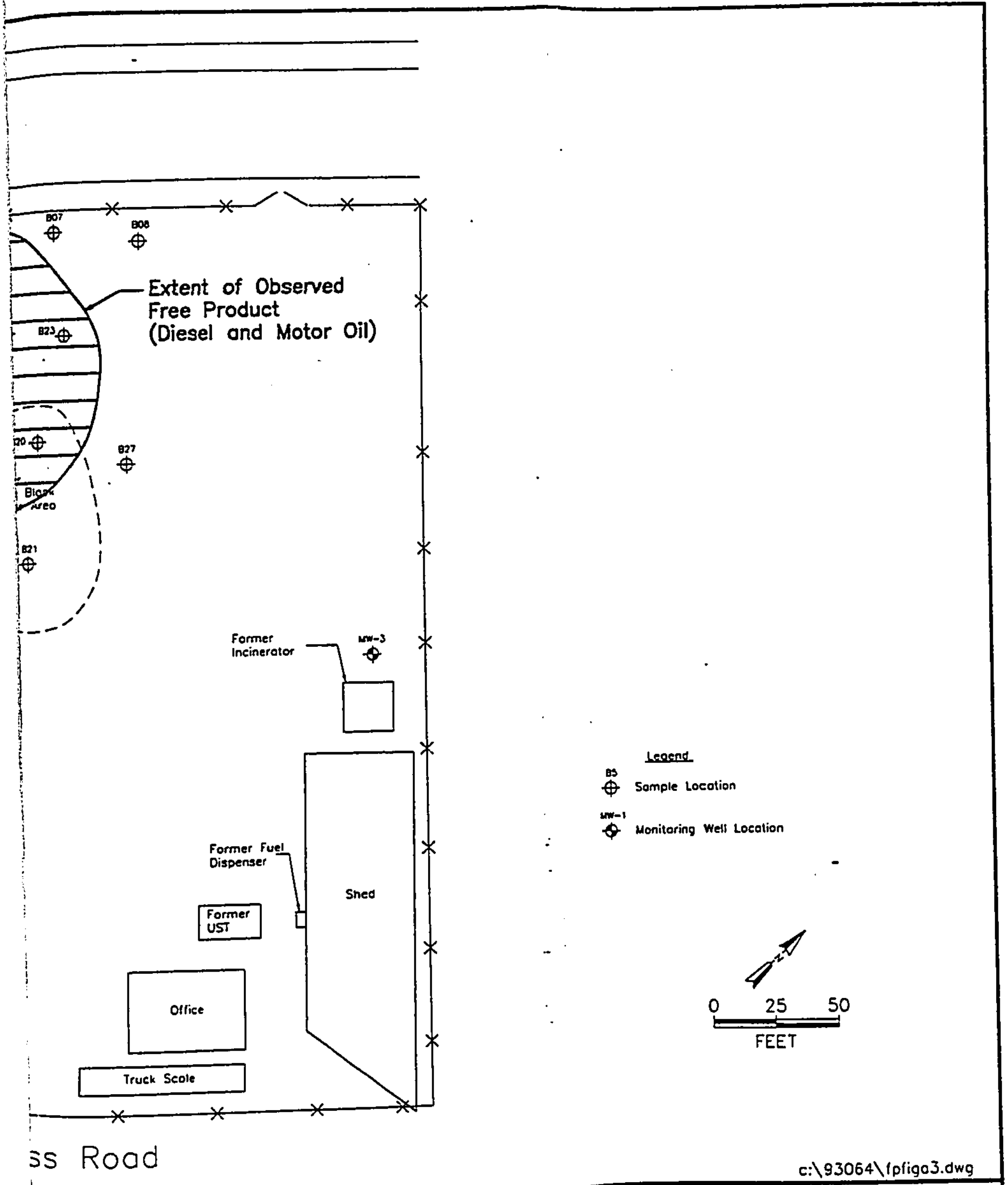


Cotton and Frazier
Consultants, Inc.

Environmental Solutions

TITLE:

EXTENTS OF OBSERVED FREE PRODUCT
Flynn–Learner – 120 Sand Island Access Road
Honolulu, Hawaii



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CHKD: LRC
APPD: WMF
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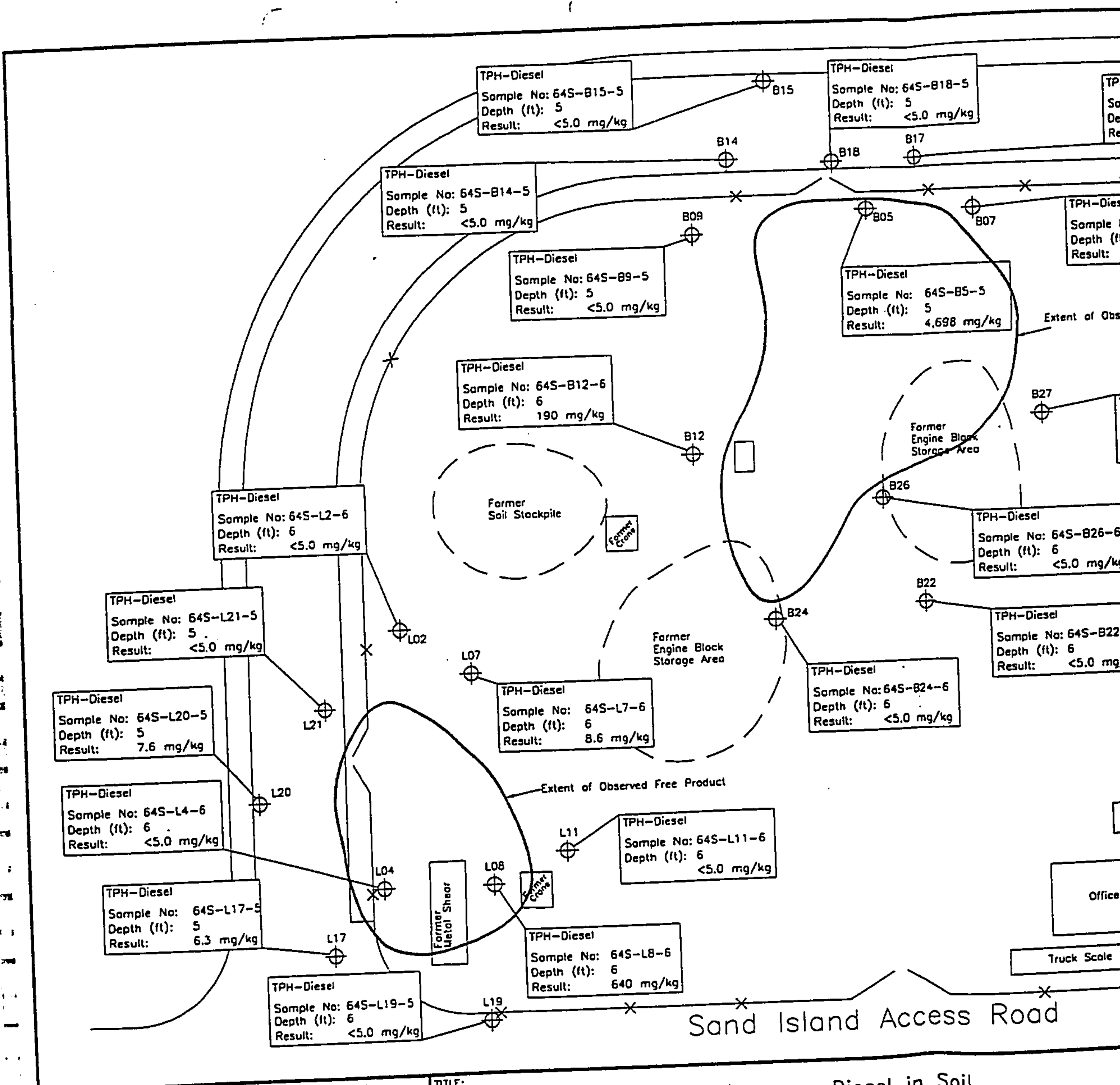
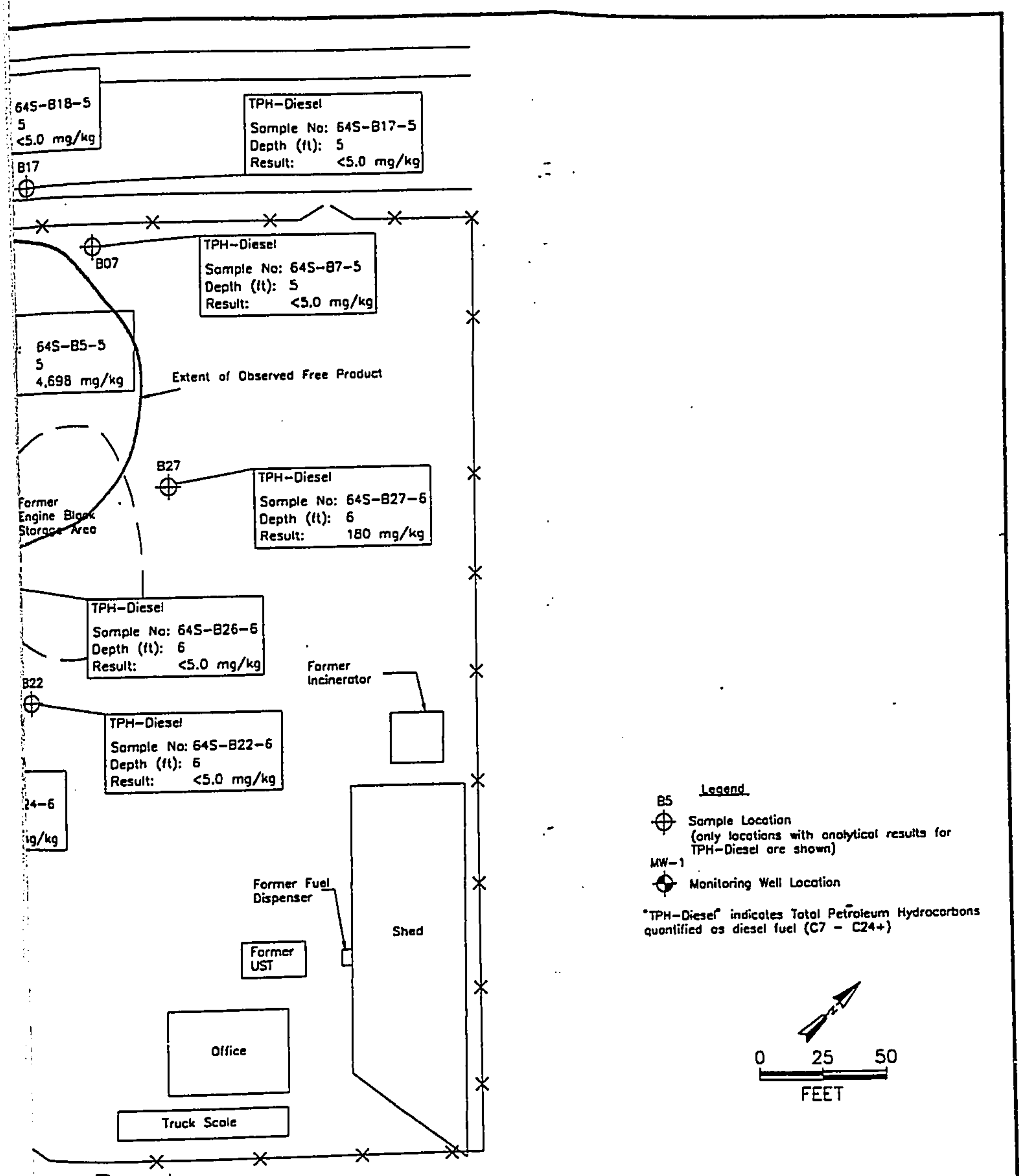
DATE: 8-23-95
REV.:



Cotton and Frazier
Consultants, Inc.

Environmental Solutions

TITLE:
Total Petroleum Hydrocarbons as Diesel in Soil
Flynn-Learner – 120 Sand Island Access Road
Honolulu, Hawaii



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Soil
Road

DWN: RWR	DES.: RWR	PROJECT NO.: 93064.1
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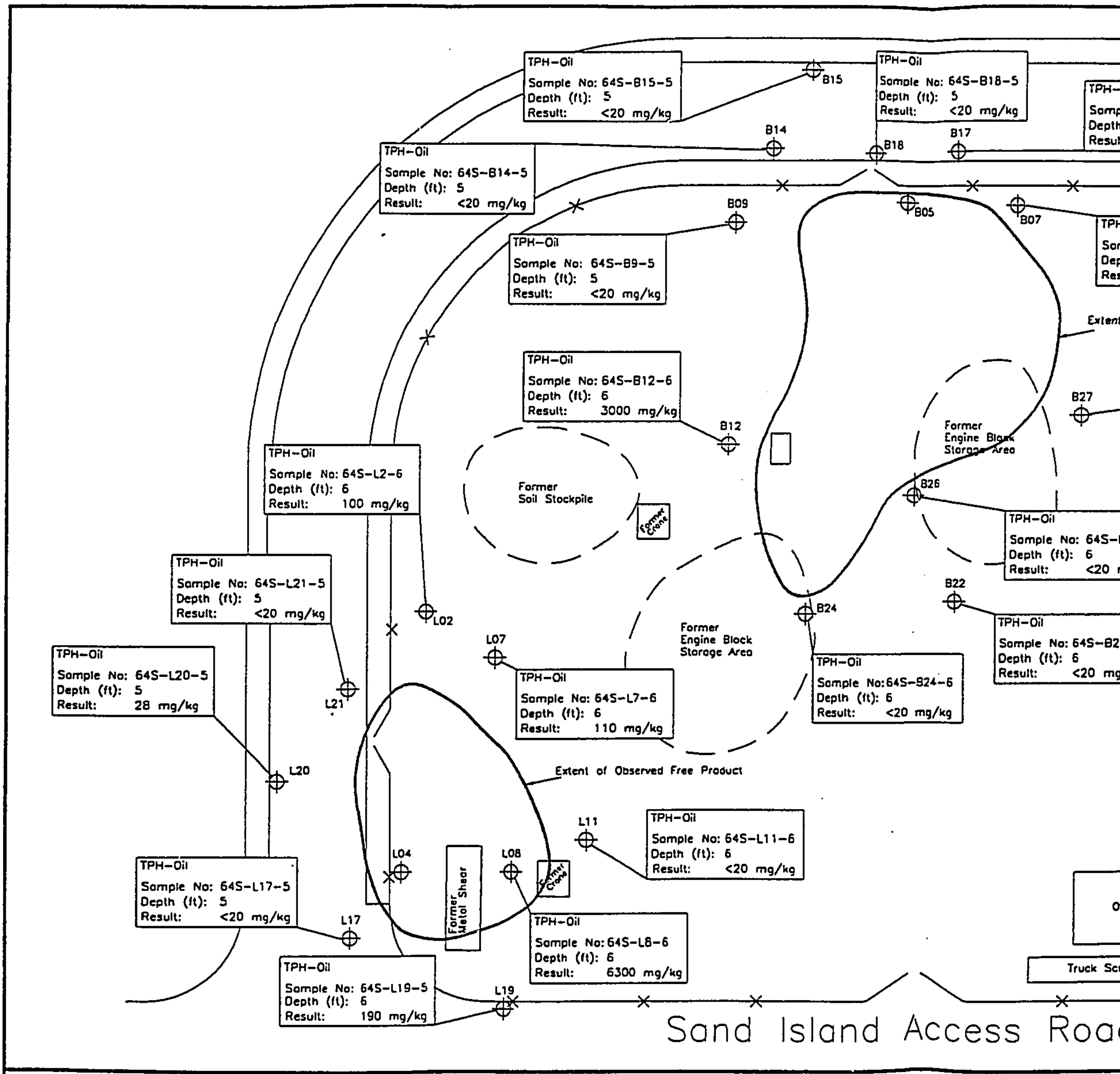
DATE: 8-23-95	REV.:	

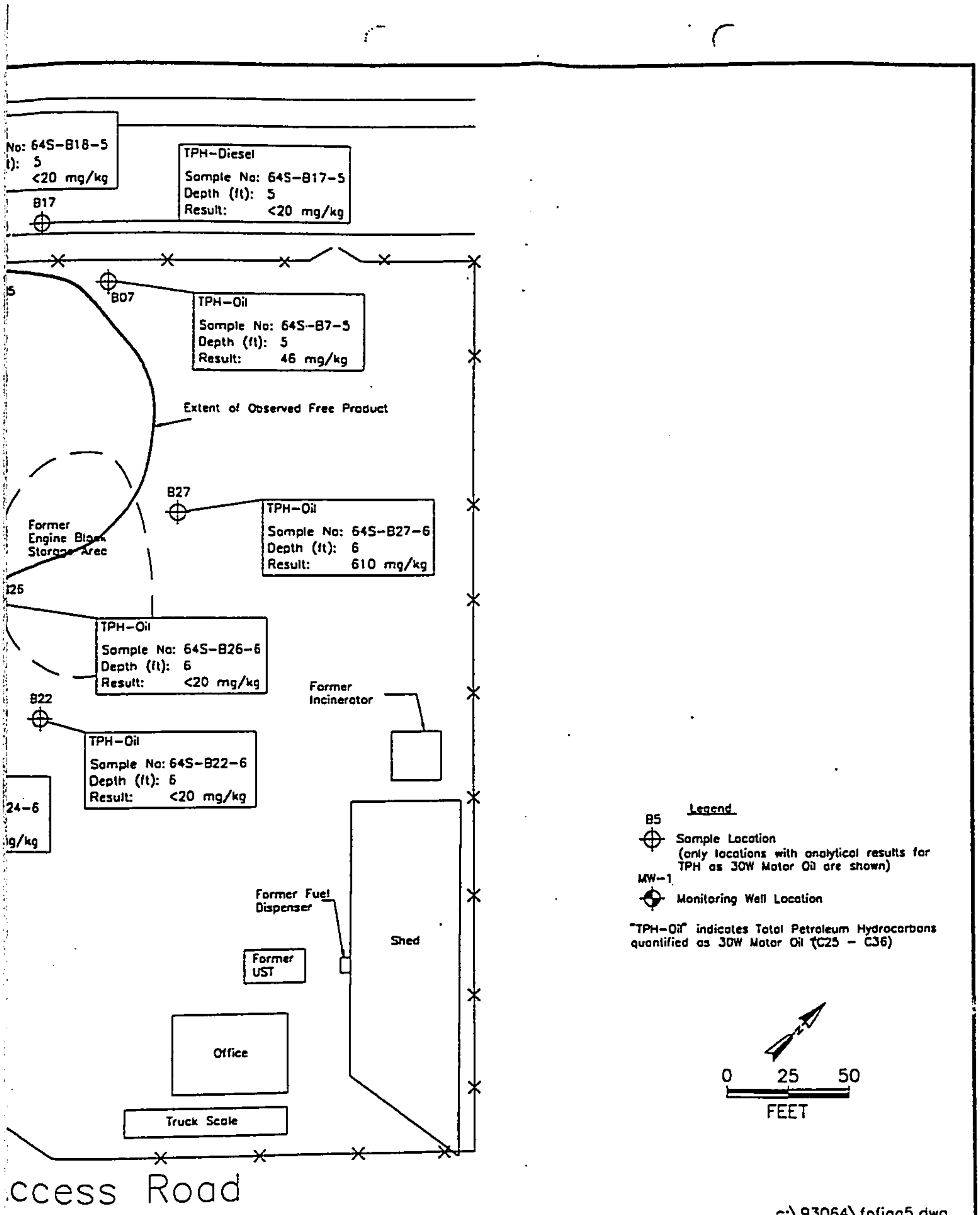


Cotton and Frazier Consultants, Inc.

Environmental Solutions

TITLE:

Total Petroleum Hydrocarbons as 30W Motor Oil in Soil
Flynn-Learner – 120 Sand Island Access Road
Honolulu, Hawaii



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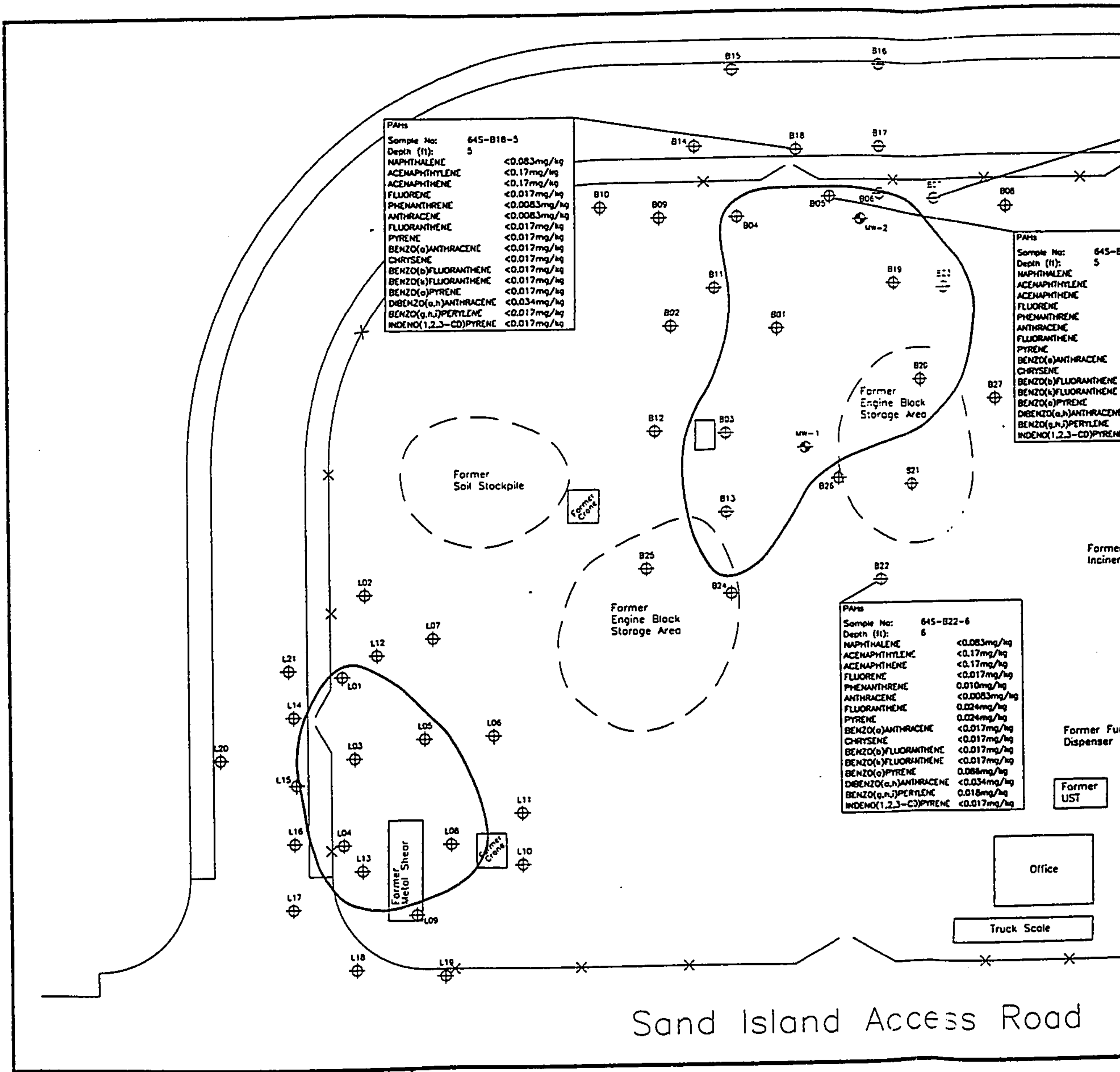
r Oil in Soil
s Road

DWN: RWR	DES.: RWR	PROJECT NO.: 93064.1
CHKD: LRC	APPD: WMF	FIGURE NO.: A-5
DATE: 8-23-95	REV.:	



PAHs	
Sample No:	645-B18-5
Depth (ft):	5
NAPHTHALENE	<0.083mg/kg
ACENAPHTHYLENE	<0.17mg/kg
ACENAPHTHENE	<0.17mg/kg
FLUORENE	<0.017mg/kg
PHENANTHRENE	<0.0083mg/kg
ANTHRACENE	<0.0083mg/kg
FLUORANTHENE	<0.017mg/kg
PYRENE	<0.017mg/kg
BENZO(a)ANTHRACENE	<0.017mg/kg
CHRYSENE	<0.017mg/kg
BENZO(b)FLUORANTHENE	<0.017mg/kg
BENZO(k)FLUORANTHENE	<0.017mg/kg
BENZO(a)PYRENE	<0.017mg/kg
DIBENZO(a,h)ANTHRACENE	<0.034mg/kg
BENZO(g,h,i)PERYLENE	<0.017mg/kg
INDENO(1,2,3-CD)PYRENE	<0.017mg/kg

PAHs	
Sample No:	645-B
Depth (ft):	5
NAPHTHALENE	
ACENAPHTHYLENE	
ACENAPHTHENE	
FLUORENE	
PHENANTHRENE	
ANTHRACENE	
FLUORANTHENE	
PYRENE	
BENZO(a)ANTHRACENE	
CHRYSENE	
BENZO(b)FLUORANTHENE	
BENZO(k)FLUORANTHENE	
BENZO(a)PYRENE	
DIBENZO(a,h)ANTHRACENE	
BENZO(g,h,i)PERYLENE	
INDENO(1,2,3-CD)PYRENE	

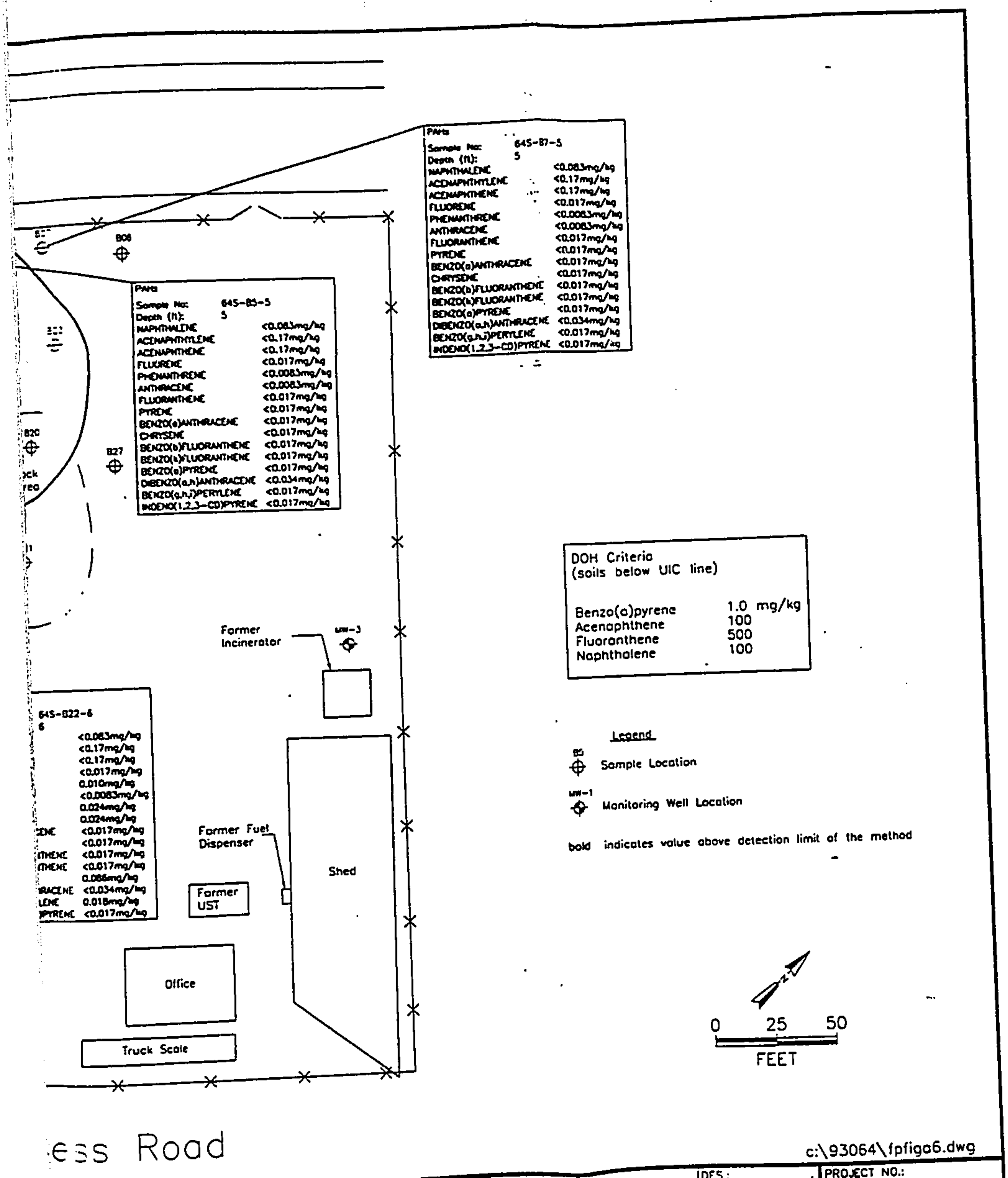
PAHs	
Sample No:	645-B22-6
Depth (ft):	6
NAPHTHALENE	<0.083mg/kg
ACENAPHTHYLENE	<0.17mg/kg
ACENAPHTHENE	<0.17mg/kg
FLUORENE	<0.017mg/kg
PHENANTHRENE	0.010mg/kg
ANTHRACENE	<0.0083mg/kg
FLUORANTHENE	0.024mg/kg
PYRENE	0.024mg/kg
BENZO(a)ANTHRACENE	<0.017mg/kg
CHRYSENE	<0.017mg/kg
BENZO(b)FLUORANTHENE	<0.017mg/kg
BENZO(k)FLUORANTHENE	<0.017mg/kg
BENZO(a)PYRENE	0.088mg/kg
DIBENZO(a,h)ANTHRACENE	<0.034mg/kg
BENZO(g,h,i)PERYLENE	0.018mg/kg
INDENO(1,2,3-CD)PYRENE	<0.017mg/kg

Cotton and Frazier
Consultants, Inc.

Environmental Solutions

TITLE:

Polynuclear Aromatic Hydrocarbons (PAHs) in Soil
Flynn-Learner - 120 Sand Island Access Road
Honolulu, Hawaiai



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in Soil
s Road

DWN: CSC	DES.: RWR	PROJECT NO.: 93064.1
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DATE: 8-23-95	REV.:	

Appendix B

Sampling Methodology
Soil Probing Logs and Observations

SOIL SAMPLE COLLECTION

Soil samples were collected using small-diameter drive point sampling (DPS) equipment manufactured by Geoprobe. Soil samples were collected by using either the Large-Bore sampler or the Macro-Core sampler

The Large-Bore sampler is a closed-tip sampler which can be driven to a specific depth interval prior to opening. The sampler is 1.375 inches in diameter and 24 inches long. Undisturbed soil samples were collected in 1.125 inch diameter by 22 inch long clear polyethylene sleeves. The Large-Bore sampler was assembled and driven to the top of the desired sampling interval. Upon reaching this depth, a stop pin was removed to allow the drive point to retract inside the sampler. As the sampler was advanced an additional 2 feet, an undisturbed soil sample filled the polyethylene sleeve.

The Macro-Core sampler is an open tube sampler. The Macro-Core sampler is 2.0 inches in diameter and 48 inches long. In stable soil the open tube sampler is driven into an existing hole that was constructed by either pre-drilling, pre-probing, or removal of soil by a previously collected Macro–Core sampler. The sampler was advanced into the open hole. The cutting shoe is tapered to minimize scraping soil off of the walls of the hole. The cutting shoe has a 1.5 inch diameter opening. As the sampler was advanced into the soil at the bottom of the hole, the soil sample filled the sampler. Soil samples were collected in 1.5 inch diameter by 45 inch long clear polyethylene sleeves which line the sampling tube.

The sampler was extracted from the subsurface and the polyethylene sleeve containing the soil sample was removed from the sampling tube. Field screening of the soil samples was conducted utilizing the PID. Soil from the desired interval, selected based on lithology, observed water saturation, PID readings, or other visual or olfactory cues, was removed and compacted without headspace into 4 ounce glass jar. Each sample was labeled and placed in a cooler containing blue ice pending delivery to a laboratory.

All sampling equipment and tools were cleaned between each sampling event. New polyethylene liners were used for each sample, and new vinyl gloves were donned for handling of all soils. The boreholes were filled with bentonite chips and covered with an asphaltic or concrete patch.

Cotton and Frazier Consultants, Inc.
Environmental Solutions

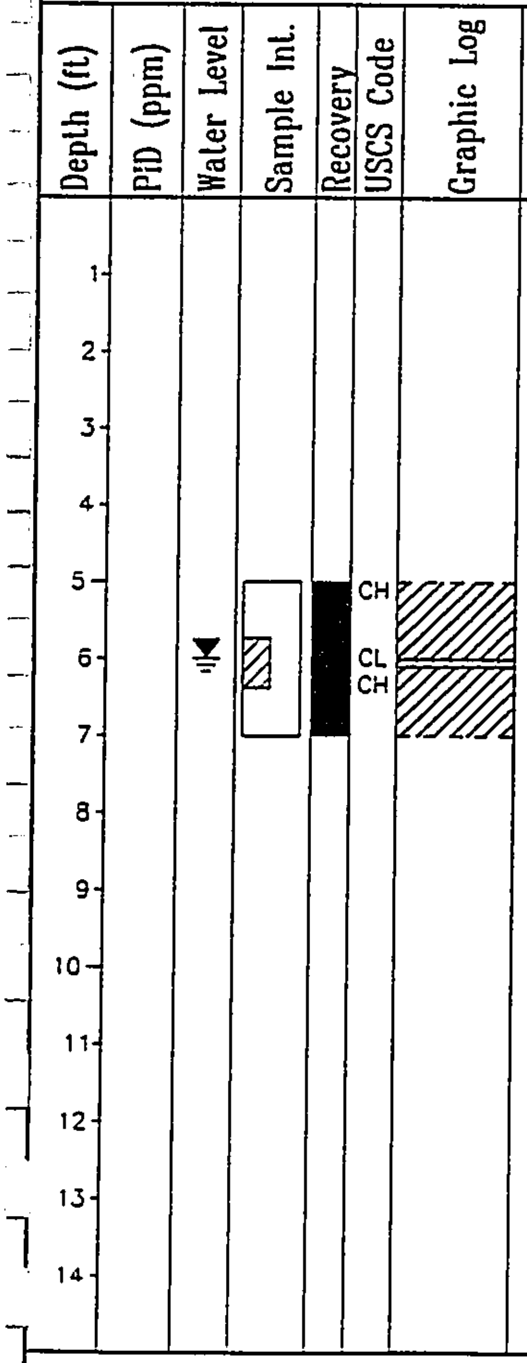
Total Depth: 7.00'
Borehole Dia.: 1.50in
Static Water Level: 6.0'
Project Number: 93064.1

Location ID:
L04

Logged By: R.Rooks

Project Name: Flynn-Learner Free Product
Consulting Firm: COTTON and FRAZIER
Date(s): 07/20/95 - 07/20/95

Probing Method: Geoprobe Large Bore
Remarks: Sample 64S-L4-6 collected at 1215.



Material Description

Soft olive gray CLAY (CH), saturated.

1" lens of sandy CLAY (CL) at approximately 6' bgs. Lens contains visible yellow free product, strong oil odor.
Soft olive gray CLAY (CH).

Bottom of boring.

– Typical Boring Log. Deatils of recovered interval recorded on following "Logs and Observations" –

COTTON and FRAZIER Consultants, Inc.

P.O. Box 27126 Honolulu, Hawaii 96827
Phone: (808) 599-1993 Fax: (808) 599-1502

Soil Probing Logs and Observations

Flynn-Learner Free Product Delineation
120 Sand Island Access Road
Honolulu, HI
CF Project #93064.1

Logged by: Robert W. Rooks, PE

July 20, 1995

Probe Location	Sample Interval (ft. bgs)	Observations
L1	6 -8	Unable to advance Macro Core sampler in fill materials. Refusal at several locations at 2'. Abandoned and moved to L2. Returned to L1 with Large Bore sampler. Pre-probe to 4' with Macro Core. Distinct change from gray coralline GRAVEL (GP) to dark gray silty very fine sand at center of sample interval. Saturated at 6' bgs. Visible free product, yellow, strong oil odor in gravel fraction. Sample 64S-L1-6 @ 1030.
L2	5 - 7	Dark brown clayey coarse SAND (SC) mixed with grayish tan coralline GRAVEL (GP), frequent glass fragments, rust staining, apparent man-made fill materials, saturated at 6' bgs. No visible product or odor. Sample 64S-L2-6 @ 1020.
L3	5 - 7	Soft olive gray CLAY (CH), saturated. No visible product released from material, but strong characteristic oil odor throughout. Classified as free product. Sample 64S-L3-6 @ 1130.
L4	5 - 7	Soft olive gray CLAY (CH), 1" lens of sandy clay at approx. 6' bgs containing visible yellow free product, strong oil odor. Sample 64S-L4-6 @ 1215.
L5	5 - 7	Mixed gray to black poorly graded coarse SAND (SP) to sandy GRAVEL (GP). Change to silty medium SAND (SP), gray. Saturated with yellowish oil-like product at 6' bgs. No sample collected.
L6	5 - 7	Light yellowish gray sandy coralline GRAVEL (GP), saturated at approx. 6' bgs. No oil odor, no visible free product. Sample 64S-L6-6 @ 1400.
L7	5 - 7	Soils same as L2, metal and glass fragments, sat. at 6' bgs. No oil odor, no visible product. Sample 64S-L7-6 @ 1420.
L8	5 - 7	Dark gray to black clayey, silty, medium SAND (SW), sat. at 6' bgs, strong oil odor, yellow oil and sheen revealed when immersed in water. Sample 64S-L8-6 @ 1435.
L9	5 - 7	Tan to olive gray silty, sandy CLAY (CL), sat. at 6' bgs. very mild oil odor, no visible product or sheen upon immersion. Sample 64S-L9-6 @ 1450.

L10	5 - 7	Tan to pale yellow sandy coralin GRAVEL (GP), saturated at 6' bgs. No visible product or discernible odor. Sample 64S-L10-6 @ 1530.
July 21, 1995		
L11	5 - 7	Tan to gray sandy coralline GRAVEL (GP), sat., very mild oil odor at bottom of interval (6.5' to 7' bgs). No visible product. Sample 64S–L11–6 @ 0740.
L12	5 - 7	Dark brown and orange-brown silty coarse SAND (SP), frequent glass and metal fragments, fill material, sat. at 6; bgs, abrupt change at 6' to tan clayey medium SAND (SP), no visible product or discernible odor. Sample 64S–L12–6 @ 0800.
L13	5 - 7	5 - 5.5': tank to pale yellow sandy coralline GRAVEL (GP), no product odor, moist. 5.5 to 7': light to olive fray silty medium SAND (SP) grading to silty very fine SAND (SP), sat. at 6' bgs. Final gradation to silty soft CLAY (CL) at bottom of interval. Visible yellowish product and strong odor at water table depth. Sample 64S-L13-6 @ 0820.
B1	5 - 7	Dark brown to black clayey, sandy GRAVEL (GP) with subangular basaltic fragments up to 1" diam. Moderate degraded petroleum odor. No visible product, but spotty sheen released upon immersion in water. Sample 64S-B1-6 @ 0900.
B2	5 - 7	Difficult probing, refusal at several points. Mixed sands and gravels, glass fragments, misc. fill material. No product odor, no sheen upon immersion in water. Sample 64S-B2-6 @ 0950.
B3	5 - 7	Intermixed gray sandy GRAVEL (GP) and black clayey GRAVEL (GP), strong petroleum odor, rainbow sheen visible upon immersion in water. Sample 64S-B3-6 @ 1030.
B4	5 - 7	Brown and black clayey GRAVEL (GP). Coarsest fraction at water table depth. Visible free product, strong degraded diesel odor. Sample 64S-B4-6 @ 1050.
B5	4 - 6	Soils same as B4, with more frequent glass shards, visible product near bottom of interval. Water table at approx. 4.5' bgs (depressed area). Strong degraded diesel odor. Sample 64S-B5-5 @ 1120.
B6	4 - 6	same at B5, strong degraded diesel odor, visible product. Sample 64S–B6–5 @ 1140.
B7	4 - 6	Dark reddish brown clayey GRAVEL (GP), sat. at 4.5' bgs. no petroleum odor, not visible product, no sheen upon immersion in water. Sample 64S-B7-5 @ 1300.
B8	4 - 6	dark gray-brown clayey GRAVEL (GP), sat at 4.5' bgs, no product odor, no visible product, no sheen upon immersion in water. Sample 64S–B8–5 @ 1315.
B9	4 - 6	Reddish-brown clayey GRAVEL (GP), sat. at 4.5' bgs, no product odor, no visible product, no sheen upon immersion in water. Sample 64S–B9–5 @ 1335.

B10	4 - 6	Same as B9, no product odor, no visible product. Sample 64S-B10-5 @ 1400.
B11	4 - 6	Dark brown clayey GRAVEL (GP), no product odor, no visible product. Sample 64S-B11-5 @ 1435.
B12	5 - 7	Dark brown to black clayey GRAVEL (GP), no visible product, no product odor. Very soft probing, minimal recovery in sampler. Sample 64S-B12-6 @ 1500.
B13	5 - 7	Dark brown to black clayey GRAVEL (GP), visible product, strong odor of degraded diesel. Sample 64S-B13-6 @ 1515.
July 31, 1995		
L14	5 - 7	Tan to silty very fine SAND (SP) grading to olive gray silty CLAY (CL), no product odor, no visible product, no sheen upon immersion in water. Sample 64S-L14-6 @ 0910.
L15	5 - 7	Tan fine to medium SAND (SP), dry, grading to gray silty CLAY (CL) at approx. 5.8' bgs. Interbedded sand and clay layers to bottom of interval. Sat. at approx. 5.5' bgs. Visible petroleum product at 5.5' bgs, moderate odor of hydraulic oil. Sample 64S-L15-6 @ 0930.
L16	5 - 7	Same as L15, sat. at 5.5' bgs. No visible product, no odor, no sheen upon immersion in water. Sample 64S-L16-6 @ 0950.
L17	4 - 6	Same as L15, no visible product, no odor, no sheen upon immersion in water. Sample 64S-L17-5 @ 1005.
L18	4 - 6	Tan sandy coralline GRAVEL (GP), no visible product, no odor, no sheen upon immersion in water. Sample 64S-L18-5 @ 1130.
L19	4 - 6	Same as L18, no odor, no visible product, no sheen upon immersion in water. Sample 64S-L19-5 @ 1140.
L20	4 - 6	Sandy coralline GRAVEL (GP) at water table depth (5.5' bgs). 1" lens of dark gray sandy basaltic GRAVEL (GP, crushed stone), possible road bed or sewer line fill material. no odor, no visible product, no sheen upon immersion in water. Sample 64S-L20-5 @1155.
L21	4 - 6	Medium to coarse coralline sand, sat at approx. 6' bgs. No odor, no visible product, no sheen upon immersion in water. Sample 64S-L21-5 @ 1305.
B14	4 - 6	Dark reddish brown gravelly, silty, clayey SAND (SW), shows moderate cohesion. Moist, no product odor, no visible product, no sheen upon immersion in water. Sample 64S-B14-5 @ 1335.
B15	4 -6	Dark reddish brown clayey, sandy GRAVEL (GW), saturated, volcanic cinders (pyroclasts) up to 0.25" diam. no product odor, no visible product, no sheen upon immersion in water. Sample 64S-B15-5 @ 1415.

B16	4 - 6	Same as B15, no visible product, no odor. Sample 64S-B16-5 @ 1430.
B17	4 - 6	Same as B15, no visible product, no odor. Sample 64S-B17-5 @ 1500.
B18	4 - 6	Same as B15, no visible product, no odor. Sample 64S-B18-5 @ 1520.
August 1, 1995		
B19	4 - 6	Black clayey GRAVEL (GP) with significant coarse sand fraction, man-made debris, fill material, glass shards. Strong odor of degraded petroleum. Saturated with visible product. Sample 64S-B19-5 @ 0830.
B20	4 - 6	Same as B19. visible product apparent, "thin" rather than viscous. Product appears as sheen on small stones and soil particles. Sample 64S-B20-5 @ 0940.
B21	4 - 6	Same as B19, no visible product, no sheen upon immersion in water, no odor. Sample 64S-B21-5 @ 0955.
B22	5 - 7	Clayey GRAVEL (GP) with glass shards to approx. 6' bgs. Abrupt change at 6' to gray silty CLAY (CL) to clayey SILT (ML) at 6'. Occasional coralline gravels in silts and clays between 6' and 7' bgs. Sat. at 6' bgs. No product odor, no visible product, no sheen on immersion in water. Sample 64S-B22-6 at 1005.
B23	5 - 7	Difficult probing, required several attempts. Dark brown to black clayey, silty GRAVEL (GP), basaltic and pyroclastic gravels, numerous glass shards, fill material. Dark black, slightly viscous, non-petroleum fluid present in sample (possible decayed organics in groundwater), strong degraded petroleum odor, visible sheen upon immersion in water. Sample 64S-B23-6 @ 1500.
B24	5 - 7	Tan to light gray sandy coralline GRAVEL (GP), sat. at approx. 6' bgs. no petroleum odor, no visible product, no sheen upon immersion in water. Sample 64S-B24-6 @ 1040.
B25	5 - 7	Sandy basaltic GRAVEL (GP) over reddish brown clayey GRAVEL (GP), saturated, no petroleum odor, no visible product, no sheen upon immersion in water. Sample 64S-B25-6 @ 1130.
B26	5 - 7	Same as B19, no visible product, no petroleum odor, no sheen upon immersion in water. Sample 64S-B26-6 @ 1150.
B27	5 - 7	Black sandy GRAVEL (GP), >10% fines, black non-petroleum liquid in saturated portion similar to B23 (described above). No visible product, no petroleum odor, no sheen upon immersion in water. Sample 64S-B27-6 @ 1430.

AnalyticalTechnologies,Inc. Corporate Offices: 5550 Morehouse Drive San Diego, CA 92121 (619) 458-9141

ATI I.D.: 508057

August 15, 1995

COTTON AND FRAZIER CONSULTANTS
801 ALEKEA STREET, SUITE 211
HONOLULU, HI 96813

Project Name: FLYNN LEARNER FREE PRODUCT
Project # : 93064.1

Attention: LEE R. CRANMER

Analytical Technologies, Inc. has received the following sample(s):

Date Received	Quantity	Matrix
August 04, 1995	12	SOIL

The sample(s) were analyzed with EPA methodology or equivalent methods as specified in the enclosed analytical schedule. The symbol for "less than" indicates a value below the reportable detection limit. If any flags appear next to the analytical data in this report, please see the attached list of flag definitions.

The results of these analyses and the quality control data are enclosed. Please note that the Sample Condition Upon Receipt Checklist is included at the end of this report.

ANN FREED
PROJECT MANAGER

for ALAN J. KLEINSCHMIDT
LABORATORY MANAGER

AnalyticalTechnologies,Inc.

SAMPLE CROSS REFERENCE

Client : COTTON AND FRAZIER CONSULTANTS
Project # : 93064.1
Project Name: FLYNN LEARNER FREE PRODUCT

Report Date: August 15, 1995
ATI I.D. : 508057

ATI #	Client Description	Matrix	Date Collected
1	64S-L17-5	SOIL	31-JUL-95
2	64S-L19-5	SOIL	31-JUL-95
3	64S-L20-5	SOIL	31-JUL-95
4	64S-L21-5	SOIL	31-JUL-95
5	64S-B14-5	SOIL	31-JUL-95
6	64S-B15-5	SOIL	31-JUL-95
7	64S-B17-5	SOIL	31-JUL-95
8	64S-B18-5	SOIL	31-JUL-95
9	64S-B24-6	SOIL	01-AUG-95
10	64S-B26-6	SOIL	01-AUG-95
11	64S-B27-6	SOIL	01-AUG-95
12	64S-B22-6	SOIL	01-AUG-95

---TOTALS---

Matrix	# Samples
SOIL	12

ATI STANDARD DISPOSAL PRACTICE

The sample(s) from this project will be disposed of in twenty-one (21) days from the date of this report. If an extended storage period is required, please contact our sample control department before the scheduled disposal date.

ANALYTICAL SCHEDULE

Client : COTTON AND FRAZIER CONSULTANTS
Project # : 93064.1
Project Name: FLYNN LEARNER FREE PRODUCT

ATI I.D.: 508057

Analysis	Technique/Description
EPA 8310 (POLYNUCLEAR AROMATIC HYDROCARBONS)	HIGH PERFORMANCE LIQUID CHROMATOGRAPHY
MOD EPA 8015-CDOHS (FUEL HYDROCARBONS-EXT. RANGE)	GC/FLAME IONIZATION DETECTOR
MOD EPA 8015-CDOHS (FUEL HYDROCARBONS: C7-C24)	GC/FLAME IONIZATION DETECTOR

GAS CHROMATOGRAPHY RESULTS

Test : EPA 8310 (POLYNUCLEAR AROMATIC HYDROCARBONS)
Client : COTTON AND FRAZIER CONSULTANTS
ATI I.D. : 508057
Project # : 93064.1
Project Name: FLYNN LEARNER FREE PRODUCT

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
8	64S-B18-5	SOIL	31-JUL-95	09-AUG-95	11-AUG-95	1.00
12	64S-B22-6	SOIL	01-AUG-95	09-AUG-95	11-AUG-95	1.00

Parameter	Units	8	12
NAPHTHALENE	MG/KG	<0.083	<0.083
ACENAPHTHYLENE	MG/KG	<0.17	<0.17
ACENAPHTHENE	MG/KG	<0.17	<0.17
FLUORENE	MG/KG	<0.017	<0.017
PHENANTHRENE	MG/KG	<0.0083	0.010
ANTHRACENE	MG/KG	<0.0083	<0.0083
FLUORANTHENE	MG/KG	<0.017	0.024
PYRENE	MG/KG	<0.017	0.024
BENZO(a)ANTHRACENE	MG/KG	<0.017	<0.017
CHRYSENE	MG/KG	<0.017	<0.017
BENZO(b)FLUORANTHENE	MG/KG	<0.017	<0.017
BENZO(k)FLUORANTHENE	MG/KG	<0.017	<0.017
BENZO(a)PYRENE	MG/KG	<0.017	0.086
DIBENZO(a,h)ANTHRACENE	MG/KG	<0.034	<0.034
BENZO(g,h,i)PERYLENE	MG/KG	<0.017	0.018
INDENO(1,2,3-cd)PYRENE	MG/KG	<0.017	<0.017
SURROGATES			
2-CHLOROANTHRACENE	%	75	80

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY - QUALITY CONTROL

REAGENT BLANK

Test : EPA 8310 (POLYNUCLEAR AROMATIC HYDROCARBONS)
Blank I.D. : 36396
Client : COTTON AND FRAZIER CONSULTANTS
Project # : 93064.1
Project Name: FLYNN LEARNER FREE PRODUCT

ATI I.D. : 508057
Date Extracted: 09-AUG-95
Date Analyzed : 10-AUG-95
Dil. Factor : 1.00

Parameters	Units	Results
NAPHTHALENE	MG/KG	<0.083
ACENAPHTHYLENE	MG/KG	<0.17
ACENAPHTHENE	MG/KG	<0.17
FLUORENE	MG/KG	<0.017
PHENANTHRENE	MG/KG	<0.0083
ANTHRACENE	MG/KG	<0.0083
FLUORANTHENE	MG/KG	<0.017
PYRENE	MG/KG	<0.017
BENZO(a)ANTHRACENE	MG/KG	<0.017
CHRYSENE	MG/KG	<0.017
BENZO(b)FLUORANTHENE	MG/KG	<0.017
BENZO(k)FLUORANTHENE	MG/KG	<0.017
BENZO(a)PYRENE	MG/KG	<0.017
DIBENZO(a,h)ANTHRACENE	MG/KG	<0.034
BENZO(g,h,i)PERYLENE	MG/KG	<0.017
INDENO(1,2,3-cd)PYRENE	MG/KG	<0.017
<u>SURROGATES</u>		
2-CHLOROANTHRACENE	%	85

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY - QUALITY CONTROL

MSMSD

Test : EPA 8310 (POLYNUCLEAR AROMATIC HYDROCARBONS)
MSMSD # : 77696
Client : COTTON AND FRAZIER CONSULTANTS

Project # : 93064.1
Project Name: FLYNN LEARNER FREE PRODUCT

ATI I.D. : 508057
Date Extracted: 09-AUG-95
Date Analyzed : 10-AUG-95
Sample Matrix : SOIL
REF I.D. : 508057-08

Parameters	Units	Sample Result	Conc Spike	Spiked Sample	% Rec	Dup Spike	Dup % Rec	RPD
ACENAPHTHYLENE	MG/KG	<0.17	3.3	2.2	67	2.1	64	5
PHENANTHRENE	MG/KG	<0.0083	0.17	0.13	76	0.14	82	7
PYRENE	MG/KG	<0.017	0.17	0.15	88	0.17	100	13
BENZO(k)FLUORANTHENE	MG/KG	<0.017	0.17	0.17	100	0.18	106	6
DIBENZO(a,h)ANTHRACENE	MG/KG	<0.034	0.33	0.34	103	0.39	118	14

% Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
RPD (Relative % Difference) = (Spiked Sample Result - Duplicate Spike Result)*100/Average Result

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY - QUALITY CONTROL

BLANK SPIKE

Test : EPA 8310 (POLYNUCLEAR AROMATIC HYDROCARBONS)
Blank Spike #: 58167
Client : COTTON AND FRAZIER CONSULTANTS
Project # : 93064.1
Project Name : FLYNN LEARNER FREE PRODUCT

ATI I.D. : 508057
Date Extracted: 09-AUG-95
Date Analyzed : 10-AUG-95
Sample Matrix : SOIL

Parameters	Units	Blank Result	Spiked Sample	Spike Conc.	% Rec
ACENAPHTHYLENE	MG/KG	<0.17	2.8	3.3	85
PHENANTHRENE	MG/KG	<0.0083	0.15	0.17	88
PYRENE	MG/KG	<0.017	0.17	0.17	100
BENZO(k)FLUORANTHENE	MG/KG	<0.017	0.18	0.17	106
DIBENZO(a,h)ANTHRACENE	MG/KG	<0.034	0.38	0.33	115

% Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
RPD (Relative % Difference) = (Spiked Sample - Blank Result)*100/Average Result

GAS CHROMATOGRAPHY RESULTS

Test : MOD EPA 8015-CDOHS (FUEL HYDROCARBONS-EXT. RANGE)
Client : COTTON AND FRAZIER CONSULTANTS
ATI I.D. : 508057
Project # : 93064.1
Project Name: FLYNN LEARNER FREE PRODUCT

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
1	64S-L17-5	SOIL	31-JUL-95	09-AUG-95	09-AUG-95	1.00
2	64S-L19-5	SOIL	31-JUL-95	09-AUG-95	10-AUG-95	1.00
3	64S-L20-5	SOIL	31-JUL-95	09-AUG-95	09-AUG-95	1.00

Parameter	Units	1	2	3
FUEL HYDROCARBONS	MG/KG	<20	190	28
HYDROCARBON RANGE		C25-C36	C25-C36	C25-C36
HYDROCARBONS QUANTITATED USING		30W	30W	30W

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY RESULTS

Test : MOD EPA 8015-CDOHS (FUEL HYDROCARBONS-EXT. RANGE)
ATI I.D. : 508057
Client : COTTON AND FRAZIER CONSULTANTS
Project # : 93064.1
Project Name: FLYNN LEARNER FREE PRODUCT

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
4	64S-L21-5	SOIL	31-JUL-95	09-AUG-95	09-AUG-95	1.00
5	64S-B14-5	SOIL	31-JUL-95	09-AUG-95	10-AUG-95	1.00
6	64S-B15-5	SOIL	31-JUL-95	09-AUG-95	10-AUG-95	1.00

Parameter	Units	4	5	6
FUEL HYDROCARBONS	MG/KG	<20	<20	<20
HYDROCARBON RANGE		C25-C36	C25-C36	C25-C36
HYDROCARBONS QUANTITATED USING		30W	30W	30W

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY RESULTS

Test : MOD EPA 8015-CDOHS (FUEL HYDROCARBONS-EXT. RANGE)
Client : COTTON AND FRAZIER CONSULTANTS
Project # : 93064.1
Project Name: FLYNN LEARNER FREE PRODUCT

ATI I.D. : 508057

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
7	64S-B17-5	SOIL	31-JUL-95	09-AUG-95	10-AUG-95	1.00
8	64S-B18-5	SOIL	31-JUL-95	09-AUG-95	10-AUG-95	1.00
9	64S-B24-6	SOIL	01-AUG-95	09-AUG-95	10-AUG-95	1.00

Parameter	Units	7	8	9
FUEL HYDROCARBONS	MG/KG	<20	<20	<20
HYDROCARBON RANGE		C25-C36	C25-C36	C25-C36
HYDROCARBONS QUANTITATED USING		30W	30W	30W

GAS CHROMATOGRAPHY RESULTS

Test : MOD EPA 8015-CDOHS (FUEL HYDROCARBONS-EXT. RANGE)
Client : COTTON AND FRAZIER CONSULTANTS
Project # : 93064.1
Project Name: FLYNN LEARNER FREE PRODUCT

ATI I.D. : 508057

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
10	64S-B26-6	SOIL	01-AUG-95	09-AUG-95	10-AUG-95	1.00
11	64S-B27-6	SOIL	01-AUG-95	09-AUG-95	10-AUG-95	1.00
12	64S-B22-6	SOIL	01-AUG-95	11-AUG-95	11-AUG-95	1.00

Parameter	Units	10	11	12
FUEL HYDROCARBONS	MG/KG	<20	610	<20
HYDROCARBON RANGE		C25-C36	C25-C36	C25-C36
HYDROCARBONS QUANTITATED USING		30W	30W	30W

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY RESULTS

Test : MOD EPA 8015-CDOHS (FUEL HYDROCARBONS: C7-C24)
Client : COTTON AND FRAZIER CONSULTANTS
Project # : 93064.1
Project Name: FLYNN LEARNER FREE PRODUCT
ATI I.D. : 508057

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
1	64S-L17-5	SOIL	31-JUL-95	09-AUG-95	10-AUG-95	1.00
2	64S-L19-5	SOIL	31-JUL-95	09-AUG-95	10-AUG-95	1.00
3	64S-L20-5	SOIL	31-JUL-95	09-AUG-95	10-AUG-95	1.00

Parameter	Units	1	2	3
FUEL HYDROCARBONS	MG/KG	6.3	21	7.6
HYDROCARBON RANGE		C18-C24+	C18-C24+	C16-C24+
HYDROCARBONS QUANTITATED USING		DIESEL	DIESEL	DIESEL
<u>SURROGATES</u>				
BIS(2-ETHYLHEXYL)PHTHALATE	%	103	96	103

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY RESULTS

Test : MOD EPA 8015-CDOHS (FUEL HYDROCARBONS: C7-C24)
Client : COTTON AND FRAZIER CONSULTANTS ATI I.D. : 508057
Project # : 93064.1
Project Name: FLYNN LEARNER FREE PRODUCT

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
4	64S-L21-5	SOIL	31-JUL-95	09-AUG-95	10-AUG-95	1.00
5	64S-B14-5	SOIL	31-JUL-95	09-AUG-95	10-AUG-95	1.00
6	64S-B15-5	SOIL	31-JUL-95	09-AUG-95	10-AUG-95	1.00

Parameter	Units	4	5	6
FUEL HYDROCARBONS	MG/KG	<5.0	<5.0	<5.0
HYDROCARBON RANGE		-	-	-
HYDROCARBONS QUANTITATED USING		-	-	-
<u>SURROGATES</u>				
BIS(2-ETHYLHEXYL)PHTHALATE	%	104	101	104

GAS CHROMATOGRAPHY RESULTS

Test : MOD EPA 8015-CDOHS (FUEL HYDROCARBONS: C7-C24)
Client : COTTON AND FRAZIER CONSULTANTS
Project # : 93064.1
Project Name: FLYNN LEARNER FREE PRODUCT

ATI I.D. : 508057

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
7	64S-B17-5	SOIL	31-JUL-95	09-AUG-95	10-AUG-95	1.00
8	64S-B18-5	SOIL	31-JUL-95	09-AUG-95	10-AUG-95	1.00
9	64S-B24-6	SOIL	01-AUG-95	09-AUG-95	10-AUG-95	1.00

Parameter	Units	7	8	9
FUEL HYDROCARBONS	MG/KG	<5.0	<5.0	<5.0
HYDROCARBON RANGE		-	-	-
HYDROCARBONS QUANTITATED USING		-	-	-
SURROGATES				
BIS(2-ETHYLHEXYL)PHTHALATE	%	96	93	98

GAS CHROMATOGRAPHY RESULTS

Test : MOD EPA 8015-CDOHS (FUEL HYDROCARBONS: C7-C24)
ATI I.D. : 508057
Client : COTTON AND FRAZIER CONSULTANTS
Project # : 93064.1
Project Name: FLYNN LEARNER FREE PRODUCT

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
10	64S-B26-6	SOIL	01-AUG-95	09-AUG-95	10-AUG-95	1.00
11	64S-B27-6	SOIL	01-AUG-95	09-AUG-95	10-AUG-95	1.00
12	64S-B22-6	SOIL	01-AUG-95	11-AUG-95	14-AUG-95	1.00

Parameter	Units	10	11	12
FUEL HYDROCARBONS	MG/KG	<5.0	180	<5.0
HYDROCARBON RANGE		-	C14-C24+	-
HYDROCARBONS QUANTITATED USING		-	DIESEL	-
<u>SURROGATES</u>				
BIS(2-ETHYLHEXYL)PHTHALATE	%	105	32*H	103

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY - QUALITY CONTROL

REAGENT BLANK

Test : MOD EPA 8015-CDOHS (FUEL HYDROCARBONS)
Blank I.D. : 36384
Client : COTTON AND FRAZIER CONSULTANTS
Project # : 93064.1
Project Name: FLYNN LEARNER FREE PRODUCT

ATI I.D. : 508057
Date Extracted: 09-AUG-95
Date Analyzed : 10-AUG-95
Dil. Factor : 1.00

Parameters	Units	Results
FUEL HYDROCARBONS	MG/KG	<5.0
HYDROCARBON RANGE		-
HYDROCARBONS QUANTITATED USING		-
<u>SURROGATES</u>		
BIS(2-ETHYLHEXYL)PHTHALATE	%	106

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY - QUALITY CONTROL

REAGENT BLANK

Test : MOD EPA 8015-CDOHS (FUEL HYDROCARBONS)
Blank I.D. : 36408
Client : COTTON AND FRAZIER CONSULTANTS
Project # : 93064.1
Project Name: FLYNN LEARNER FREE PRODUCT

ATI I.D. : 508057
Date Extracted: 11-AUG-95
Date Analyzed : 11-AUG-95
Dil. Factor : 1.00

Parameters	Units	Results
FUEL HYDROCARBONS	MG/KG	<5.0
HYDROCARBON RANGE		-
HYDROCARBONS QUANTITATED USING		-
<u>SURROGATES</u>		
BIS(2-ETHYLHEXYL)PHTHALATE	%	103

GAS CHROMATOGRAPHY - QUALITY CONTROL

MSMSD

Test : MOD EPA 8015-CDOHS (FUEL HYDROCARBONS)
MSMSD # : 77679
Client : COTTON AND FRAZIER CONSULTANTS

Project # : 93064.1
Project Name: FLYNN LEARNER FREE PRODUCT

ATI I.D. : 508057
Date Extracted: 09-AUG-95
Date Analyzed : 10-AUG-95
Sample Matrix : SOIL
REF I.D. : 508045-04

Parameters	Units	Sample Result	Conc Spike	Spiked Sample	% Rec	Dup Spike	Dup % Rec	RPD
FUEL HYDROCARBONS	MG/KG	18	100	87	69	100	82	14

% Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
RPD (Relative % Difference) = (Spiked Sample Result - Duplicate Spike Result)*100/Average Result

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY - QUALITY CONTROL

BLANK SPIKE

Test : MOD EPA 8015-CDOHS (FUEL HYDROCARBONS)
Blank Spike #: 58155
Client : COTTON AND FRAZIER CONSULTANTS
Project # : 93064.1
Project Name : FLYNN LEARNER FREE PRODUCT

ATI I.D. : 508057
Date Extracted: 09-AUG-95
Date Analyzed : 10-AUG-95
Sample Matrix : SOIL

Parameters	Units	Blank Result	Spiked Sample	Spike Conc.	% Rec
FUEL HYDROCARBONS	MG/KG	<5.0	96	100	96

% Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
RPD (Relative % Difference) = (Spiked Sample - Blank Result)*100/Average Result

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY - QUALITY CONTROL

BLANK SPIKE

Test : MOD EPA 8015-CDOHS (FUEL HYDROCARBONS)
Blank Spike #: 58182
Client : COTTON AND FRAZIER CONSULTANTS
Project # : 93064.1
Project Name : FLYNN LEARNER FREE PRODUCT

ATI I.D. : 508057
Date Extracted: 11-AUG-95
Date Analyzed : 11-AUG-95
Sample Matrix : SOIL

Parameters	Units	Blank Result	Spiked Sample	Spike Conc.	% Rec
FUEL HYDROCARBONS	MG/KG	<5.0	90	100	90

% Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
RPD (Relative % Difference) = (Spiked Sample - Blank Result)*100/Average Result

ANALYTICAL TECHNOLOGIES, INC.
SAN DIEGO
FLAGS

ORGANICS

FLAG	MESSAGE DESCRIPTION
A	A TIC IS A SUSPECTED ALDOL-CONDENSATION PRODUCT
B	ANALYTE FOUND IN THE ASSOCIATED REAGENT BLANK
C	PESTICIDE, WHERE THE IDENTIFICATION WAS CONFIRMED BY GC/MS
CO	THESE COMPOUNDS CO-ELUTE AND ARE QUANTITATED AS ONE PEAK
D	COMPOUND IDENTIFIED IN AN ANALYSIS AT SECONDARY DILUTION
E	ANALYTE AMOUNT EXCEEDS THE CALIBRATION RANGE
J	ESTIMATED VALUE
H	QUANTIFIED AS DIESEL BUT CHROMATOGRAPHIC PATTERN DOES NOT MATCH THAT OF DIESEL
K	QUANTIFIED AS KEROSENE BUT CHROMATOGRAPHIC PATTERN DOES NOT MATCH THAT OF KEROSENE
L	QUANTIFIED AS GASOLINE BUT CHROMATOGRAPHIC PATTERN DOES NOT MATCH THAT OF GASOLINE
N	PRESUMPTIVE EVIDENCE OF A COMPOUND
P	PESTICIDE/AROCLOR TARGET ANALYTE, WHERE THERE IS GREATER THAN 25% DIFFERENCE FOR DETECTED CONCENTRATION BETWEEN 2 GC COLUMNS
TR	COMPOUND DETECTED AT AN UNQUANTIFIABLE TRACE LEVEL
U	COMPOUND WAS ANALYZED FOR BUT NOT DETECTED
X	SEE CASE NARRATIVE
Y	SEE CASE NARRATIVE
Z	SEE CASE NARRATIVE
*	OUTSIDE OF QUALITY CONTROL LIMITS
*D	COMPOUND ANALYZED FROM A SECONDARY ANALYSIS
*F	RESULT OUTSIDE OF ATI'S QUALITY CONTROL LIMITS
*G	RESULT OUTSIDE QUALITY CONTROL LIMITS. INSUFFICIENT SAMPLE FOR RE-EXTRACTION/ANALYSIS
*H	RESULT OUTSIDE OF LIMITS DUE TO SAMPLE MATRIX INTERFERENCE
*I	BECAUSE OF NECESSARY SAMPLE DILUTION, VALUE WAS OUTSIDE QC LIMITS
*K	DUE TO THE NECESSARY DILUTION OF THE SAMPLE, RESULT WAS NOT ATTAINABLE
*L	ANALYTE IS A SUSPECTED LAB CONTAMINANT
*P	A STANDARD WAS USED TO QUANTITATE THIS VALUE
*R	DATA IS NOT USABLE
*T	SURROGATE RECOVERY IS OUTSIDE QC CONTROL LIMITS. NO CORRECTIVE ACTION INDICATED BY METHOD
*V	SAMPLE RESULT IS >4X SPIKED CONCENTRATION, THEREFORE SPIKE IS NOT DETECTABLE
*Y	RESULT NOT ATTAINABLE DUE TO SAMPLE MATRIX INTERFERENCE
@A	RESULTS OUT OF LIMITS DUE TO SAMPLE NON-HOMOGENEITY
@C	*VARIABLE MESSAGE*
@D	RESULT COULD NOT BE CONFIRMED DUE TO MATRIX INTERFERENCE ON THE CONFIRMATION COLUMN
@E	RESULT MAY BE FALSELY ELEVATED DUE TO SAMPLE MATRIX INTERFERENCE
@F	RESULT OUTSIDE OF CONTRACT SPECIFIED QUALITY CONTROL LIMITS
@G	RESULT OUTSIDE OF CONTRACT SPECIFIED ADVISORY LIMITS
@H	DETECTION LIMIT ELEVATED DUE TO MATRIX INTERFERENCE
@M	RESULT NOT CONFIRMED BY U.V. DUE TO SAMPLE MATRIX INTERFERENCE
@N	RESULT NOT CONFIRMED BY FLUORESCENCE DUE TO SAMPLE MATRIX INTERFERENCE
@P	RESULT QUANTITATED USING FLUORESCENCE ONLY DUE TO THE LOW CONCENTRATION
@Q	DETECTION LIMIT ELEVATED DUE TO LIMITED SAMPLE FOR ANALYSIS
@T	RESULT DUE TO TCLP EXTRACTION MATRIX INTERFERENCE. NO QC LIMITS HAVE BEEN ESTABLISHED
@U	SAMPLE CHROMATOGRAM DOES NOT RESEMBLE COMMON FUEL HYDROCARBON FINGERPRINTS
@Z	SAMPLE CHROMATOGRAM DOES NOT RESEMBLE A FUEL HYDROCARBON

ACCESSION #: SC 2057 INITIALS: LM

ATI-SanDiego
SAMPLE CONDITION UPON RECEIPT CHECKLIST
(FOR RE-ACCESSIONS, COMPLETE #7 THRU #9)

1	Does this project require special handling according to NFESC Levels C, D, AFCEE or CLP protocols? If yes, complete a) and b) a) pH sample aliquoted: yes /no /na b) Either 1) Record Bottle Lot #'s: Or 2) Attach Sample Kit Request Form(s)	YES	[✓ NO]
2	Number of Coolers Received If more than one cooler received attach Multiple Cooler Documentation Form (MCD) Indicate "see MCD" on Item 11 below	1	
3	Are custody seals required for this project ?	YES	[✓ N/A]
	a) are Custody Seals present on Cooler(s) ?	YES	[✓ NO]
	If yes, are seals intact ? [✓ N/A]	YES	NO
	b) are Custody Seals present on the sample ?	YES	[✓ NO]
	If yes, are seals intact ? [✓ N/A]	YES	NO
4	Is there a Chain-Of-Custody (COC)* per cooler ? if not, if a problem is found indicate which samples/test were in the affected cooler on the MCD.	[✓ YES]	NO
5	Is the COC* complete per cooler ? Relinquished: [✓ yes]/no Requested analysis: [✓ yes]/no	[✓ YES]	NO
6	Is the COC* in agreement with the samples received? # Samples: [✓ yes]/no Sample ID's: [✓ yes]/no Date sampled: [✓ yes]/no Matrix: [✓ yes]/no # containers: [✓ yes]/no	[✓ YES]	NO
7	Are the samples preserved correctly?	[✓ YES]	NO
8	Is there enough sample for all the requested analyses?	[✓ YES]	NO
9	Are all samples within holding times for the requested analyses?	[✓ YES]	NO
10	Record cooler temperature. Contact PM if temperature is not 4°C ± 2°C.	2.0 °C	
	Is ice present in cooler?	[✓ YES]	NO
11	Were all sample containers received intact (ie. not broken, leaking, etc.)?	[✓ YES]	NO
12	Are samples requiring no headspace, headspace free? [✓ N/A]	~~YES~~	LM 5/4/ NO
13	Are VOA 1st stickers required?	YES	[✓ NO]
14	Are there special comments on the Chain of Custody which require client contact?	YES	[✓ N/A]
15	If yes, was ATI Project Manager notified?	YES	NO

Describe "no" items: ______________________

Was client contacted? yes / no

If yes, Date: __________ Name of Person contacted: ______

Describe actions taken or client instructions: ______________________

*Or other representative documents, letters, and/or shipping memos

ATIFRM902(03/95)

AnalyticalTechnologies,Inc. Corporate Offices: 5550 Morehouse Drive San Diego, CA 92121 (619) 458-9141

ATI I.D.: 50808.

August 21, 1995

COTTON AND FRAZIER CONSULTANTS
801 ALEKEA STREET, SUITE 211
HONOLULU, HI 96813

Project Name: FLYNN LEARNER TANK
Project # : 93064.1

Attention: LEE CRANMER

Analytical Technologies, Inc. has received the following sample(s):

Date Received	Quantity	Matrix
August 08, 1995	1	PRODUCT
August 08, 1995	1	WATER

The sample(s) were analyzed with EPA methodology or equivalent methods as specified in th enclosed analytical schedule. The symbol for "less than" indicates a value below the reportabl detection limit. If any flags appear next to the analytical data in this report, please see th attached list of flag definitions.

The results of these analyses and the quality control data are enclosed. Please note that th Sample Condition Upon Receipt Checklist is included at the end of this report.

ANN FREED
PROJECT MANAGER

for ALAN J. KLEINSCHMIDT
LABORATORY MANAGER

AnalyticalTechnologies,Inc. SAMPLE CROSS REFERENCE

Client : COTTON AND FRAZIER CONSULTANTS
Project # : 93064.1
Project Name: FLYNN LEARNER TANK

Report Date: August 21, 1995
ATI I.D. : 508082

ATI #	Client Description	Matrix	Date Collected
1	64.1W-T1	WATER	04-AUG-95
2	64.1P-HO	PRODUCT	04-AUG-95

---TOTALS---

Matrix	# Samples
PRODUCT	1
WATER	1

ATI STANDARD DISPOSAL PRACTICE

The sample(s) from this project will be disposed of in twenty-one (21) days from the date o this report. If an extended storage period is required, please contact our sample contro department before the scheduled disposal date.

AnalyticalTechnologies,Inc. **ANALYTICAL SCHEDULE**

Client : COTTON AND FRAZIER CONSULTANTS
Project # : 93064.1
Project Name: FLYNN LEARNER TANK

ATI I.D.: 50808

Analysis	Technique/Description
EPA 8010 (HALOGENATED VOLATILE ORGANICS)	GC/ELECTROLYTIC CONDUCTIVITY DETECTOR
MOD EPA 8015-CDOHS (FUEL HYDROCARBONS-EXT. RANGE)	GC/FLAME IONIZATION DETECTOR
MOD EPA 8015-CDOHS (FUEL HYDROCARBONS: C7-C24)	GC/FLAME IONIZATION DETECTOR
MOD EPA 8015-CDOHS/8020 (HYDROCARBONS C6-C12/BTXE)	GC/FLAME ION./PHOTO IONIZATION DETECTOR
MOD EPA8015-CDOHS FUEL CHARACTERIZATION/N-ALKANES	GC/FLAME IONIZATION DETECTOR

Test : MOD EPA8015-CDOHS FUEL CHARACTERIZATION/N-ALKANES
C7
Client : COTTON AND FRAZIER CONSULTANTS
Project # : 93064.1
Project Name: FLYNN LEARNER TANK

ATI I.D. : 508082

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
2	64.1P-HO	PRODUCT	04-AUG-95	09-AUG-95	11-AUG-95	2000.00

Parameter	Units	2
PERCENT HYDROCARBONS (DIESEL RANGE)	%	14

AnalyticalTechnologies,Inc. GAS CHROMATOGRAPHY - QUALITY CONTROL

REAGENT BLANK

Test : MOD EPA 8015-CDOHS (FUEL HYDROCARBONS)
Blank I.D. : 36401
Client : COTTON AND FRAZIER CONSULTANTS
Project # : 93064.1
Project Name: FLYNN LEARNER TANK

ATI I.D. : 508082
Date Extracted: 11-AUG-95
Date Analyzed : 11-AUG-95
Dil. Factor : 1.00

Parameters	Units	Results
FUEL HYDROCARBONS	MG/L	<0.50
HYDROCARBON RANGE		-
HYDROCARBONS QUANTITATED USING		-
SURROGATES		
BIS(2-ETHYLHEXYL)PHTHALATE	%	117

GAS CHROMATOGRAPHY - QUALITY CONTROL

MSMSD

Test : MOD EPA 8015-CDOHS (FUEL HYDROCARBONS)
MSMSD # : 77708
Client : COTTON AND FRAZIER CONSULTANTS

Project # : 93064.1
Project Name: FLYNN LEARNER TANK

ATI I.D. : 508082
Date Extracted: 11-AUG-95
Date Analyzed : 11-AUG-95
Sample Matrix : WATER
REF I.D. : 508082-01

Parameters	Units	Sample Result	Conc Spike	Spiked Sample	% Rec	Dup Spike	Dup % Rec	RPD
FUEL HYDROCARBONS	MG/L	17	10	29	120	29	120	0

% Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
RPD (Relative % Difference) = (Spiked Sample Result - Duplicate Spike Result)*100/Average Resul

BLANK SPIKE

Test : MOD EPA 8015-CDOHS (FUEL HYDROCARBONS)
Blank Spike #: 58172
Client : COTTON AND FRAZIER CONSULTANTS
Project # : 93064.1
Project Name : FLYNN LEARNER TANK

ATI I.D. : 508082
Date Extracted: 11-AUG-95
Date Analyzed : 11-AUG-95
Sample Matrix : WATER

Parameters	Units	Blank Result	Spiked Sample	Spike Conc.	% Rec
FUEL HYDROCARBONS	MG/L	<0.50	12	10	120

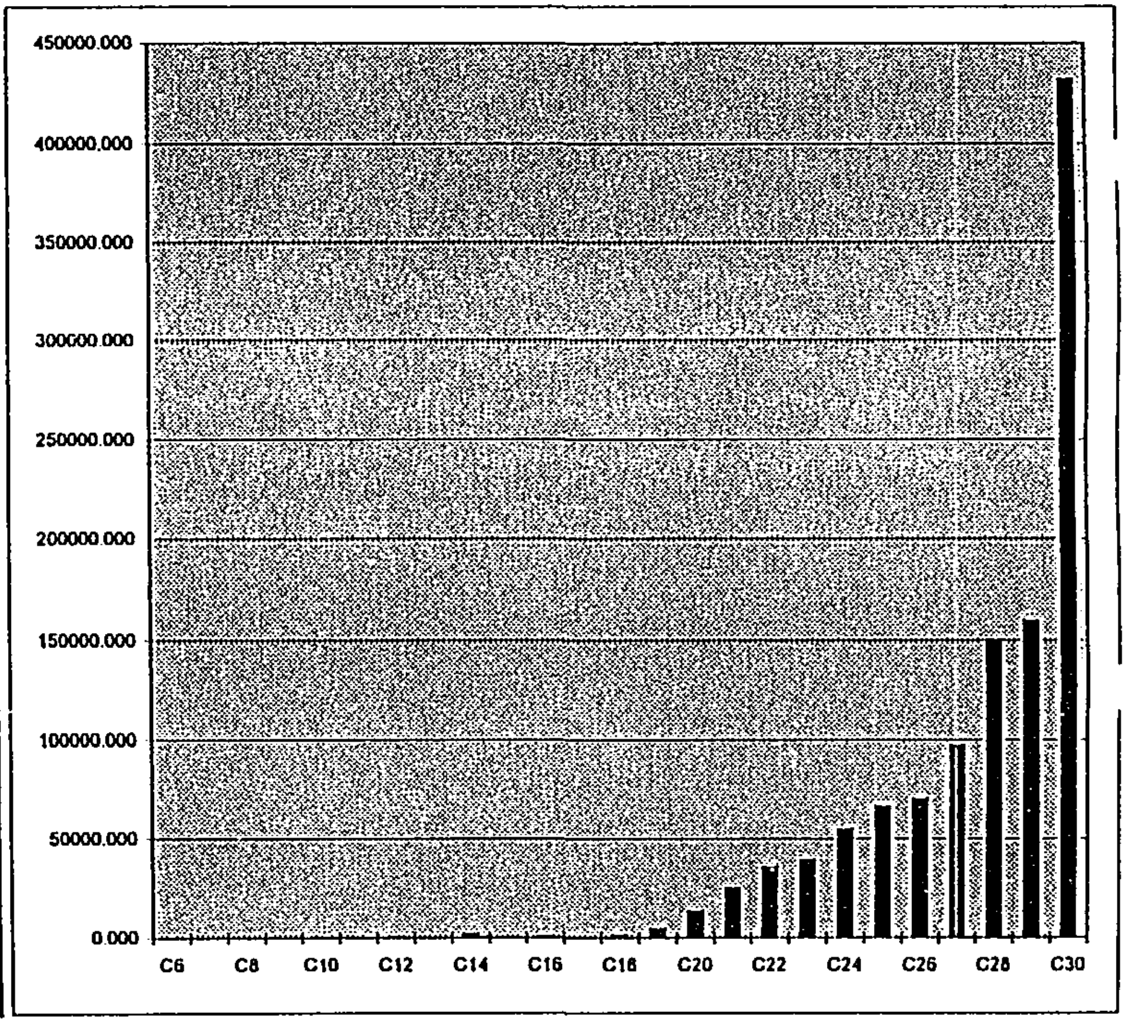
% Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
RPD (Relative % Difference) = (Spiked Sample - Blank Result)*100/Average Result

Client: COTTON & FRAZIER
Client Descript.: 64.1P-HO
Matrix PRODUCT
ATI Sample Number 508082-02
Amount Ext'd: N/A ml
Extract Vol: N/A ml
Dilution: 2000
Date of Analysis 9-Aug-95
ATI Data Filename: 3080943
Pract. Quant. Limit 1000.00 mg/L
Comment:

FINAL RESULTS:
139550.74 mg/L Diesel quantitated between C7 and C24
1016573.12 mg/L Motor Oil quantitated between C24 and C30

Paraffin Range	Fuel Conc.	Percent of Total	Cum. Percent
C6	0.000	0.0%	0.0%
C7	0.000	0.0%	0.0%
C8	0.000	0.0%	0.0%
C9	0.000	0.0%	0.0%
C10	0.000	0.0%	0.0%
C11	0.000	0.0%	0.0%
C12	166.371	0.0%	0.0%
C13	0.000	0.0%	0.0%
C14	2022.698	0.2%	0.2%
C15	0.000	0.0%	0.2%
C16	567.378	0.0%	0.2%
C17	0.000	0.0%	0.2%
C18	1133.733	0.1%	0.3%
C19	4619.026	0.4%	0.7%
C20	13639.661	1.2%	1.9%
C21	25486.918	2.2%	4.1%
C22	36270.735	3.1%	7.3%
C23	39258.224	3.4%	10.7%
C24	55060.820	4.8%	15.4%
C25	67072.097	5.8%	21.2%
C26	70284.668	6.1%	27.3%
C27	97350.722	8.4%	35.7%
C28	150862.340	13.0%	48.8%
C29	160017.167	13.8%	62.6%
C30	432311.292	37.4%	100.0%
Totals:	1,156,123.85	100.0%	

Table of concentrations within standard fuel carbon ranges. All concentrations in mg/L.



Analytical Technologies, Inc. 5550 Morehouse Dr. San Diego, CA 92121 (619) 458-9141

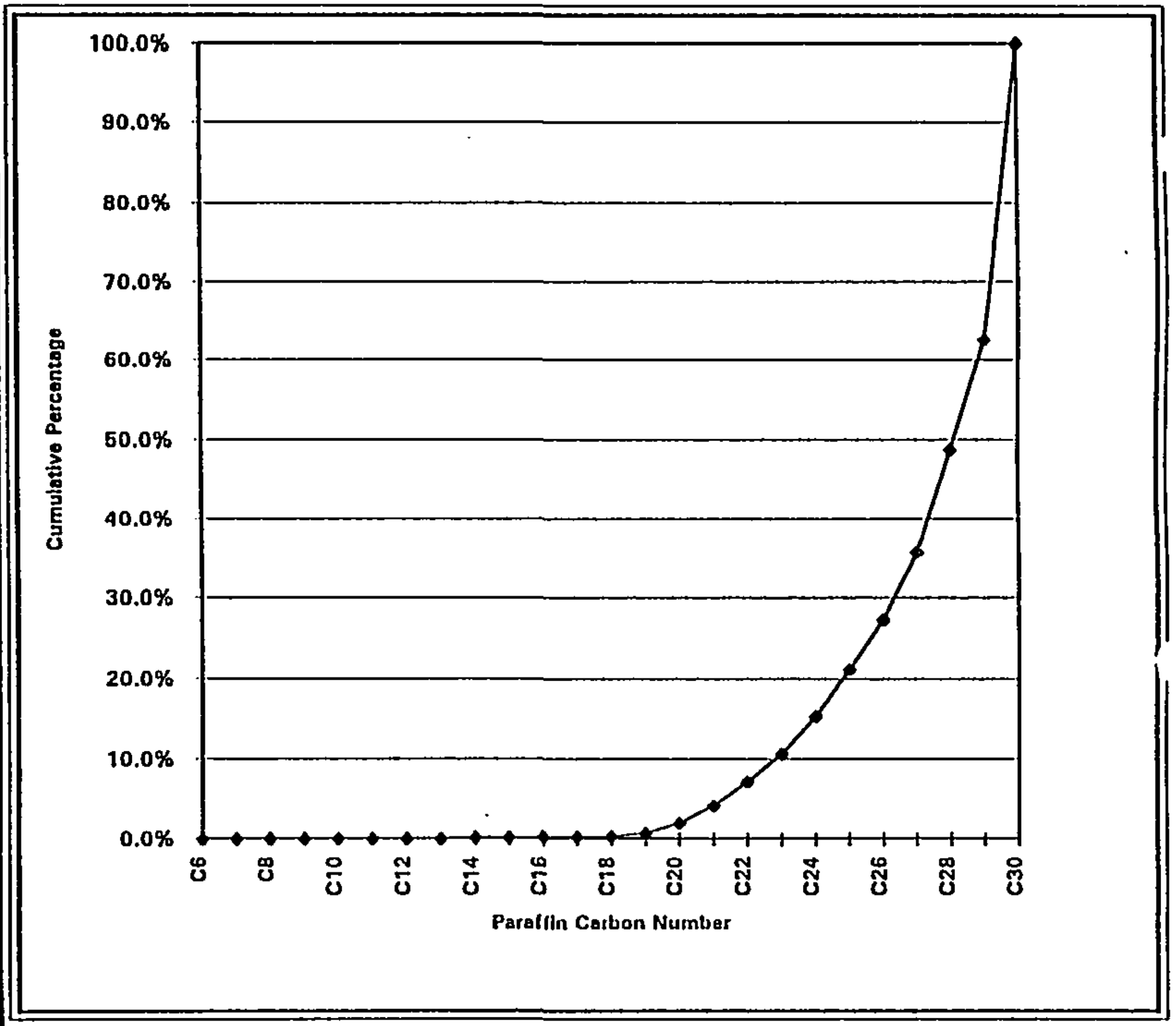
Client: COTTON & FRAZIER
Client Descript.: 64.1P-HO
Matrix PRODUCT
ATI Sample Number 508082-02

Results: 139550.74 mg/L Diesel quantitated between C7 and C24
1016573.12 mg/L Motor Oil quantitated between C24 and C30

Amount Ext'd: N/A ml
Extract Vol: N/A ml
Dilution: 2000
Date of Analysis 9-Aug-95
ATI Data Filename: 3080943
Pract. Quant. Limit 1000.00 mg/L
Comment:

Paraffin Range	Fuel mg/L	Percent of Total	Cum. Percent
C6	0.0	0.0%	0.0%
C7	0.0	0.0%	0.0%
C8	0.0	0.0%	0.0%
C9	0.0	0.0%	0.0%
C10	0.0	0.0%	0.0%
C11	0.0	0.0%	0.0%
C12	166.4	0.0%	0.0%
C13	0.0	0.0%	0.0%
C14	2,022.7	0.2%	0.2%
C15	0.0	0.0%	0.2%
C16	567.4	0.0%	0.2%
C17	0.0	0.0%	0.2%
C18	1,133.7	0.1%	0.3%
C19	4,619.0	0.4%	0.7%
C20	13,639.7	1.2%	1.9%
C21	25,486.9	2.2%	4.1%
C22	36,270.7	3.1%	7.3%
C23	39,258.2	3.4%	10.7%
C24	55,060.8	4.8%	15.4%
C25	67,072.1	5.8%	21.2%
C26	70,284.7	6.1%	27.3%
C27	97,350.7	8.4%	35.7%
C28	150,362.3	13.0%	48.8%
C29	160,017.2	13.8%	62.6%
C30	432,311.3	37.4%	100.0%
Totals:	1,156,123.85	100.0%	

Graph of Cumulative Percent by Paraffin Range



ACCESSION #: SC 082

INITIALS: LM

ATI-SanDiego
SAMPLE CONDITION UPON RECEIPT CHECKLIST
(FOR RE-ACCESSIONS, COMPLETE #7 THRU #9)

1	Does this project require special handling according to NFESC Levels C, D, AFCEE or CLP protocols? If yes, complete a) and b) a) pH sample aliquoted: yes /no /na b) Either 1) Record Bottle Lot #'s: Or 2) Attach Sample Kit Request Form(s)	YES	[✓ NO]
2	Number of Coolers Received If more than one cooler received attach Multiple Cooler Documentation Form (MCD) Indicate "see MCD" on Item 11 below	1	
3	Are custody seals required for this project ?	YES	[✓ N/A]
	a) are Custody Seals present on Cooler(s) ?	YES	[✓ NO]
	If yes, are seals intact ? [✓ N/A]	YES	NO
	b) are Custody Seals present on the sample ?	YES	[✓ NO]
	If yes, are seals intact ? [✓ N/A]	YES	NO
4	Is there a Chain-Of-Custody (COC)* per cooler ? If not, if a problem is found indicate which samples/test were in the affected cooler on the MCD.	[✓ YES]	NO
5	Is the COC* complete per cooler ? Relinquished: [✓ yes]/no Requested analysis: [✓ yes]/no	[✓ YES]	NO
6	Is the COC* in agreement with the samples received? # Samples: [✓ yes]/no Sample ID's [✓ yes]/no Date sampled: [✓ yes]/no Matrix: [✓ yes]/no # containers: [✓ yes]/no	[✓ YES]	NO
7	Are the samples preserved correctly?	YES	[✓ NO]
8	Is there enough sample for all the requested analyses?	[✓ YES]	NO
9	Are all samples within holding times for the requested analyses?	[✓ YES]	NO
10	Record cooler temperature. Contact PM if temperature is not 4°C ± 2°C.	5.0 °C	
	Is ice present in cooler?	[✓ YES]	NO
11	Were all sample containers received intact (ie. not broken, leaking, etc.)?	[✓ YES]	NO
12	Are samples requiring no headspace, headspace free? N/A	[✓ YES]	NO
13	Are VOA 1st stickers required?	YES	[✓ NO]
14	Are there special comments on the Chain of Custody which require client contact?	YES	[✓ N/A]
15	If yes, was ATI Project Manager notified?	YES	NO

Describe "no" items: #7) Sample Container for TPH-D (2 x 4 oz A/c) received Unpreserved, preserved in lab w/ HCl per Ann Freed.

Was client contacted? yes / no

If yes, Date: ______ Name of Person contacted: ______

Describe actions taken or client instructions: ______

*Or other representative documents, letters, and/or shipping memos

ATIFRM902(03/95)

Cotton and Frazier Consultants, Inc.
"Environmental Solutions"
P.O. Box 27126
Honolulu, Hawaii 96827

Telephone: (808) 599-1993 FAX: (808) 599-1502

508082

Chain of Custody Record/ Analysis Record

PROJECT NAME: Flynn Learner Tanks

LOCATION: Sand Island Access Rd. JOB NUMBER: 93064.1

SAMPLER: Robert W. Rooks, PE PROJECT MGR: ~~Robert W. Rooks, PE~~ Lee Cronin

					CONTAINERS						Analysis Requested										
SAMPLE #	LAB SAMPLE ID#	TIME COLLECTED	DATE COLLECTED	MATRIX: S=SOIL W=WATER A=AIR	40 ml. VOA	1 L. Glass	Brass Ring	8-oz. Glass	150ml Glass	plastic	TPH-Gas / BTEX	TPH-D	TPH-O&G	6010	~~6010 [illegible]~~	8015 Mod t alk (paraffin)				Hold for Further Analysis	RUSH (See Below)
01 64.1W-T1		0800	8/4/95	Water	4	1			2		+	X	X	X	##						
02 64.1P-110		0800	8/4/95	Product						1						X					

Relinquished By Sampler:
Signature:
Printed Name: Bob Rooks
Date/Time: 8/4/95 0900

Relinquished By:
Signature:
Printed Name: Robert W. Rooks
Date/Time: 8/7/95 1430

Relinquished By:
Signature:
Printed Name:
Date/Time:

Received By:
Signature:
Printed Name: Cold storage
Date/Time:

Received By:
Signature:
Printed Name: Fed Ex
Date/Time:

Received By:
Signature:
Printed Name: Lucio Mendez
Date/Time: 8/8/95 9:00

LABORATORY:
Total # Containers:
Samples Received Chilled? Yes No
Samples in good condition? Yes No

Special Handling
Turnaround:
24 hour 48 hour
72 hour [✓ Regular]
Other____

Comments:
5.0°C

AnalyticalTechnologies, Inc. Corporate Offices: 5550 Morehouse Drive San Diego, CA 92121 (619) 458-9141

ATI I.D.: 507243

August 10, 1995

COTTON AND FRAZIER CONSULTANTS
801 ALEKEA STREET, SUITE 211
HONOLULU, HI 96813

Project Name: FLYNN-LEARNER FP
Project # : 93064.1

Attention: LEE CRANMER

Analytical Technologies, Inc. has received the following sample(s):

Date Received	Quantity	Matrix
July 25, 1995	9	SOIL

The sample(s) were analyzed with EPA methodology or equivalent methods as specified in the enclosed analytical schedule. The symbol for "less than" indicates a value below the reportable detection limit. If any flags appear next to the analytical data in this report, please see the attached list of flag definitions.

The results of these analyses and the quality control data are enclosed. Please note that the Sample Condition Upon Receipt Checklist is included at the end of this report.

ANN FREED
PROJECT MANAGER

Christopher Myers
FOR ALAN J. KLEINSCHMIDT
LABORATORY MANAGER

AnalyticalTechnologies,Inc.

SAMPLE CROSS REFERENCE

Client : COTTON AND FRAZIER CONSULTANTS
Project # : 93064.1
Project Name: FLYNN-LEARNER FP

Report Date: August 10, 1995
ATI I.D. : 507245

ATI #	Client Description	Matrix	Date Collected
1	64S-L2-6	SOIL	20-JUL-95
2	64S-L4-6	SOIL	20-JUL-95
3	64S-L7-6	SOIL	20-JUL-95
4	64S-L8-6	SOIL	20-JUL-95
5	64S-L11-6	SOIL	21-JUL-95
6	64S-B5-5	SOIL	21-JUL-95
7	64S-B7-5	SOIL	21-JUL-95
8	64S-B9-5	SOIL	21-JUL-95
9	64S-B12-6	SOIL	21-JUL-95

---TOTALS---

Matrix	# Samples
SOIL	9

ATI STANDARD DISPOSAL PRACTICE

The sample(s) from this project will be disposed of in twenty-one (21) days from the date of this report. If an extended storage period is required, please contact our sample control department before the scheduled disposal date.

ANALYTICAL SCHEDULE

Client : COTTON AND FRAZIER CONSULTANTS
Project # : 93064.1
Project Name: FLYNN-LEARNER FP

ATI I.D.: 507245

Analysis	Technique/Description
EPA 8310 (POLYNUCLEAR AROMATIC HYDROCARBONS)	HIGH PERFORMANCE LIQUID CHROMATOGRAPHY
MOD EPA 8015-CDOHS (FUEL HYDROCARBONS-EXT. RANGE)	GC/FLAME IONIZATION DETECTOR
MOD EPA 8015-CDOHS (FUEL HYDROCARBONS: C7-C24)	GC/FLAME IONIZATION DETECTOR

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY RESULTS

Test : EPA 8310 (POLYNUCLEAR AROMATIC HYDROCARBONS)
Client : COTTON AND FRAZIER CONSULTANTS
ATI I.D. : 507245
Project # : 93064.1
Project Name: FLYNN-LEARNER FP

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
6	64S-B5-5	SOIL	21-JUL-95	02-AUG-95	09-AUG-95	1.00
7	64S-B7-5	SOIL	21-JUL-95	02-AUG-95	09-AUG-95	1.00

Parameter	Units	6	7
NAPHTHALENE	MG/KG	<0.083	<0.083
ACENAPHTHYLENE	MG/KG	<0.17	<0.17
ACENAPHTHENE	MG/KG	<0.17	<0.17
FLUORENE	MG/KG	<0.017	<0.017
PHENANTHRENE	MG/KG	<0.0083	<0.0083
ANTHRACENE	MG/KG	<0.0083	<0.0083
FLUORANTHENE	MG/KG	<0.017	<0.017
PYRENE	MG/KG	<0.017	<0.017
BENZO(a)ANTHRACENE	MG/KG	<0.017	<0.017
CHRYSENE	MG/KG	<0.017	<0.017
BENZO(b)FLUORANTHENE	MG/KG	<0.017	<0.017
BENZO(k)FLUORANTHENE	MG/KG	<0.017	<0.017
BENZO(a)PYRENE	MG/KG	<0.017	<0.017
DIBENZO(a,h)ANTHRACENE	MG/KG	<0.034	<0.034
BENZO(g,h,i)PERYLENE	MG/KG	<0.017	<0.017
INDENO(1,2,3-cd)PYRENE	MG/KG	<0.017	<0.017
<u>SURROGATES</u>			
2-CHLOROANTHRACENE	%	85	80

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY - QUALITY CONTROL

REAGENT BLANK

Test : EPA 8310 (POLYNUCLEAR AROMATIC HYDROCARBONS)
Blank I.D. : 36357
Client : COTTON AND FRAZIER CONSULTANTS
Project # : 93064.1
Project Name: FLYNN-LEARNER FP

ATI I.D. : 507245
Date Extracted: 02-AUG-95
Date Analyzed : 09-AUG-95
Dil. Factor : 1.00

Parameters	Units	Results
NAPHTHALENE	MG/KG	<0.083
ACENAPHTHYLENE	MG/KG	<0.17
ACENAPHTHENE	MG/KG	<0.17
FLUORENE	MG/KG	<0.017
PHENANTHRENE	MG/KG	<0.0083
ANTHRACENE	MG/KG	<0.0083
FLUORANTHENE	MG/KG	<0.017
PYRENE	MG/KG	<0.017
BENZO(a)ANTHRACENE	MG/KG	<0.017
CHRYSENE	MG/KG	<0.017
BENZO(b)FLUORANTHENE	MG/KG	<0.017
BENZO(k)FLUORANTHENE	MG/KG	<0.017
BENZO(a)PYRENE	MG/KG	<0.017
DIBENZO(a,h)ANTHRACENE	MG/KG	<0.034
BENZO(g,h,i)PERYLENE	MG/KG	<0.017
INDENO(1,2,3-cd)PYRENE	MG/KG	<0.017
SURROGATES		
2-CHLOROANTHRACENE	%	85

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY - QUALITY CONTROL

MSMSD

Page

Test : EPA 8310 (POLYNUCLEAR AROMATIC HYDROCARBONS)
MSMSD # : 77637
Client : COTTON AND FRAZIER CONSULTANTS

Project # : 93064.1
Project Name: FLYNN-LEARNER FP

ATI I.D. : 507245
Date Extracted: 02-AUG-95
Date Analyzed : 09-AUG-95
Sample Matrix : SOIL
REF I.D. : 507260-05

Parameters	Units	Sample Result	Conc Spike	Spiked Sample	% Rec	Dup Spike	Dup % Rec	RPD
ACENAPHTHYLENE	MG/KG	<0.17	3.3	3.0	91	3.3	100	10
PHENANTHRENE	MG/KG	0.010	0.17	0.17	94	0.18	100	6
PYRENE	MG/KG	0.037	0.17	0.23	114	0.24	119	4
BENZO(k)FLUORANTHENE	MG/KG	0.037	0.17	0.22	108	0.23	114	4
DIBENZO(a,h)ANTHRACENE	MG/KG	<0.034	0.33	0.27	82	0.33	100	20

% Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
RPD (Relative % Difference) = (Spiked Sample Result - Duplicate Spike Result)*100/Average Resul

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GAS CHROMATOGRAPHY - QUALITY CONTROL

BLANK SPIKE

Test : EPA 8310 (POLYNUCLEAR AROMATIC HYDROCARBONS)
Blank Spike #: 58115
Client : COTTON AND FRAZIER CONSULTANTS
Project # : 93064.1
Project Name : FLYNN-LEARNER FP

ATI I.D. : 507245
Date Extracted: 02-AUG-95
Date Analyzed : 09-AUG-95
Sample Matrix : SOIL

Parameters	Units	Blank Result	Spiked Sample	Spike Conc.	% Rec
ACENAPHTHYLENE	MG/KG	<0.17	3.0	3.3	91
PHENANTHRENE	MG/KG	<0.0083	0.16	0.17	94
PYRENE	MG/KG	<0.017	0.17	0.17	100
BENZO(k)FLUORANTHENE	MG/KG	<0.017	0.18	0.17	106
DIBENZO(a,h)ANTHRACENE	MG/KG	<0.034	0.38	0.33	115

% Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
RPD (Relative % Difference) = (Spiked Sample - Blank Result)*100/Average Result

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY RESULTS

Test : MOD EPA 8015-CDOHS (FUEL HYDROCARBONS-EXT. RANGE)
Client : COTTON AND FRAZIER CONSULTANTS ATI I.D. : 507245
Project # : 93064.1
Project Name: FLYNN-LEARNER FP

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
1	64S-L2-6	SOIL	20-JUL-95	01-AUG-95	05-AUG-95	1.00
3	64S-L7-6	SOIL	20-JUL-95	01-AUG-95	05-AUG-95	1.00
4	64S-L8-6	SOIL	20-JUL-95	01-AUG-95	07-AUG-95	20.00

Parameter	Units	1	3	4
FUEL HYDROCARBONS	MG/KG	100	110	6300
HYDROCARBON RANGE		C25-C36	C25-C36	C25-C36
HYDROCARBONS QUANTITATED USING		30W	30W	30W

GAS CHROMATOGRAPHY RESULTS

Test : MOD EPA 8015-CDOHS (FUEL HYDROCARBONS-EXT. RANGE)
Client : COTTON AND FRAZIER CONSULTANTS
Project # : 93064.1
Project Name: FLYNN-LEARNER FP

ATI I.D. : 507245

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
5	64S-L11-6	SOIL	21-JUL-95	01-AUG-95	05-AUG-95	1.00
7	64S-B7-5	SOIL	21-JUL-95	01-AUG-95	05-AUG-95	1.00
8	64S-B9-5	SOIL	21-JUL-95	01-AUG-95	05-AUG-95	1.00

Parameter	Units	5	7	8
FUEL HYDROCARBONS	MG/KG	<20	46	<20
HYDROCARBON RANGE		C25-C36	C25-C36	C25-C36
HYDROCARBONS QUANTITATED USING		30W	30W	30W

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GAS CHROMATOGRAPHY RESULTS

Test : MOD EPA 8015-CDOHS (FUEL HYDROCARBONS-EXT. RANGE)
Client : COTTON AND FRAZIER CONSULTANTS
ATI I.D. : 507245
Project # : 93064.1
Project Name: FLYNN-LEARNER FP

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
9	64S-B12-6	SOIL	21-JUL-95	01-AUG-95	07-AUG-95	10.00

Parameter	Units	9
FUEL HYDROCARBONS	MG/KG	3000
HYDROCARBON RANGE		C25-C36
HYDROCARBONS QUANTITATED USING		30W

GAS CHROMATOGRAPHY RESULTS

Test : MOD EPA 8015-CDOHS (FUEL HYDROCARBONS: C7-C24)
Client : COTTON AND FRAZIER CONSULTANTS
ATI I.D. : 507245
Project # : 93064.1
Project Name: FLYNN-LEARNER FP

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
1	64S-L2-6	SOIL	20-JUL-95	01-AUG-95	02-AUG-95	1.00
2	64S-L4-6	SOIL	20-JUL-95	01-AUG-95	02-AUG-95	1.00
3	64S-L7-6	SOIL	20-JUL-95	01-AUG-95	02-AUG-95	1.00

Parameter	Units	1	2	3
FUEL HYDROCARBONS	MG/KG	<5.0	<5.0	8.6
HYDROCARBON RANGE		-	-	C15-C24+
HYDROCARBONS QUANTITATED USING		-	-	DIESEL
SURROGATES				
BIS(2-ETHYLHEXYL)PHTHALATE	%	100	102	97

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GAS CHROMATOGRAPHY RESULTS

Test : MOD EPA 8015-CDOHS (FUEL HYDROCARBONS: C7-C24)
Client : COTTON AND FRAZIER CONSULTANTS
Project # : 93064.1
Project Name: FLYNN-LEARNER FP

ATI I.D. : 507245

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
4	64S-L8-6	SOIL	20-JUL-95	01-AUG-95	02-AUG-95	1.00
5	64S-L11-6	SOIL	21-JUL-95	01-AUG-95	02-AUG-95	1.00
6	64S-B5-5	SOIL	21-JUL-95	01-AUG-95	02-AUG-95	10.00

Parameter	Units	4	5	6
FUEL HYDROCARBONS	MG/KG	640	<5.0	4200
HYDROCARBON RANGE		C7-C24+	-	C12-C24
HYDROCARBONS QUANTITATED USING		DIESEL	-	DIESEL
<u>SURROGATES</u>				
BIS(2-ETHYLHEXYL)PHTHALATE	%	105	104	97

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY RESULTS

Test : MOD EPA 8015-CDOHS (FUEL HYDROCARBONS: C7-C24)
Client : COTTON AND FRAZIER CONSULTANTS
Project # : 93064.1
Project Name: FLYNN-LEARNER FP

ATI I.D. : 507245

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
7	64S-B7-5	SOIL	21-JUL-95	01-AUG-95	02-AUG-95	1.00
8	64S-B9-5	SOIL	21-JUL-95	01-AUG-95	02-AUG-95	1.00
9	64S-B12-6	SOIL	21-JUL-95	01-AUG-95	02-AUG-95	1.00

Parameter	Units	7	8	9
FUEL HYDROCARBONS	MG/KG	<5.0	<5.0	190
HYDROCARBON RANGE		-	-	C12-C24+
HYDROCARBONS QUANTITATED USING		-	-	DIESEL
<u>SURROGATES</u>				
BIS(2-ETHYLHEXYL)PHTHALATE	%	105	108	100

GAS CHROMATOGRAPHY - QUALITY CONTROL

REAGENT BLANK

Test : MOD EPA 8015-CDOHS (FUEL HYDROCARBONS)
Blank I.D. : 36309
Client : COTTON AND FRAZIER CONSULTANTS
Project # : 93064.1
Project Name: FLYNN-LEARNER FP

ATI I.D. : 507245
Date Extracted: 01-AUG-95
Date Analyzed : 01-AUG-95
Dil. Factor : 1.00

Parameters	Units	Results
FUEL HYDROCARBONS	MG/KG	<5.0
HYDROCARBON RANGE		-
HYDROCARBONS QUANTITATED USING		-
SURROGATES		
BIS(2-ETHYLHEXYL)PHTHALATE	%	102

GAS CHROMATOGRAPHY - QUALITY CONTROL

MSMSD

Test : MOD EPA 8015-CDOHS (FUEL HYDROCARBONS)
MSMSD # : 77438
Client : COTTON AND FRAZIER CONSULTANTS

Project # : 93064.1
Project Name: FLYNN-LEARNER FP

ATI I.D. : 507245
Date Extracted: 01-AUG-95
Date Analyzed : 02-AUG-95
Sample Matrix : SOIL
REF I.D. : 507328-04

Parameters	Units	Sample Result	Conc Spike	Spiked Sample	% Rec	Dup Spike	Dup % Rec	RPD
FUEL HYDROCARBONS	MG/KG	<5.0	100	98	98	97	97	1

% Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
RPD (Relative % Difference) = (Spiked Sample Result - Duplicate Spike Result)*100/Average Result

GAS CHROMATOGRAPHY - QUALITY CONTROL

BLANK SPIKE

Test : MOD EPA 8015-CDOHS (FUEL HYDROCARBONS)
Blank Spike #: 57933
Client : COTTON AND FRAZIER CONSULTANTS
Project # : 93064.1
Project Name : FLYNN-LEARNER FP

ATI I.D. : 507245
Date Extracted: 01-AUG-95
Date Analyzed : 01-AUG-95
Sample Matrix : SOIL

Parameters	Units	Blank Result	Spiked Sample	Spike Conc.	% Rec
FUEL HYDROCARBONS	MG/KG	<5.0	97	100	97

% Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
RPD (Relative % Difference) = (Spiked Sample - Blank Result)*100/Average Result

DOCUMENT CAPTURED AS RECEIVED

Analytical Technologies, Inc.   5550 Morehouse Dr.   San Diego, CA 92121   (619) 458-9141

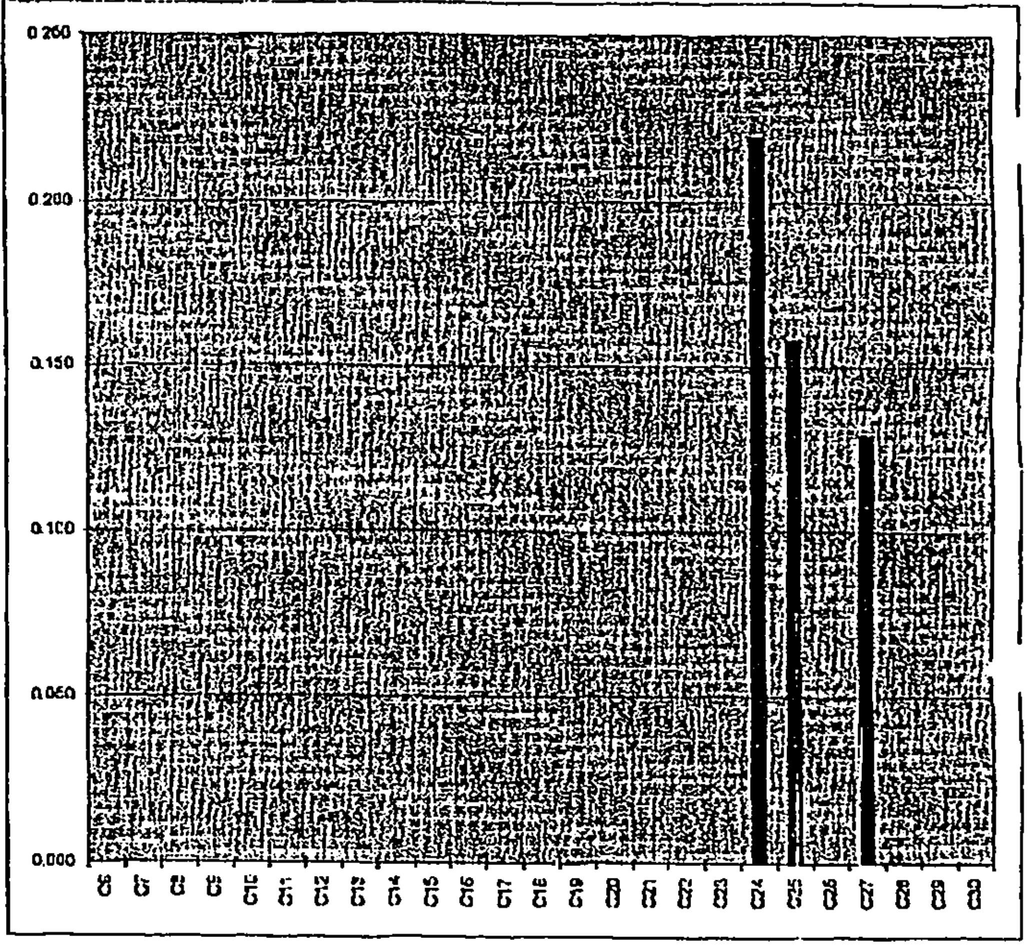
Client: COTTON & FRAZIER
Client Descript.: 64S-L4-6
Matrix SOIL
ATI Sample Number 507245-02N 8/1

Amount Ext'd: 10.0 grams
Extract Vol: 10.0 ml
Dilution: 1
Date of Analysis 2-Aug-95
ATI Data Filename: 3080120
Pract. Quant. Limit 5.00 mg/Kg
Comment:

FINAL RESULTS:
0.51 mg/Kg Diesel quantitated between C7 and C30

Paraffin Range	Fuel Conc.	Percent of Total	Cum. Percent
C6	0.000	0.0%	0.0%
C7	0.000	0.0%	0.0%
C8	0.000	0.0%	0.0%
C9	0.000	0.0%	0.0%
C10	0.000	0.0%	0.0%
C11	0.000	0.0%	0.0%
C12	0.000	0.0%	0.0%
C13	0.000	0.0%	0.0%
C14	0.000	0.0%	0.0%
C15	0.000	0.0%	0.0%
C16	0.000	0.0%	0.0%
C17	0.000	0.0%	0.0%
C18	0.000	0.0%	0.0%
C19	0.000	0.0%	0.0%
C20	0.000	0.0%	0.0%
C21	0.000	0.0%	0.0%
C22	0.000	0.0%	0.0%
C23	0.000	0.0%	0.0%
C24	0.220	43.3%	43.3%
C25	0.158	31.2%	74.5%
C26	0.000	0.0%	74.5%
C27	0.129	25.5%	100.0%
C28	0.000	0.0%	100.0%
C29	0.000	0.0%	100.0%
C30	0.000	0.0%	100.0%
Totals:	0.51	100.0%	

Table of concentrations within standard fuel carbon ranges. All concentrations in mg/Kg.



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SIMDFID3.XLS

Analytical Technologies, Inc. 5550 Morehouse Dr. San Diego, CA 92121 (619) 458-9141

Client: COTTON & FRAZIER

Client Descript.: 64S-L4-6

Matrix SOIL

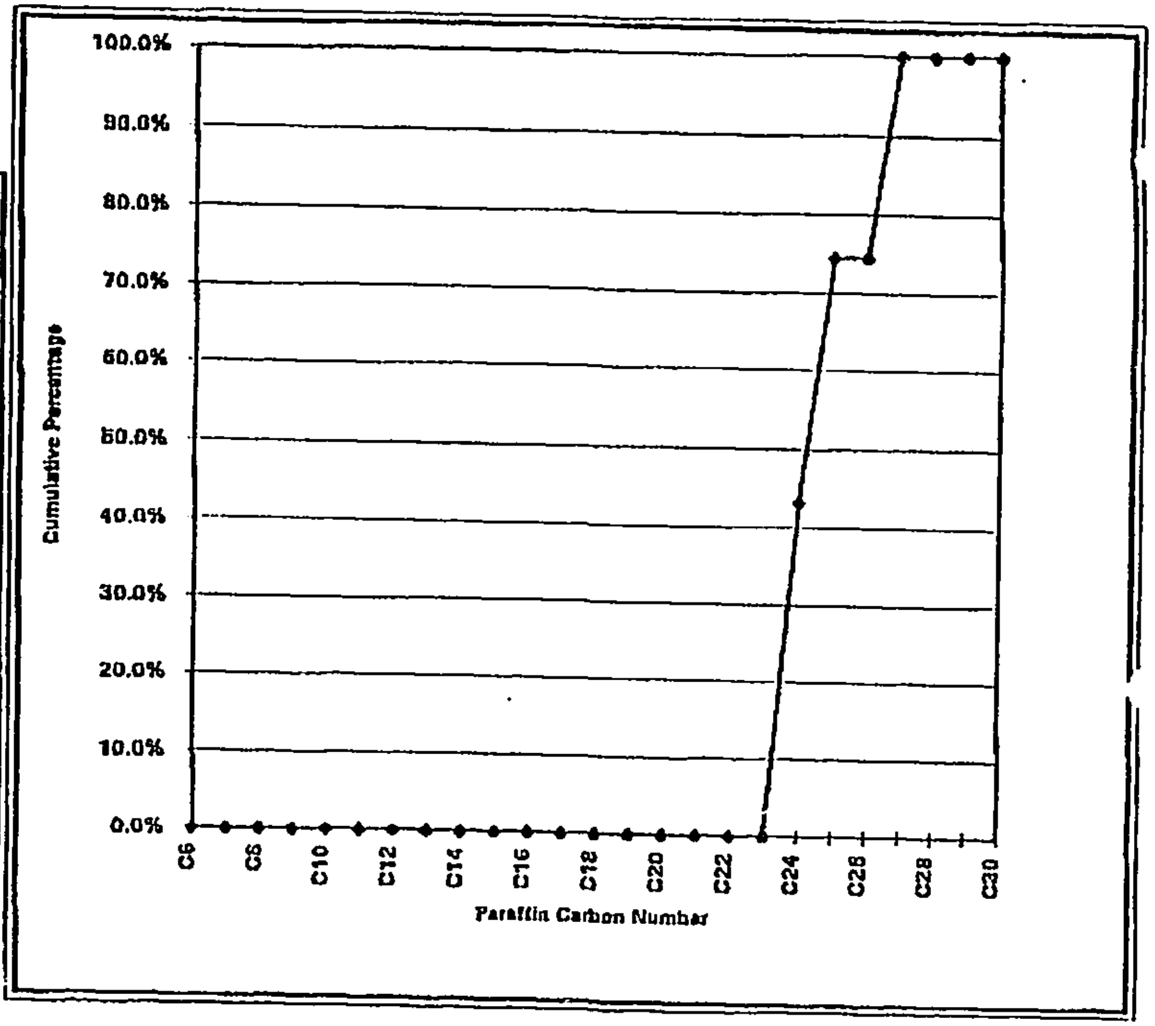
ATI Sample Number 507245-02N 8/1

Results: 0.51 mg/Kg Diesel quantitated between C7 and C30

Amount Ext'd:	10.0 grams
Extract Vol:	10.0 ml
Dilution:	1
Date of Analysis	2-Aug-95
ATI Data Filename:	3080120
Pract. Quant. Limit	5.00 mg/Kg
Comment:	

Paraffin Range	Fuel mg/Kg	Percent of Total	Cum. Percent
C6	0.0	0.0%	0.0%
C7	0.0	0.0%	0.0%
C8	0.0	0.0%	0.0%
C9	0.0	0.0%	0.0%
C10	0.0	0.0%	0.0%
C11	0.0	0.0%	0.0%
C12	0.0	0.0%	0.0%
C13	0.0	0.0%	0.0%
C14	0.0	0.0%	0.0%
C15	0.0	0.0%	0.0%
C16	0.0	0.0%	0.0%
C17	0.0	0.0%	0.0%
C18	0.0	0.0%	0.0%
C19	0.0	0.0%	0.0%
C20	0.0	0.0%	0.0%
C21	0.0	0.0%	0.0%
C22	0.0	0.0%	0.0%
C23	0.0	0.0%	0.0%
C24	0.2	43.3%	43.3%
C25	0.2	31.2%	74.5%
C26	0.0	0.0%	74.5%
C27	0.1	25.5%	100.0%
C28	0.0	0.0%	100.0%
C29	0.0	0.0%	100.0%
C30	0.0	0.0%	100.0%
Totals:	0.51	100.0%	

Graph of Cumulative Percent by Paraffin Range



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DOCUMENT CAPTURED AS RECEIVED

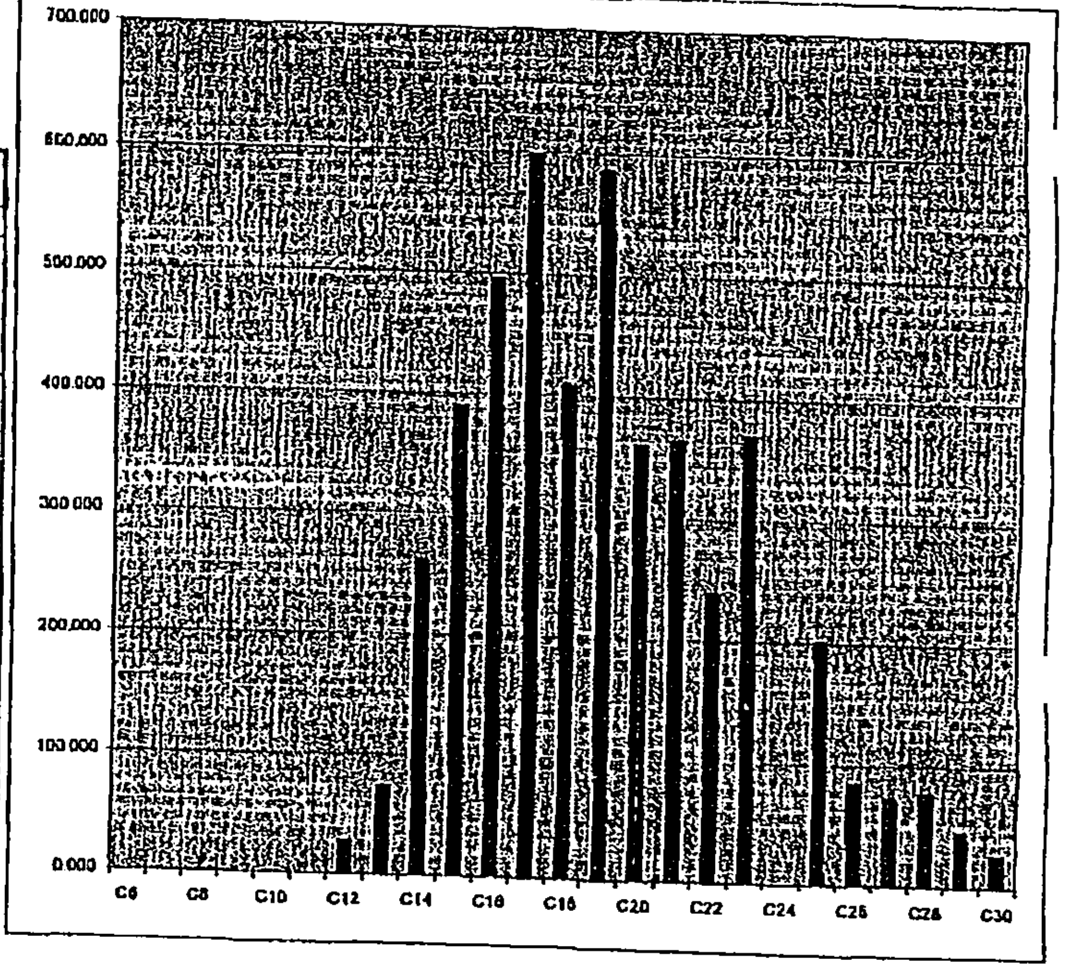
Analytical Technologies, Inc. 5550 Morehouse Dr. San Diego, CA 92121 (619) 458-9141

Client: COTTON & FRAZIER
Client Descript.: 64S-B5-5
Matrix SOIL
ATI Sample Number 507245-06N X10
Amount Ext'd: 10.0 grams
Extract Vol: 10.0 ml
Dilution: 10
Date of Analysis 2-Aug-95
ATI Data Filename: 4080139
Pract. Quant. Limit 50.00 mg/Kg
Comment:

FINAL RESULTS:
4698.51 mg/Kg Diesel quantitated between C7 and C30

Paraffin Range	Fuel Conc.	Percent of Total	Cum. Percent
C6	0.000	0.0%	0.0%
C7	0.000	0.0%	0.0%
C8	0.000	0.0%	0.0%
C9	0.000	0.0%	0.0%
C10	0.804	0.0%	0.0%
C11	0.000	0.0%	0.0%
C12	27.716	0.6%	0.6%
C13	73.376	1.6%	2.2%
C14	262.794	5.6%	7.8%
C15	390.298	8.3%	16.1%
C16	498.698	10.6%	26.6%
C17	600.255	12.8%	39.4%
C18	409.669	8.7%	48.1%
C19	587.902	12.5%	60.6%
C20	362.187	7.7%	68.4%
C21	366.046	7.8%	76.1%
C22	240.187	5.1%	81.3%
C23	371.010	7.9%	89.2%
C24	0.000	0.0%	89.2%
C25	202.864	4.3%	93.5%
C26	84.887	1.8%	95.3%
C27	72.306	1.5%	96.8%
C28	77.687	1.7%	98.5%
C29	45.574	1.0%	99.4%
C30	26.377	0.6%	100.0%
Totals:	4,698.51	100.0%	

Table of concentrations within standard fuel carbon ranges. All concentrations in mg/Kg.



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SIMDFID4.XLS

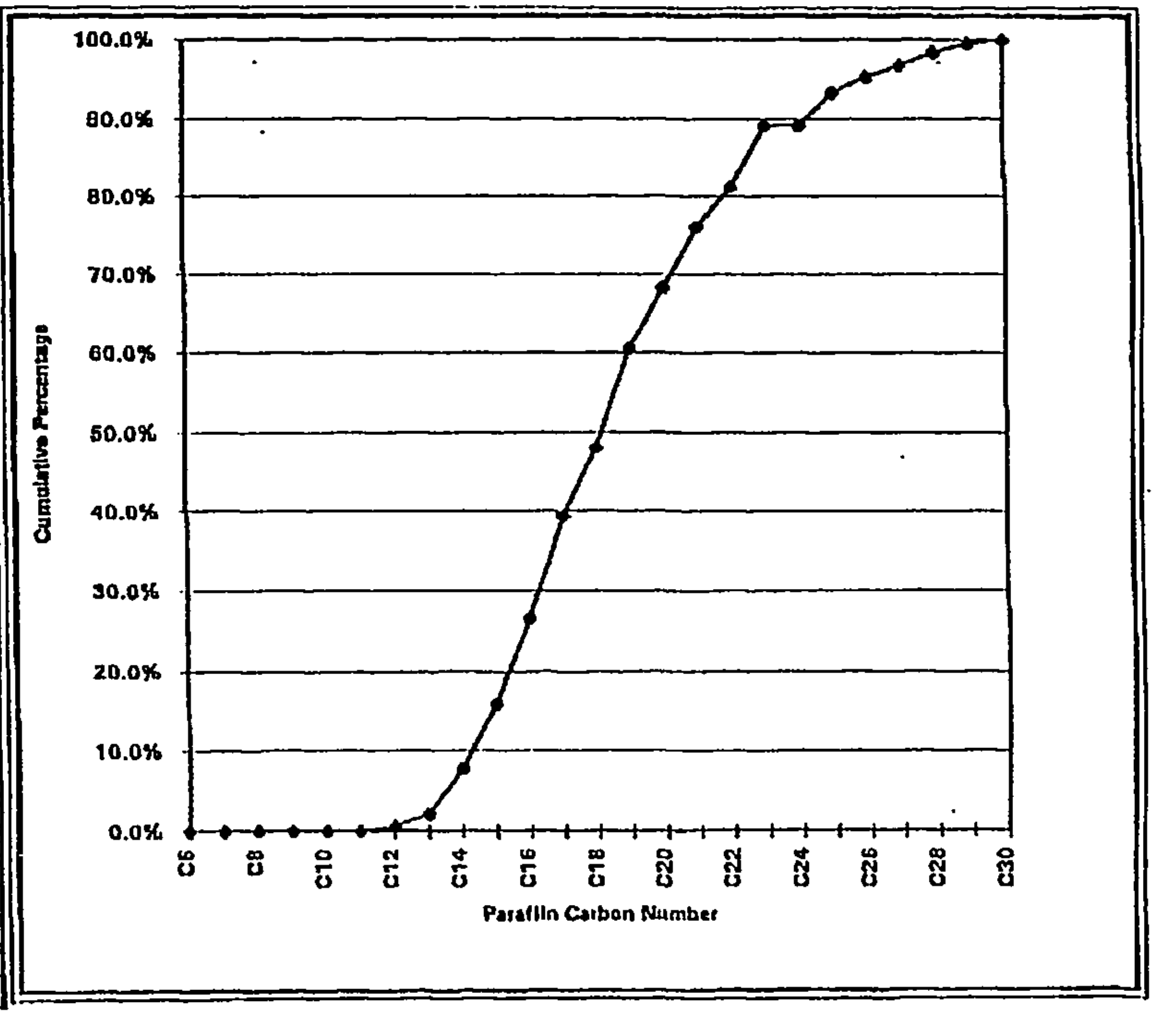
Analytical Technologies, Inc. 5550 Morehouse Dr. San Diego, CA 92121 (619) 458-9141

Client: COTTON & FRAZIER Results: 4698.51 mg/Kg Diesel quantitated between C7 and C30

Client Descript.: 64S-B5-5
Matrix SOIL
TI Sample Number 507245-06N X10
Amount Ext'd: 10.0 grams
Extract Vol: 10.0 ml
Dilution: 10
Date of Analysis 2-Aug-95
ATI Data Filename: 4080139
Pract. Quant. Limit 0.00 mg/Kg
Comment:

Paraffin Range	Fuel mg/Kg	Percent of Total	Cum. Percent
C6	0.0	0.0%	0.0%
C7	0.0	0.0%	0.0%
C8	0.0	0.0%	0.0%
C9	0.0	0.0%	0.0%
C10	0.8	0.0%	0.0%
C11	0.0	0.0%	0.0%
C12	27.7	0.6%	0.6%
C13	73.4	1.6%	2.2%
C14	262.8	5.6%	7.8%
C15	390.3	8.3%	16.1%
C16	496.7	10.6%	26.6%
C17	600.8	12.8%	39.4%
C18	409.6	8.7%	48.1%
C19	587.9	12.5%	60.6%
C20	362.2	7.7%	68.4%
C21	366.0	7.8%	76.1%
C22	240.2	5.1%	81.3%
C23	371.0	7.9%	89.2%
C24	0.0	0.0%	89.2%
C25	202.9	4.3%	93.5%
C26	84.9	1.8%	95.3%
C27	72.3	1.5%	96.8%
C28	77.7	1.7%	98.5%
C29	45.6	1.0%	99.4%
C30	26.4	0.6%	100.0%
Totals:	4,698.51	100.0%	

Graph of Cumulative Percent by Paraffin Range



ACCESSION #: SD 245

INITIALS: LM

ATI-SanDiego

SAMPLE CONDITION UPON RECEIPT CHECKLIST

(FOR RE-ACCESSIONS, COMPLETE #7 THRU #9)

1	Does this project require special handling according to NFESC Levels C, D, AFCEE or CLP protocols? If yes, complete a) and b) a) pH sample aliquoted: yes /no /na b) Either 1) Record Bottle Lot #'s: Or 2) Attach Sample Kit Request Form(s)	YES	[✓ NO]
2	Number of Coolers Received If more than one cooler received attach Multiple Cooler Documentation Form (MCD) Indicate "see MCD" on Item 11 below	1	
3	Are custody seals required for this project ?	YES	[✓ N/A]
	a) are Custody Seals present on Cooler(s) ?	YES	[✓ NO]
	If yes, are seals intact ? N/A	YES	NO
	b) are Custody Seals present on the sample ?	YES	[✓ NO]
	If yes, are seals intact ? N/A	YES	NO
4	Is there a Chain-Of-Custody (COC)* per cooler ? if not, if a problem is found indicate which samples/test were in the affected cooler on the MCD.	[✓ YES]	NO
5	Is the COC* complete per cooler ? Relinquished: [✓ yes]/no Requested analysis: [✓ yes]/no	[✓ YES]	NO
6	Is the COC* in agreement with the samples received? # Samples: [✓ yes]/no Sample ID's: [✓ yes]/no Date sampled: yes/[✓ no] Matrix: [✓ yes]/no # containers: [✓ yes]/no	YES	[✓ NO]
7	Are the samples preserved correctly?	[✓ YES]	NO
8	Is there enough sample for all the requested analyses?	[✓ YES]	NO
9	Are all samples within holding times for the requested analyses?	[✓ YES]	NO
10	Record cooler temperature. Contact PM if temperature is not 4°C ± 2°C.	2.0 °C	
	Is ice present in cooler?	[✓ YES]	NO
11	Were all sample containers received intact (ie. not broken, leaking, etc.)?	[✓ YES]	NO
12	Are samples requiring no headspace, headspace free? N/A	[✓ YES]	NO
13	Are VOA 1st stickers required?	[✓ YES]	NO LM
14	Are there special comments on the Chain of Custody which require client contact?	[✓ YES]	[✓ ~~N/A~~] 7/2[illegible]
15	If yes, was ATI Project Manager notified?	[✓ YES]	NO

Describe "no" items: #6) Sample 64S-BS-5 has Sample date as 7/21/95 on COC. however container states 7/20/95

Was client contacted? yes / no

If yes, Date: ________ Name of Person contacted:

Describe actions taken or client instructions:

*Or other representative documents, letters, and/or shipping memos

Cotton and Frazier Consultants, Inc.
Environmental Solutions
P.O. Box 27126
Honolulu, Hawaii 96827
[ship to: 801 Alakea Street, Honolulu, HI 96813]
Telephone: (808) 599-1993 FAX: (808) 599-1502

507245

Chain of Custody Record/ Analysis Request

PROJECT NAME:
LOCATION:
JOB NUMBER:
SAMPLER:
PROJECT MGR:

	SAMP_ID	SAMP_DATE 1995	SAMP_TIME	SITE_ID	SAMP_DEPTH (ft)	SAMP_TYPE S=SOIL or SLUDGE W=WATER Use S for Soil Vapor	PROG_TYPE	SP_ID & CASE_ID	GROSS?	CONTAINERS 40 ml. VOA	1 L. Amber Glass	4 oz. Glass			Analysis Requested 8015MSpec. (Dies.&oil)	8015M (30W oil)	8015M+alk. (paraffin)	8310 PAHs)			Remarks	HOLD FOR FURTHER ANALYSIS	RUSH (see below)
01	64S-L2-6	7/20	1020	L02	6'	S	S	7/95	N			X				X							
02	64S-L4-6	7/20	1215	L04	6'	S	S	7/95	Y			X					X				sample contains free product		
03	64S-L7-6	7/20	1420	L07	6'	S	S	7/95	N			X				X							
04	64S-L8-6	7/20	1435	L08	6'	S	S	7/95	N			X				X							
05	64S-L11-6	7/21	0740	L11	6'	S	S	7/95	N			X				X							
06	64S-B5-5	7/21	1120	B05	5'	S	S	7/95	Y			X					X	X			sample contains free product		
07	64S-B7-5	7/21	1300	B07	5'	S	S	7/95	N			X			X			X					
08	64S-B9-5	7/21	1335	B09	5'	S	S	7/95	N			X			X								
09	64S-B12-6	7/21	1500	B12	6'	S	S	7/95	N			X			X								

Relinquished By:
Signature: Robert W. Rooks
Printed Name: Robert W. Rooks, PE
Date/Time: 7/21/95 1600
Received By:
Signature:
Printed Name: cold storage at CF
Date/Time:

Relinquished By:
Signature: Robert W. Rooks
Printed Name: Robert W. Rooks, PE
Date/Time: 7/24/95 1200
Received By:
Signature:
Printed Name: FedEx for shipping
Date/Time:

Relinquished By:
Signature:
Printed Name:
Date/Time:
Received By:
Signature:
Printed Name: Lucia Mendez
Date/Time: 7/25/95 9:20

DELIVERABLES:
Diskette (GIS/Key): x
Fax copy: x
Written Final Report: x
Use LAB_ID code: ATI

Special Handling
Turnaround:
24 hour
48 hour
72 hour
[✓ Regular]
Other____

Comments:
1. please return cooler and blue ice
2. call Project Manager with questions regarding field inputs

DOCUMENT CAPTURED AS RECEIVED

Cotton and Frazier Consultants, Inc.
Environmental Solutions
P.O. Box 27126
Honolulu, Hawaii 96827
[ship to: 801 Alakea Street, Honolulu, HI 96813]
Telephone: (808) 599-1993 FAX: (808) 599-1502

©1992

508057

Chain of Custody Record/ Analysis Request

PROJECT NAME: FLYNN LEARNER FREE PRODUCT

LOCATION: Sand Island Access Rd. JOB NUMBER: 93064.1

SAMPLER: R.W. Rooks PROJECT MGR: Lee R. Cranmer

	SAMP_ID	SAMP_DATE	SAMP_TIME	SITE_ID	SAMP_DEPTH (ft)	SAMP_TYPE S - SOIL or SLUDGE W - WATER Use S for Soil Vapor	PROC_TYPE	SP_ID & CASE_ID	GROSS?	CONTAINERS 40 ml VOA	CONTAINERS 1L Amber Glass	CONTAINERS 4oz Glass			8015M Spec. (dies. & oil)	8015M (30W size)	8015M + alk (paraffin)	8310 (PAH)			Remarks	HOLD FOR FURTHER ANALYSIS	RUSH (see below)
01	LAS L17-5	7/31/95	1015	L17	5'	S	S	7/95	N			✓											
02	LAS-L19-5	7/31/95	1140	L19	5'	↓	↓	↓	N			✓				X							
03	LAS-L20-5	7/31/95	1155	L20	5'	↓	↓	↓	N			✓				X							
04	LAS-L21-5'	7/31/95	1305	L21	5'	↓	↓	↓	N			✓				X							
05	LAS B14-5	7/31/95	1335	B14	5'	↓	↓	↓	N			✓				X							
06	LAS-B15-5	7/31/95	1415	B15	5'	↓	↓	↓	N			✓			X								
07	LAS-B17-5	7/31/95	1500	B17	5'	↓	↓	↓	N			✓			X								
08	LAS B18-5	7/31/95	1520	B18	5'	↓	↓	↓	N			✓			X								
09	LAS-B24-6	8/1/95	1040	B24	6'	↓	↓	↓	N			✓			X			X					
10	LAS-B26-6	8/1/95	1130	B26	6'	↓	↓	↓	N			✓			X								
11	LAS-B27-6	8/1/95	1430	B27	6'	↓	↓	↓	N			✓			X								
12	LAS-B22-6	8/1/95	1005	B22	6'	↓	↓	↓	N			✓			X			X					

Relinquished By: Signature: Robert W. Rooks	Relinquished By: Signature: Robert W. Rooks	Relinquished By: Signature:
Printed Name: Robert W. Rooks PE	Printed Name: Robert W. Rooks, PE	Printed Name:
Date/Time: 8/1/95 1700	Date/Time: 8/3/95 1200	Date/Time:
Received By: Signature: storage	Received By: Signature: Sel	Received By: Signature:
Printed Name: cold Office	Printed Name: Fed. Ex	Printed Name: LUCID Mendez
Date/Time: CF	Date/Time: shipping	Date/Time: 8/4/95 9:00

DELIVERABLES:
Diskette (GIS/Key): X
Fax copy: X
Written Final Report: X
Use LAB_ID code: ATI

Special Handling
Turnaround:
24 hour 48 hour
72 hour Regular
Other 5-day

Comments:
1. please return cooler and blue ice
2. call Project Manager with questions regarding field inputs

2.0°C

Page ____ of ____.

FOUNDATION INVESTIGATION
FLYNN LEARNER WAREHOUSES
120 SAND ISLAND ACCESS ROAD
HONOLULU, HAWAII
TMK: 1-2-23: 9

for

THE LEARNER COMPANY

ERNEST K. HIRATA & ASSOCIATES, INC.
W.O. 95-1729.1
October 4, 1995

ERNEST K. HIRATA & ASSOCIATES, INC.

Soils and Foundation Engineering

99-1433 Koaha Place • Aiea, Hawaii 96701-3279
Phone (808) 486-0787 • Fax (808) 486-0870

ERNEST K. HIRATA P.E.
PAUL S. MORIMOTO P.E.
DAVID M. KITAMURA P.E.
JUNG K. KIM P.E.

October 19, 1995
W.O. 95-1729.1

OCT 24 1995
RECEIVED

Mr. Jack Hecht
Flynn-Learner
c/o The Learner Company
2711 Navy Drive
Stockton, California 95206

Dear Mr. Hecht:

Re: **Addendum No. 1**
Foundation Investigation
Flynn Learner Warehouses
120 Sand Island Access Road
Honolulu, Hawaii
TMK: 1-2-23: 9

We understand that up to H-20 type vehicles may be using the warehouse facilities. We would like to provide this addendum to include pavement sections to accommodate these types of vehicles.

The following design may be used for flexible pavement sections.

For H-10 vehicles:

2.5"	Asphaltic Concrete
8.0"	Base Course
10.5"	Total Thickness

For H-20 vehicles:

3.0"	Asphaltic Concrete
8.0"	Base Course
11.0"	Total Thickness

The following design may be used for rigid pavement sections, and may be used for loadings up to H-20 type vehicles.

6.0"	Concrete
6.0"	Base Course
12.0"	Total Thickness

The subgrade and base course should be compacted to a minimum 95 percent compaction as determined by ASTM D1557.

Should you have any questions, please feel free to call us.

Sincerely,

ERNEST K. HIRATA & ASSOCIATES, INC.

Ernest K. Hirata

Ernest K. Hirata, P.E.

cc: Bob Nitta - Sueda & Associates, Inc.
Edgar Lee - Engineering Design Group

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JUNG K. KIM P.E.

October 4, 1995
W.O. 95-1729.1

Mr. Jack Hecht
Flynn-Learner
c/o The Learner Company
2711 Navy Drive
Stockton, California 95206

Dear Mr. Hecht:

Our report, "Foundation Investigation, Flynn Learner Warehouses, 120 Sand Island Access Road, Honolulu, Hawaii, TMK: 1-2-23: 9," dated October 4, 1995, our Work Order 95-1729.1 is enclosed. This investigation was conducted in general conformance with the scope of work presented in our proposal dated July 11, 1995.

Conventional spread footings may be used to support the proposed structures. However, due to the variable condition of the existing surface fill and the underlying soft, compressible silty clays, precautionary measures are recommended to reduce the effects of settlement on the proposed structures.

The following is a summary of our geotechnical recommendations. This summary is not intended to be a substitute for our report which includes more detailed explanations of our recommendations, as well as additional requirements.

- Allowable bearing value = 1000 PSF
- Passive earth pressure = 300 PCF
- Coefficient of friction = 0.4

Additional geotechnical recommendations are presented in this report. We appreciate this opportunity to be of service. Should you have any questions concerning this report, please feel free to call on us.

Very truly yours,

ERNEST K. HIRATA & ASSOCIATES, INC.

Ernest K. Hirata

Ernest K. Hirata President

EKH:ph

TABLE OF CONTENTS

APPENDIX

FOUNDATION INVESTIGATION
FLYNN LEARNER WAREHOUSES
120 SAND ISLAND ACCESS ROAD
HONOLULU, HAWAII
TMK: 1-2-23: 9

INTRODUCTION

This report presents the results of our foundation investigation performed for the Flynn Learner Warehouses at 120 Sand Island Access Road. Our work scope for this study included the following:

- A visual reconnaissance of the site and its vicinity to observe existing conditions which may affect the project. The general location of the project site is shown on the enclosed Location Map, Plate 1.
- A review of available soils information pertinent to the site and the proposed project, including our previous foundation investigation report dated March 13, 1989.
- Drilling and sampling 4 exploratory borings to depths ranging from approximately 9.5 to 11.5 feet to determine the subsurface soil conditions. The soils encountered are described on the Boring Logs, Plates B1 through B4. The approximate exploratory boring locations are shown on the enclosed Boring Location Plan, Plate 2.
- Laboratory testing of selected soil samples to determine classification and engineering properties. Laboratory testing procedures are presented in the Appendix of Laboratory Testing, Pages 1 and 2. Laboratory test results are shown on the Boring Logs, and on Plates C1 though C3, D1, D2, E and F.
- Engineering analyses of the field and laboratory data.

- Preparation of this report presenting geotechnical recommendations for design of shallow foundations, slabs-on-grade, resistance to lateral pressures, flexible pavement, and site grading.

PROJECT CONSIDERATIONS

Information concerning the proposed project was furnished by personnel from your office, and the design team, which included:

Sueda & Associates, Inc., - Architects
Hida, Okamoto & Associates, Inc. - Civil Engineers
Engineering Design Group, Inc. - Structural Engineers
Cotton and Frazier Consultants, Inc. - Environmental Engineers

The proposed project includes the construction of four single story warehouses of steel frame construction, with concrete slabs-on-grade. The plan area of the warehouses will vary from approximately 5,430 to 30,000 square feet. Maximum column loads are anticipated to be approximately 50 kips, and wall loads are expected to be on the order of 1 kip per lineal foot. Asphaltic concrete pavement will be used for parking and driveway areas.

We understand that cut and fill quantities will be balanced. Based on recent discussions, we assume that maximum fill heights will be on the order of 2 feet. Additional site work may be required in isolated areas due to environmental concerns.

SITE CONDITIONS

The project site is located on the northwest side of Sand Island Access Road, at its intersection with Pahounui Drive. Pahounui Drive borders the property on the northwest and southwest, while industrial warehouses are located to the northeast.

A steel paneled shed, a building of CMU construction, and a truck scale are located in the western section of the property. The remainder of the site is vacant of structures, and covered only by sparse vegetation. Scrap metal, plastic, and glass fragments were observed mixed into the surface soils. An 8-foot high CMU wall separates the project site from the property bordering on the northeast. A chain link fence encloses the remainder of the property.

The project site is relatively level, with a total relief of approximately 2 feet. Drainage generally flows toward the northeast.

FIELD EXPLORATION

The site was explored on August 23, 1995 by drilling 4 exploratory test borings with a Mobile B53 truck-mounted drill rig. The borings varied in depth from approximately 9.5 to 11.5 feet. The soils were continuously logged by our field technician and classified by visual examination in accordance with the Unified Soil Classification System. A Boring Log Legend is presented on Plate A1 and the Unified Soil Classification is shown on Plate A2. The approximate boring locations are shown on Plate 2, and the soils encountered are logged on Plates B1 through B4.

Representative soil samples were recovered from the borings for selected laboratory testing and analyses. Representative samples were obtained by driving a 3-inch O.D. thin-walled split tube sampler with a 140-pound hammer from a height of 30 inches. The blow counts required for 12 inches of penetration are shown at the appropriate depths on the enclosed Boring Logs.

SOIL CONDITIONS

The subsurface soil conditions were similar to the soils encountered in our previous investigation. The surface fill material consisted primarily of brown silty sand, with gravel, cobbles, scrap metal, plastic, and glass debris. The fill was generally in a medium dense condition, and extended to depths ranging from approximately 4 to 6 feet. Boring B2 encountered approximately 2 feet of medium dense, tan sand underlying the surface fill.

Gray silty clay was encountered below the surface soils at depths ranging from about 4 to 8 feet. The silty clay was in a soft and highly compressible condition, and extended to the maximum depths drilled in borings B1, B2, and B3. Boring B4 encountered dense coralline material at a depth of approximately 8 feet.

Groundwater was encountered in all borings at depths ranging from about 6 to 8.8 feet. Variation in the groundwater level can be expected due to tidal fluctuations.

CONCLUSIONS AND RECOMMENDATIONS

Based on our field investigation, laboratory testing, and analyses, it is our opinion that the use of conventional spread footings for support of the proposed warehouses is feasible. However, due to the variable condition of the existing surface fill, and the potential for new fill placement, precautionary measures are recommended.

Consolidation of the underlying soft silty clay will occur. To reduce the effects of settlement due to site grading on the proposed structures, we recommend that additional fill placement in building areas be minimized, but if necessary, the fill be placed as early as possible in the project schedule. Relatively uniform fill heights should be maintained under building areas to reduce differential settlements. Depending on the final fill heights required, a settlement monitoring program may need to be implemented, and construction of the building foundations possibly deferred until most of the settlements occur.

To further reduce the potential for differential settlement, we recommend that all footings be underlain by at least 2 feet of granular fill compacted to a minimum 95 percent compaction as determined by ASTM D 1557. The compacted fill section should also extend at least 1 foot beyond the edge of footings. In most areas, we expect that overexcavation of the existing fill will be necessary. The existing fill material may be reused provided all rock fragments larger than six inches in maximum dimension, scrap metal, plastic and glass are removed.

Foundations

As previously indicated, conventional spread footings founded on a minimum 2 feet of compacted granular fill may be used to support the proposed structures. The compacted fill section should also extend at least 1 foot beyond the edge of footings.

The existing fill material may be reused. Imported structural fill should consist of well-graded non-expansive material, such as select borrow. The fill should be placed in level lifts and compacted to a minimum 95 percent compaction as determined by ASTM D 1557.

Footings may be designed for a bearing value of 1000 pounds per square foot, and should be a minimum of 16 inches in width, and embedded at least 12 inches below finish adjacent grade.

Footings located on, or near the top of slopes, should be embedded such that a minimum horizontal distance of 5 feet is maintained between the bottom edge of footing and slope face.

Lateral Design

The bearing value indicated above is for the total of dead and frequently applied live loads, and may be increased by one-third for short duration loading which includes the effect of wind and seismic forces. Resistance to lateral loading may be provided by friction acting at the base of foundations and by passive earth pressure acting on the buried portions of foundations.

An allowable coefficient of friction of 0.4 may be used with the dead load forces. Passive earth pressure may be computed as an equivalent fluid having a density of 250 pounds per cubic foot with a maximum earth pressure of 2500 pounds per square foot. Unless covered by pavement or concrete slabs, the upper 12 inches of soil should not be considered in computing lateral resistance.

Retaining Walls

Retaining walls may be supported by conventional spread footings. Recommendations presented in the *Foundations* and *Lateral Design* sections of this report may be used in the design of retaining wall footings.

For active earth pressure considerations, equivalent fluid pressures of 40 and 55 pounds per cubic foot per foot of depth may be used for freestanding and restrained conditions, respectively.

To prevent buildup of hydrostatic pressures, weepholes or subdrains should be included in the design of all retaining structures.

Settlement

Analyses were performed to provide an estimate of settlements expected due to fill placement and structural loads. Based on a fill height of 2 feet, a maximum column load of 50 kips, and a wall load of 1 kip per lineal foot, maximum settlements on the order of 1 inch were computed. Differential settlement is not anticipated to exceed 3/8 inch. In addition, settlements may occur in the areas overexcavated and backfilled due to environmental concerns.

Should the loading conditions significantly vary from that assumed above, the new fill heights or building loads should be forwarded to our office for review.

Floor Slabs

All slab-on-grade areas not receiving new fill should be scarified and recompacted to a minimum 95 percent compaction as determined by ASTM D 1557, prior to placement of cushion material.

To provide uniform support and a capillary break, all slabs-on-grade should be underlain by a 4-inch cushion of clean gravel, such as #3 Fine (ASTM C 33, Size No. 67). All building slabs should also be protected by a plastic moisture barrier placed over the cushion material. A thin layer of sand should overlie moisture barrier to aid the concrete curing process.

Slabs-on-grade subjected to vehicular loads should be underlain by 6 inches of base course in lieu of the 4-inch gravel cushion. The base course and subgrade should be compacted to a minimum 95 percent compaction as determined by ASTM D 1557.

Pavement Design

Flexible pavement for driveways and parking areas may be designed based on the following section. The subgrade and base course should be compacted to a minimum 95 percent compaction as determined by ASTM D1557.

2.5"	Asphaltic Concrete
6.0"	Base Course
8.5"	Total Thickness

Site Grading

The project site should be cleared of all vegetation, scrap metal, large plastic and glass fragments, and other deleterious material. Prior to placement of fill, the existing ground should be scarified to a depth of six inches and compacted to a minimum 95 percent compaction as determined by ASTM D 1557.

The existing fill material may be reused in compacted/structural fills provided all rock fragments larger than six inches in maximum dimension, scrap metal, plastic and glass are removed. The underlying silty clay will not be acceptable for reuse in compacted fills.

Imported structural fill should be well-graded, non-expansive granular material. Specifications for imported structural fill should indicate a maximum particle size of 3 inches, and state that not more than 20 percent of soil by weight shall pass the #200 sieve. In addition, the plasticity index (P.I.) of that portion of the soil passing the #40 sieve shall not be greater than 10. Yard fill necessary for landscaping need not adhere to these specifications.

All structural fill shall be placed in horizontal lifts restricted to eight inches in loose thickness and compacted to a minimum 95 percent compaction as determined by ASTM D 1557. Fill placed in areas which slope steeper than 5:1 (horizontal to vertical), should be continually benched as the fill is brought up in lifts.

ADDITIONAL SERVICES

We recommend that we perform a general review of the final design plans and specifications. This will allow us to verify that the earthwork recommendations have been properly interpreted and implemented in the design plans and construction specifications.

For continuity, we also recommend that we be retained to provide observation and monitoring services of structural fill placement during construction. The preparation of all footing excavations for placement of reinforcing steel and concrete should also be monitored by an engineer from our staff. This service will allow us to verify that our recommendations are properly interpreted and included in construction, and to make necessary modifications to those recommendations, thereby reducing construction delays in the event subsurface conditions differ from those anticipated.

LIMITATIONS

The boring logs indicate the approximate subsurface soil conditions encountered only at those times and locations where our borings were made, and may not represent conditions at other times and locations.

This report was prepared specifically for the Learner Company and their consultants for design of the proposed warehouses at 120 Sand Island Access Road. The boring logs and recommendations presented in this report are for design purposes only, and are not intended for use in developing cost estimates by the contractor.

During construction, should subsurface conditions differ from those encountered in our borings, we should be advised immediately in order to re-evaluate our recommendations, and to revise or verify them in writing before proceeding with construction.

Our recommendations and conclusions are based upon the site materials observed, the preliminary design information made available, the data obtained from our site exploration, our engineering analyses, and our experience and engineering judgement. The conclusions and recommendations are professional opinions which we have strived to develop in a manner consistent with that level of care, skill, and competence ordinarily exercised by members of the profession in good standing, currently practicing under similar conditions. No other warranty is expressed or implied.

Respectfully submitted,

ERNEST K. HIRATA & ASSOCIATES, INC.

Ernest K. Hirata

Ernest K. Hirata, P.E.

No. 5083-C

This work was prepared by
me or under my supervision

APPENDIX OF LABORATORY TESTING

CLASSIFICATION

Field classification was verified in the laboratory in accordance with the Unified Soil Classification System. Laboratory classification was determined by visual examination. The final classifications are shown at the appropriate locations on the Boring Logs, Plates B1 through B4.

MOISTURE-DENSITY

The field moisture content and dry unit weight were determined for each of the representative samples. The information was useful in providing a gross picture of the soil consistency between borings and any local variations. The dry unit weight was determined in pounds per cubic foot while the moisture content was determined as a percentage of dry weight. Samples were obtained using a 3 inch O.D. split tube sampler. Test results are shown at the appropriate depths on the Boring Logs, Plates B1 through B4.

CONSOLIDATION

Settlement predictions of the soil's behavior under load were made on the basis of consolidation test results. Test samples were 2.42 inches in diameter and 1 inch in height. Porous stones were placed in contact with the top and bottom of each test sample to permit the addition and release of pore fluid. Loads were applied in several increments in a geometric progression, and the resulting deformations recorded at selected time intervals. Results of tests on representative samples are plotted on the Consolidation Test Reports, Plates C1 through C3.

SHEAR TESTS

Shear tests were performed in the Direct Shear Machine which is of the strain control type. The rate of deformation was approximately 0.02 inches per minute. Each sample was sheared under varying confining loads in order to determine the Coulomb shear strength parameters, cohesion and angle of internal friction. Eighty percent of the maximum value was taken to determine the shear strength parameters. Test results are presented on Plates D1 through D2.

PROCTOR TESTS

Proctor tests were performed on bag samples to determine the optimum moisture content at which each soil type compacts to 100 percent density. The tests were performed in general accordance with ASTM D 1557, and results are shown on Plate E.

CALIFORNIA BEARING RATIO TESTS

CBR tests were performed on bag samples to evaluate the relative quality of subgrade soils to be used in the design of flexible pavements. The tests were performed in general accordance with ASTM D 1883, and results are shown on Plate F.

MAJOR DIVISIONS			GROUP SYMBOLS		TYPICAL NAMES
COARSE GRAINED SOILS (More than 50% of the material is LARGER than No. 200 sieve size.)	GRAVELS (More than 50% of coarse fraction is LARGER than the No. 4 sieve size.)	CLEAN GRAVELS (Little or no fines.)	⁘	GW	Well graded gravels, gravel-sand mixtures, little or no fines.
			⁘	GP	Poorly graded gravels or gravel-sand mixtures, little or no fines.
		GRAVELS WITH FINES (Appreciable amt. of fines.)	▥	GM	Silty gravels, gravel-sand-silt mixtures.
			▨	GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS (More than 50% of coarse fraction is SMALLER than the No. 4 sieve size.)	CLEAN SANDS (Little or no fines.)	░	SW	Well graded sands, gravelly sands, little or no fines.
			░	SP	Poorly graded sands or gravelly sands, little or no fines.
		SANDS WITH FINES (Appreciable amt. of fines.)	▥	SM	Silty sands, sand-silt mixtures.
			▨	SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS (More than 50% of the material is SMALLER than No. 200 sieve size.)	SILTS AND CLAYS (Liquid limit LESS than 50.)		▥	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
			▨	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			▥	OL	Organic silts and organic silty clays of low plasticity.
	SILTS AND CLAYS (Liquid limit GREATER than 50.)		▥	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
			▨	CH	Inorganic clays of high plasticity, fat clays.
			▨	OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS			⌄	PT	Peat and other highly organic soils.
			▦	FRESH TO MODERATELY WEATHERED BASALT	
			▤	VOLCANIC TUFF / HIGHLY TO COMPLETELY WEATHERED BASALT	
			◇	CORAL	

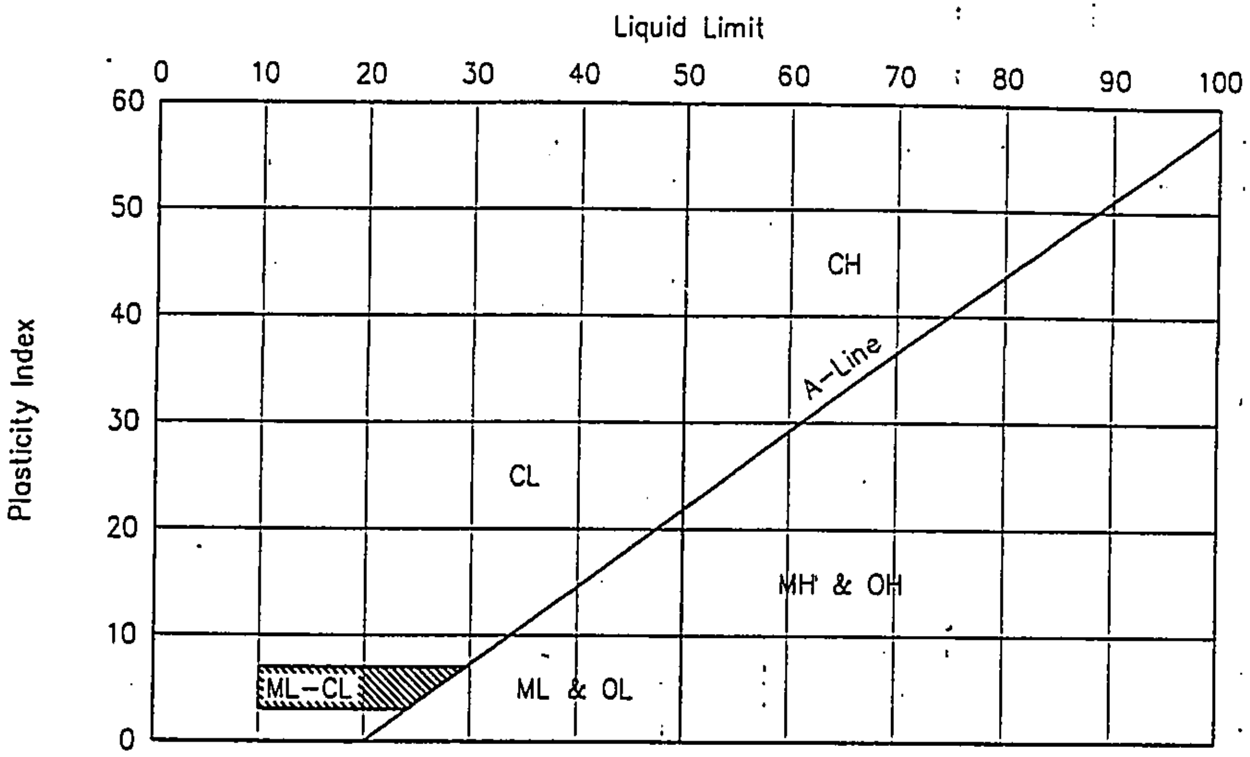
SAMPLE DEFINITION

☒ 2" O.D. Standard Split Spoon Sampler	☒ Shelby Tube	RQD Rock Quality Designation
☐ 3" O.D. Split Tube Sampler	▮ NX / 4" Coring	▽ Water Level

W.O. 95-1729.1	Flynn Learner Warehouses
Ernest K. Hirata & Associates, Inc.	BORING LOG LEGEND

Plate A1

PLASTICITY CHART



GRADATION CHART

COMPONENT DEFINITIONS BY GRADATION	
COMPONENT	SIZE RANGE
Boulders	Above 12 in.
Cobbles	3 in. to 12 in.
Gravel	3 in. to No. 4 (4.76 mm)
Coarse gravel	3 in. to 3/4 in.
Fine gravel	3/4 in. to No. 4 (4.76 mm)
Sand	No. 4 (4.76 mm) to No. 200 (0.074 mm)
Coarse sand	No. 4 (4.76 mm) to No. 10 (2.0 mm)
Medium sand	No. 10 (2.0 mm) to No. 40 (0.42 mm)
Fine sand	No. 40 (0.42 mm) to No. 200 (0.074 mm)
Silt and clay	Smaller than No. 200 (0.074 mm)

W.O. 95-1729.1	Flynn Learner Warehouses
Ernest K. Hirata & Associates, Inc.	UNIFIED SOIL CLASSIFICATION SYSTEM Plate A2

ERNEST K. HIRATA & ASSOCIATES, INC.

Soils and Foundation Engineering

BORING LOG

W.O. 95-1729.1

BORING NO. B1 DRIVING WT. 140 lb. DATE OF DRILLING 8-23-95
SURFACE ELEV. 99±* DROP 30 in. WATER LEVEL @ 6.0 ft.

DEPTH	GRAPH	SAMPLE	BLOWS PER FOOT	DRY DENSITY (PCF)	MOIST. CONT. (%)	DESCRIPTION
0	░					Silty SAND (SM) - Brown, moist, medium dense, with gravel, cobbles, glass, metal and plastic fragments. (Fill)
	░	▭	35/2"	Tip Recovery		
	▨	☐	17	Tip Recovery		Silty CLAY (CL) - Dark gray, medium stiff, with sand and coral fragments.
5 ▽	▨					
	▨	☐	22	90	36	
	▨					Soft from 7 feet.
	▨	☐	8	67	59	
10						End boring at 9.5 feet.
15						
20						
25						
						* See Boring Location Plan for reference benchmark.
30						Plate B1

ERNEST K. HIRATA & ASSOCIATES, INC.

Soils and Foundation Engineering

BORING LOG

W.O. 95-1729.1

BORING NO. B2
DRIVING WT. 140 lb.
DATE OF DRILLING 8-23-95
SURFACE ELEV. 101±
DROP 30 in.
WATER LEVEL @ 8.8 ft.

DEPTH	GRAPH	SAMPLE	BLOWS PER FOOT	DRY DENSITY (PCF)	MOIST. CONT. (%)	DESCRIPTION
0						Silty SAND (SM) - Brown, moist, medium dense to dense, with gravel, cobbles, glass, metal, concrete and plastic fragments. (Fill)
		☐	32	No Recovery		
		☐	19	80	26	Clayey from 3.5 feet.
5		☐	29	97	16	
						SAND (SP) - Tan, moist, medium dense, with coral fragments.
		☐	9	92	32	
▽						Silty CLAY (CL) - Gray, soft, with sand and coral fragments.
10		☐	7	88	35	
						End boring at 10.5 feet.
15						
20						
25						
30						

Plate B2

ERNEST K. HIRATA & ASSOCIATES, INC.
Soils and Foundation Engineering

BORING LOG

W.O. 95-1729.1

BORING NO. B3
DRIVING WT. 140 lb.
DATE OF DRILLING 8-23-95
SURFACE ELEV. 99±
DROP 30 in.
WATER LEVEL @ 7.5 ft.

DEPTH	GRAPH	SAMPLE	BLOWS PER FOOT	DRY DENSITY (PCF)	MOIST. CONT. (%)	DESCRIPTION
0	░					Silty SAND (SM) – Mottled brown, moist, medium dense, with gravel, coral, glass, metal and plastic fragments. (Fill)
	░	☐	23	89	29	
	░	☐	8	88	23	Loose at 3 feet.
5	░	☐	20/6"			
	▨		2/6"	68	60	Silty CLAY (CL) – Dark gray, soft, with sand and coral fragments.
▽	▨	☐	7	70	52	
10	▨	☐	7	No Recovery		
						End boring at 11.5 feet.
15						
20						
25						
30						

Plate B3

ERNEST K. HIRATA & ASSOCIATES, INC.
Soils and Foundation Engineering

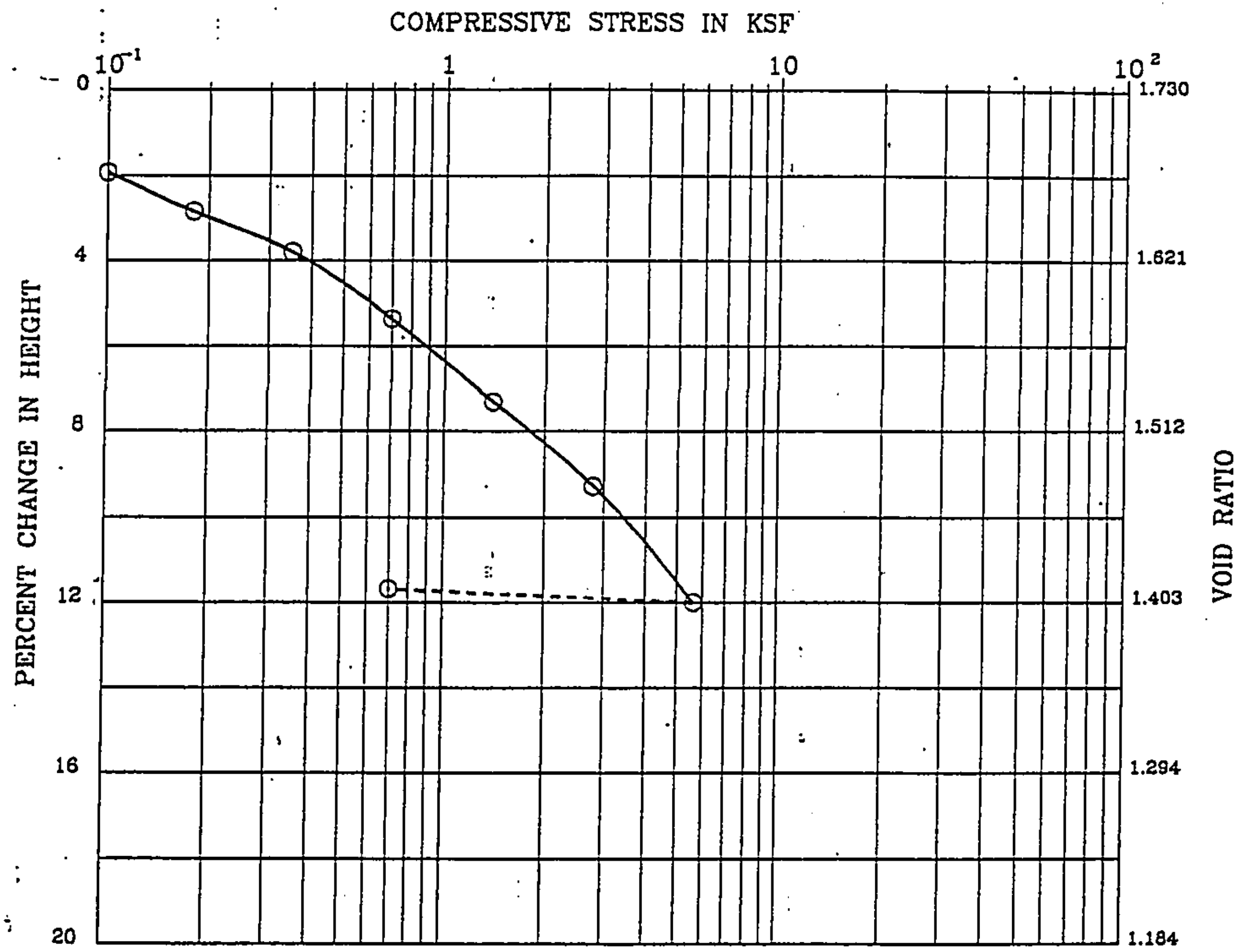
BORING LOG

W.O. 95-1729.1

BORING NO. B4 DRIVING WT. 140 lb. DATE OF DRILLING 8-23-95
SURFACE ELEV. 100± DROP 30 in. WATER LEVEL @ 6.5 ft.

DEPTH	GRAPH	SAMPLE	BLOWS PER FOOT	DRY DENSITY (PCF)	MOIST. CONT. (%)	DESCRIPTION
0						Silty SAND (SM) - Mottled brown, moist, medium dense to dense, with gravel, glass, metal and plastic fragments. (Fill)
		☐	72	104	8	
5		☐	19	93	9	
▽		☐	5	Tip Recovery		Silty CLAY (CL) - Dark gray, soft, with wood and coral fragments. Petroleum odor detected.
		▭	50/3"	Tip Recovery		CORAL - Tan, dense.
10		▭	10/No Penetration			
						End boring at 10 feet.
15						
20						
25						
30						

Plate B4

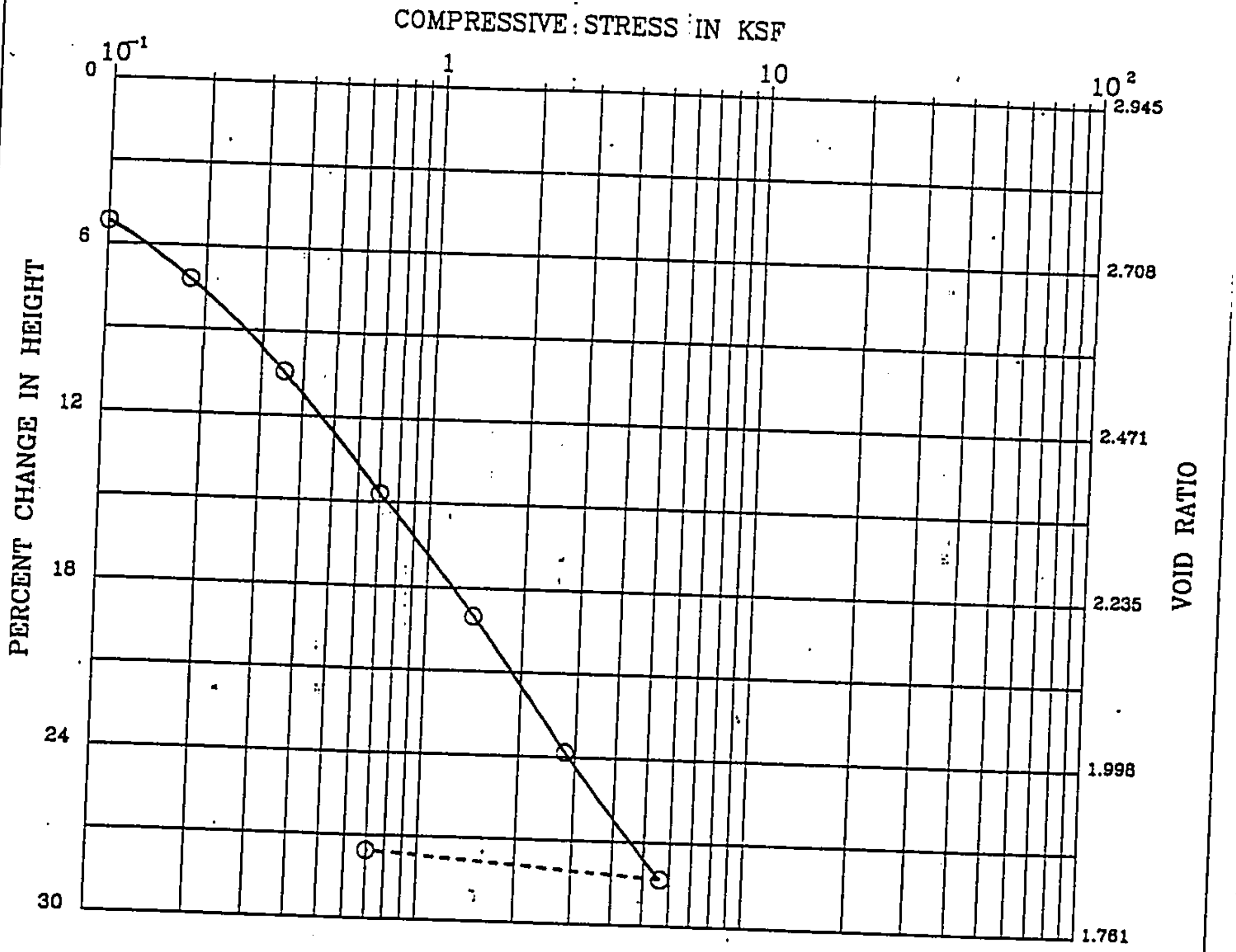


BORING	:	B1	DESCRIPTION	:	Dark gray silty clay
DEPTH (ft)	:	8	LIQUID LIMIT	:	
SPEC. GRAVITY	:	2.93	PLASTIC LIMIT	:	

	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	PERCENT SATURATION	VOID RATIO
INITIAL	59.0	67.1	100	1.730
FINAL	48.0	76.0	100	1.411

Remark : Date: 8/29/95 Water added at 700 PSF

W.O. 95-1729.1	Flynn Learner Warehouses
Ernest K. Hirata & Associates, Inc.	CONSOLIDATION TEST Plate C1



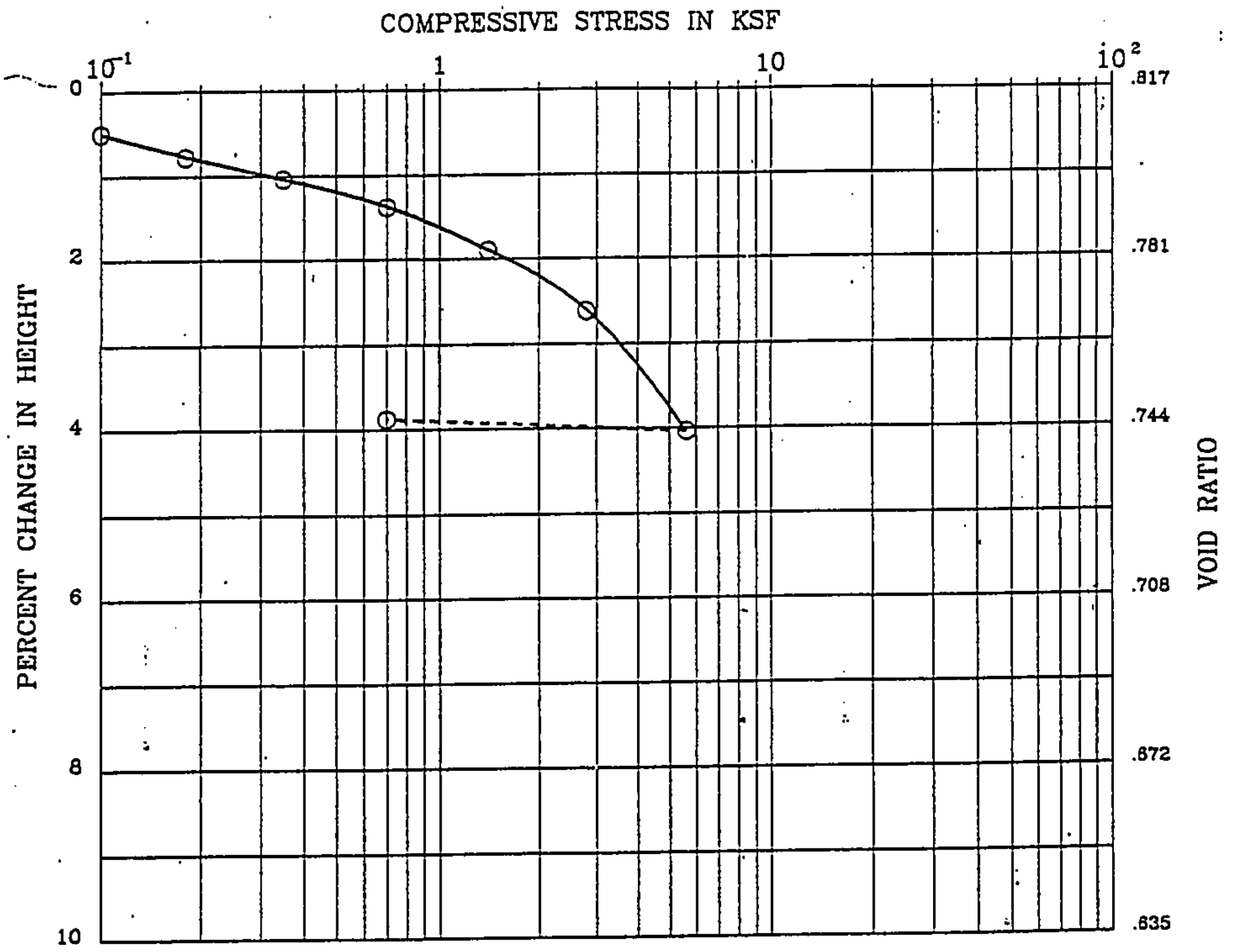
BORING : B3
DEPTH (ft) : 5
SPEC. GRAVITY :

DESCRIPTION : Dark gray silty clay
LIQUID LIMIT :
PLASTIC LIMIT :

	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	PERCENT SATURATION	VOID RATIO
INITIAL	59.7	67.7	87	2.945
FINAL	43.5	93.3	100	1.860

Remark : Date: 8/29/95

W.O. 95-1729.1	Flynn Learner Warehouses
Ernest K. Hirata & Associates, Inc.	CONSOLIDATION TEST Plate C2



BORING : B4

DEPTH (ft) : 4

SPEC. GRAVITY : 2.70

DESCRIPTION : Mottled brown silty sand

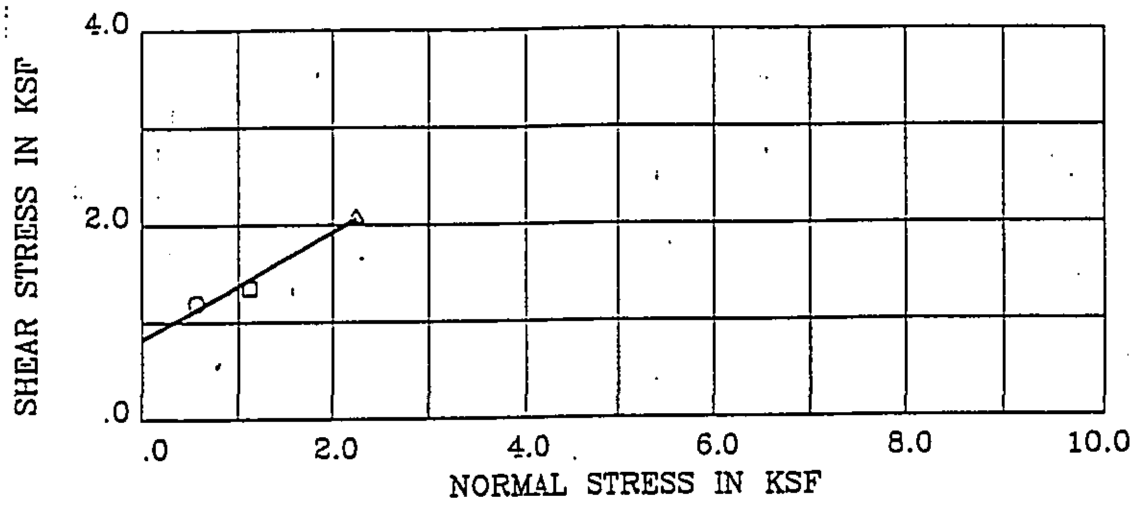
LIQUID LIMIT :

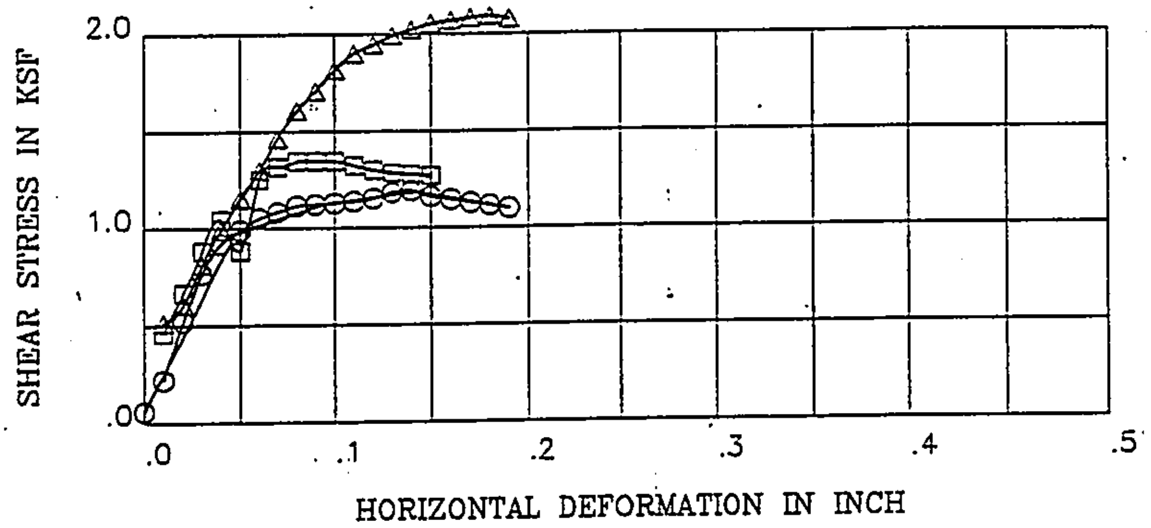
PLASTIC LIMIT :

	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	PERCENT SATURATION	VOID RATIO
INITIAL	8.9	92.8	30	.817
FINAL	7.9	96.6	29	.746

Remark : Date: 8/30/95

W.O. 95-1729.1	Flynn Learner Warehouses	
Ernest K. Hirata & Associates, Inc.	CONSOLIDATION TEST	Plate C3





BORING/SAMPLE : B2 DEPTH (ft) : 3
DESCRIPTION : Brown silty sand
STRENGTH INTERCEPT (C) : .823 KSF (PEAK STRENGTH)
FRICTION ANGLE (PHI) : 28.9 DEG (PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	26.3	80.1	1.104	.56	1.19	.06
□	26.3	80.1	1.104	1.12	1.35	1.27
△	26.3	80.1	1.104	2.24	2.09	2.07

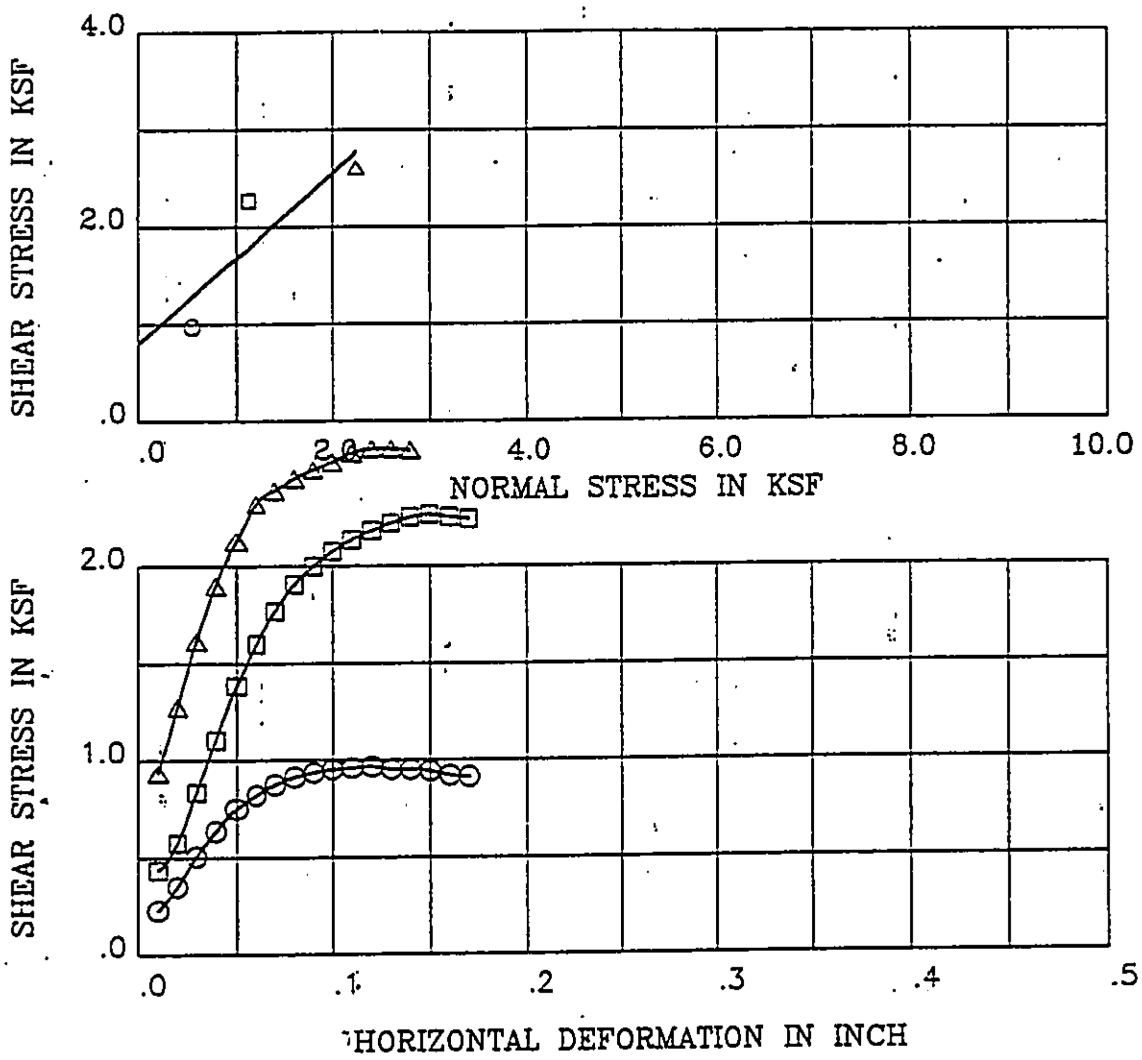
Remark : Date: 9-5-95

W.O. 95-1729.1
Flynn Learner Warehouses

Ernest K. Hirata
& Associates, Inc.

DIRECT SHEAR TEST

Plate D1



BORING/SAMPLE : B4 DEPTH (ft) : 2

DESCRIPTION : Mottled brown silty sand

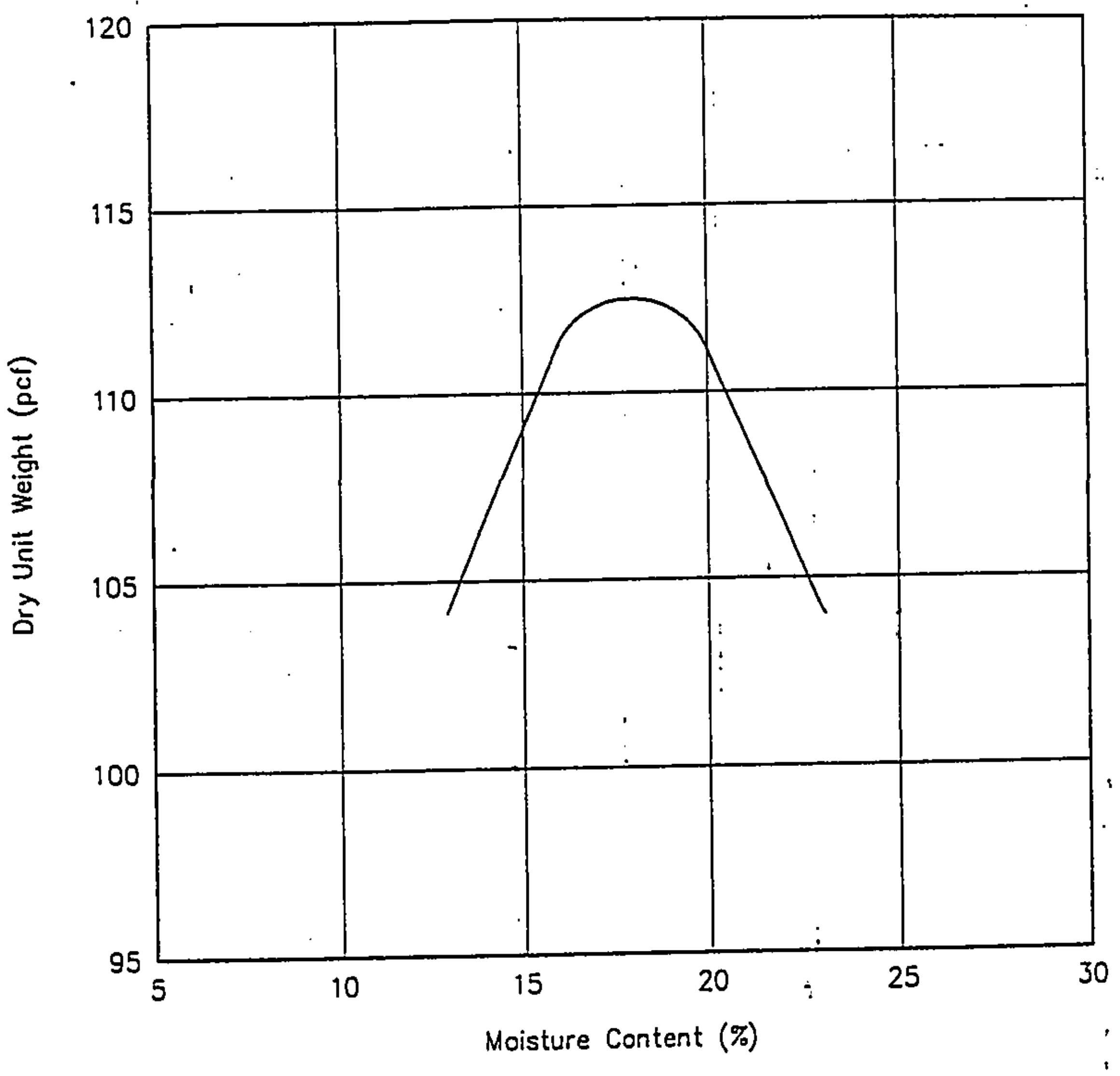
STRENGTH INTERCEPT (C) : .798 KSF (PEAK STRENGTH)

FRICTION ANGLE (PHI) : 41.3 DEG (PEAK STRENGTH)

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	VOID RATIO	NORMAL STRESS (ksf)	PEAK SHEAR (ksf)	RESIDUAL SHEAR (ksf)
○	8.0	103.6	.626	.56	.97	.91
□	8.0	103.6	.626	1.12	2.27	2.24
△	8.0	103.6	.626	2.24	2.61	2.60

Remark : Date: 9-5-95

W.O. 95-1729.1	Flynn Learner Warehouses	
Ernest K. Hirata & Associates, Inc.	DIRECT SHEAR TEST	Plate D2



Soil Data

Location: Near Boring B2 at the surface

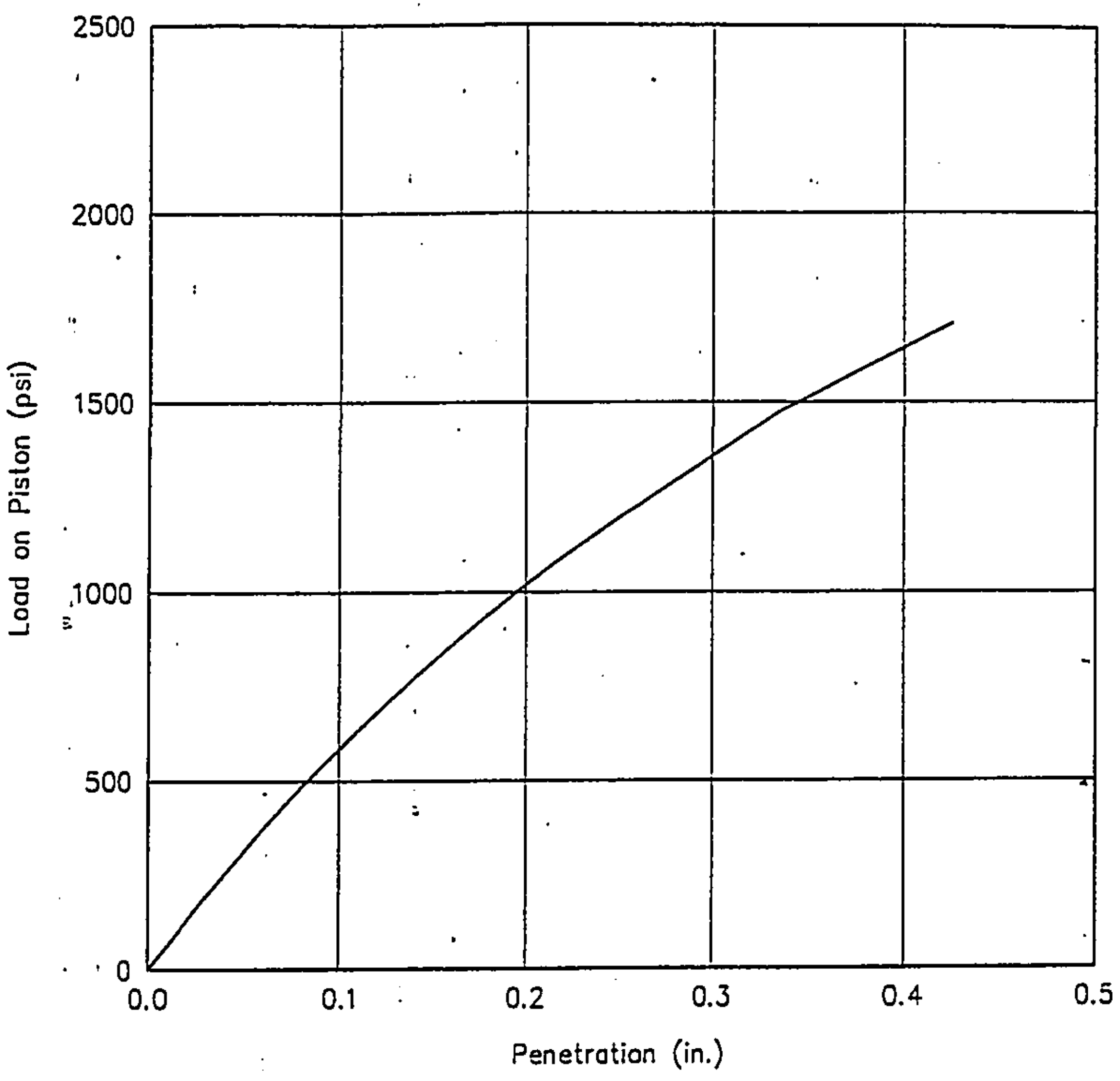
Description: Brown silty sand

Test Results

Maximum Dry Density: 112.5 pcf

Optimum Moisture Content: 18.0%

W.O. 95-1729.1	Flynn Learner Warehouses
Ernest K. Hirata & Associates, Inc.	MAXIMUM DENSITY CURVE Plate E



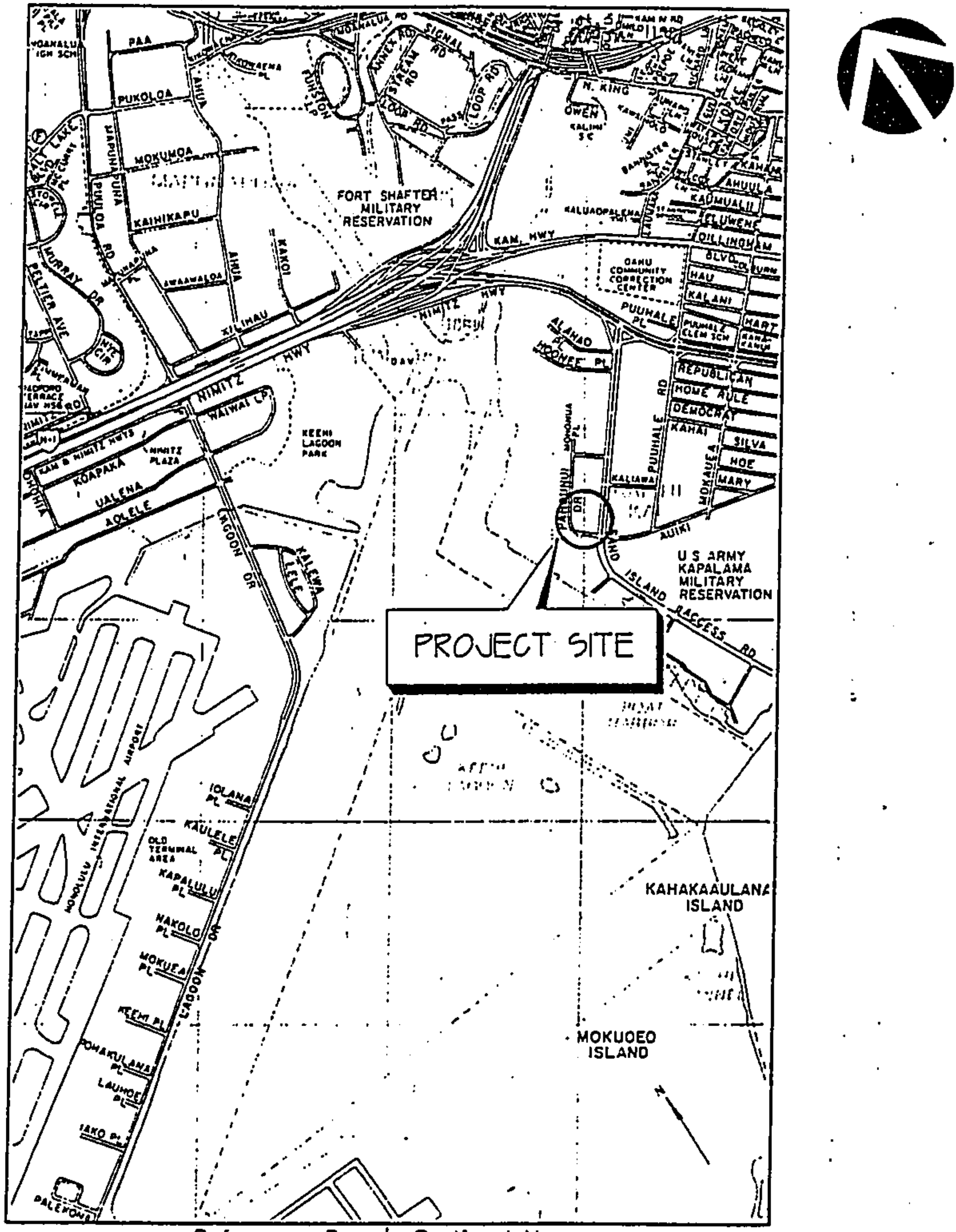
Soil Data

Location:	Near Boring B2 at the surface
Description:	Brown silty sand
Maximum Dry Density:	112.5 pcf
Optimum Moisture Content:	18.0%

Test Results

CBR Value:	59%
Expansion:	0.1%

W.O. 95-1729.1	Flynn Learner Warehouses
Ernest K. Hirata & Associates, Inc.	STRESS PENETRATION CURVE Plate F



Reference: Bryan's Sectional Maps
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W.O. 95-1729.1

Flynn Learner Warehouses

Ernest K. Hirata
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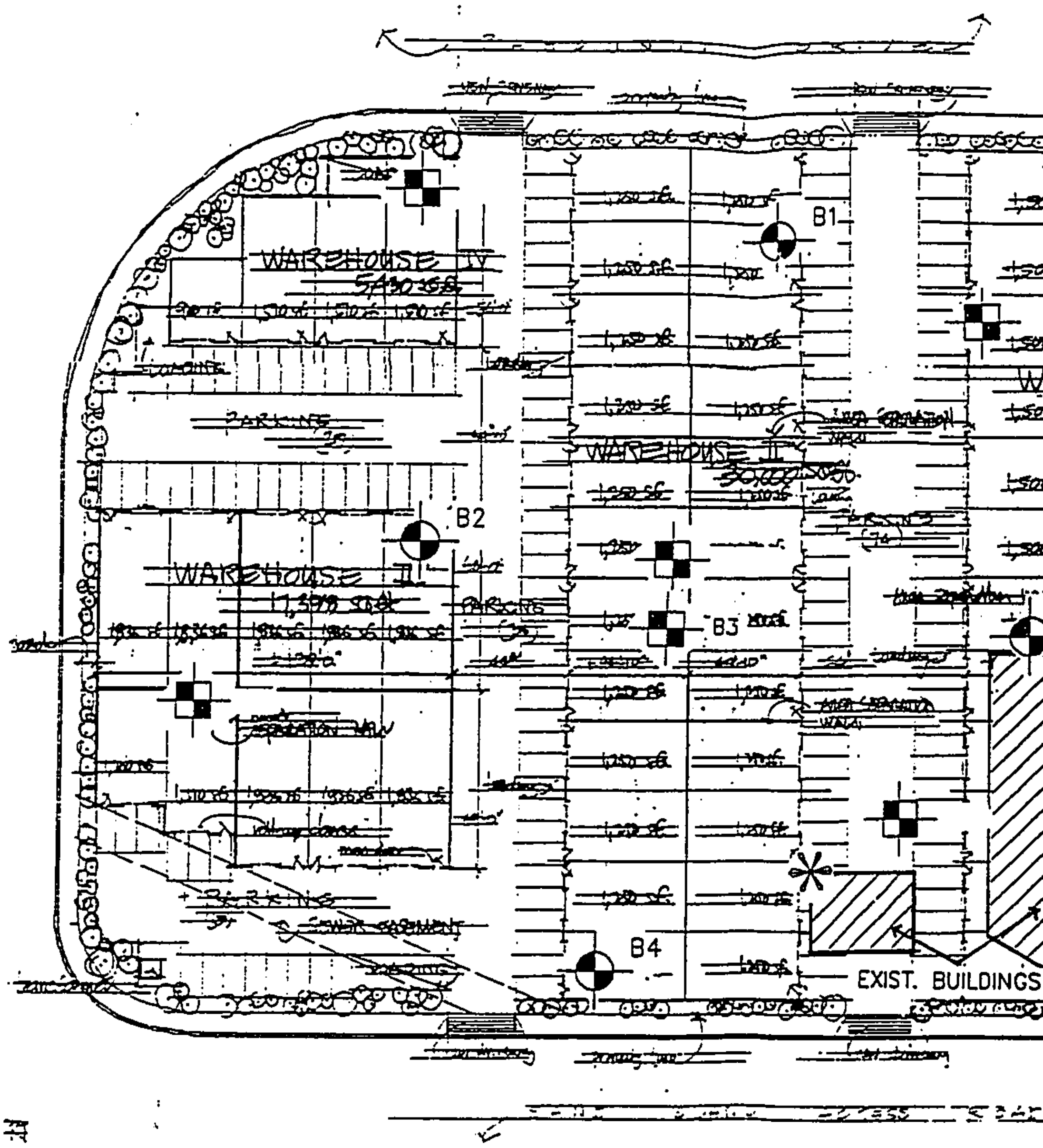
LOCATION MAP

Plate 1



LEGEND:

⊕ Approximate Location of Borings

▚ Approximate Location of Previous Borings Drilled in February 1989.

✳ Reference Benchmark Elevation at Building Corner.
Assume Elevation 100.

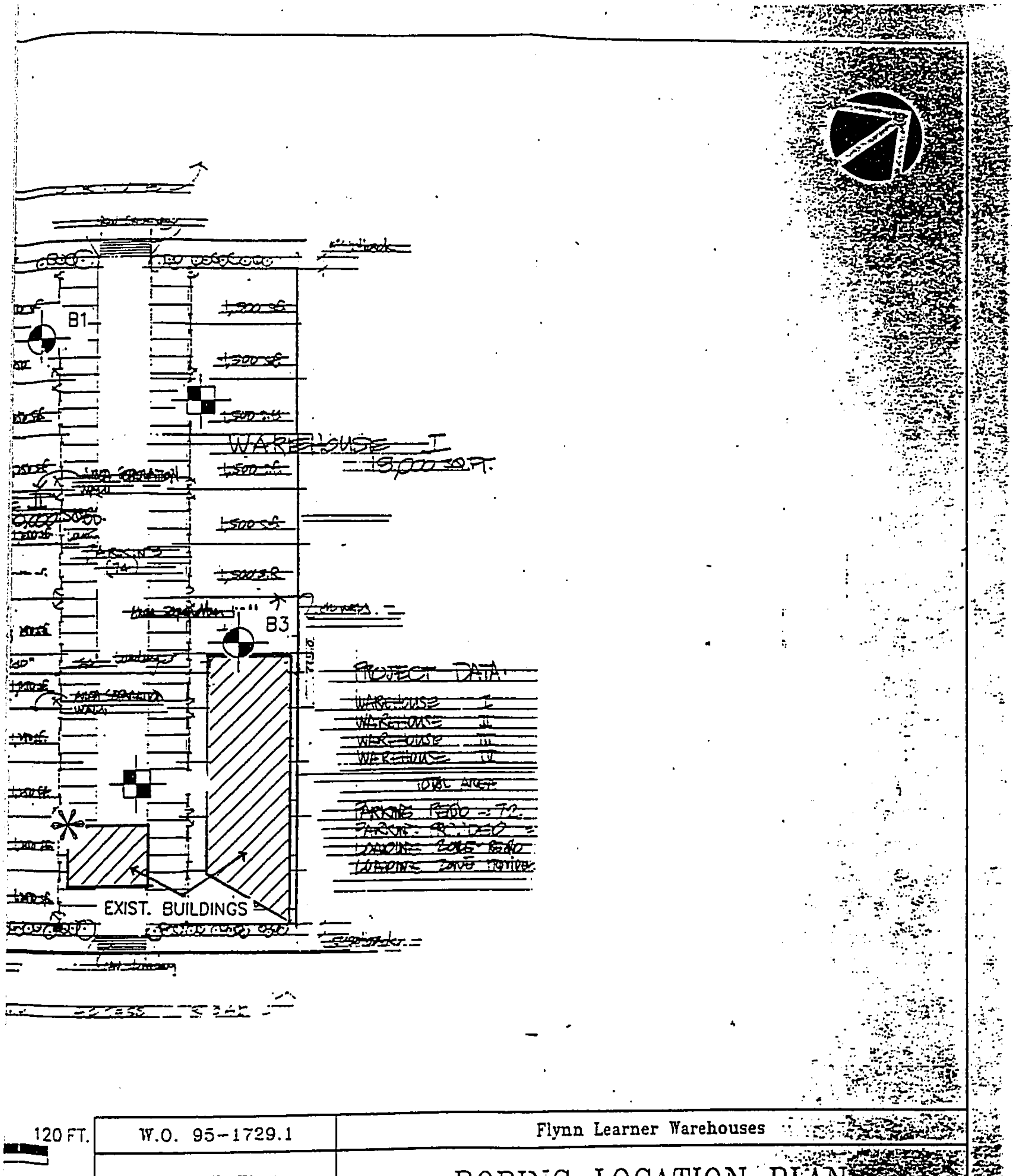
Reference: Site Development Plan prepared by Sueda & Associates, Inc., dated August 1995.

GRAPHIC SCALE:
0 30 60 120 FT.
1" = 60'

W.O. 95-17

Ernest K. H
& Associates

DOCUMENT CAPTURED AS RECEIVED



W.O. 95-1729.1

Flynn Learner Warehouses

Ernest K. Hirata
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BORING LOCATION PLAN

Plate 2