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COUNTY SANITATION DISTRICT NO. 2
OF LOS ANGELES COUNTY
CALIFORNIA

PROPOSAL FOR SELECTION OF SUBSURFACE SOIL BORING SITES NORTHEASTERLY OF THE PALOS VERDES LANDFILL

PREPARED FOR

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LOS ANGELES REGION
107 SOUTH BROADWAY - SUITE 4027
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Report
Date - Aug. 1987
Title - Proposal for Selection of Subsurface Soil Boring Sites Northeasterly of the PVLF
Author - CSF

PROPOSAL FOR SELECTION OF SUBSURFACE SOIL BORING SITES NORTHEASTERLY OF THE PALOS VERDES LANDFILL

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PROPOSAL FOR SELECTION OF SUBSURFACE SOIL BORING SITES NORTHEASTERLY OF THE PALOS VERDES LANDFILL

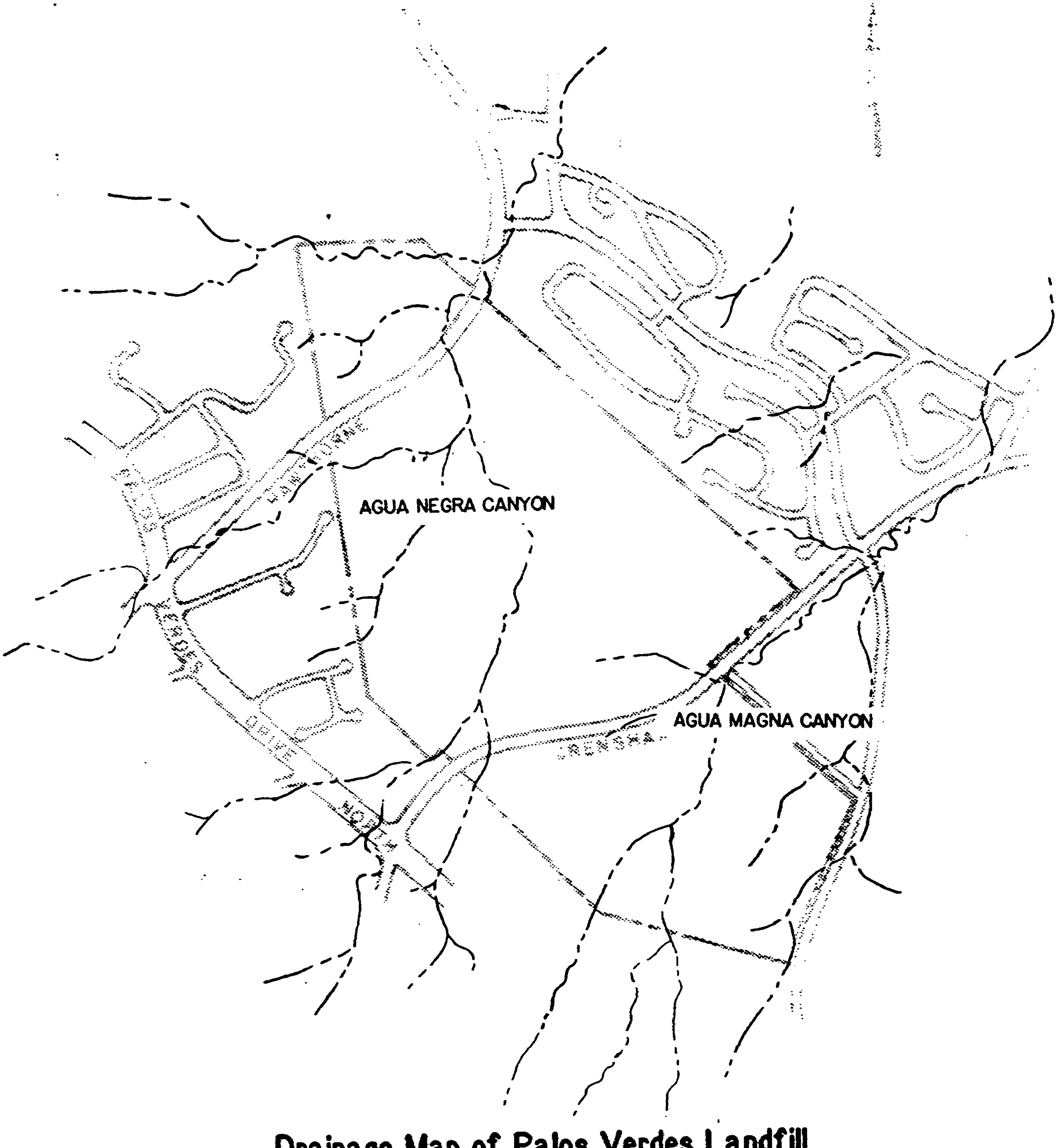
1.0 INTRODUCTION

The proposal (plan) incorporated herein has been prepared pursuant to a request dated August 3, 1987 from the California Regional Water Quality Control Board - Los Angeles Region (CRWQCB). This plan presents a subsurface soil boring study as an alternate to the installation of three off-site downgradient monitoring wells for the Palos Verdes Landfill at locations M27A, M28A and M29A. Soil and water data gathered from the study will be used to assist in the recommendations for locating new monitoring wells to replace the originally proposed M27A, M28A and M29A monitoring wells. Included in this proposal are sections discussing Site History, Geology of Study Area, Exploration and Subsurface Soil Investigation Sites, Exploration and Geological Survey Procedures, and Schedule for Conduct of Study.

2.0 SITE HISTORY

Mining and landfill operations have radically altered the original drainage pattern in the area over the last 60 years. The original drainage was a well developed dendritic pattern with a slight tendency towards parallel drainage and some small entrenched meanders (Figure 1). The entrenched meanders are particularly evident on the lower course of Agua Negra Canyon and extend out onto its alluvial fan. Some canyons were steep walled and relatively deep when compared to others, mostly tributary canyons, that were merely the low areas between gently rounded hills.

During mining operations many of the tributaries and the deeper canyon bottoms were either completely or partially filled with tailings. This practice continued throughout the mining history of the site and some canyons have multiple layers of tailings. In the main canyons and some of the larger tributaries,



Drainage Map of Palos Verdes Landfill

Original drainage pattern.

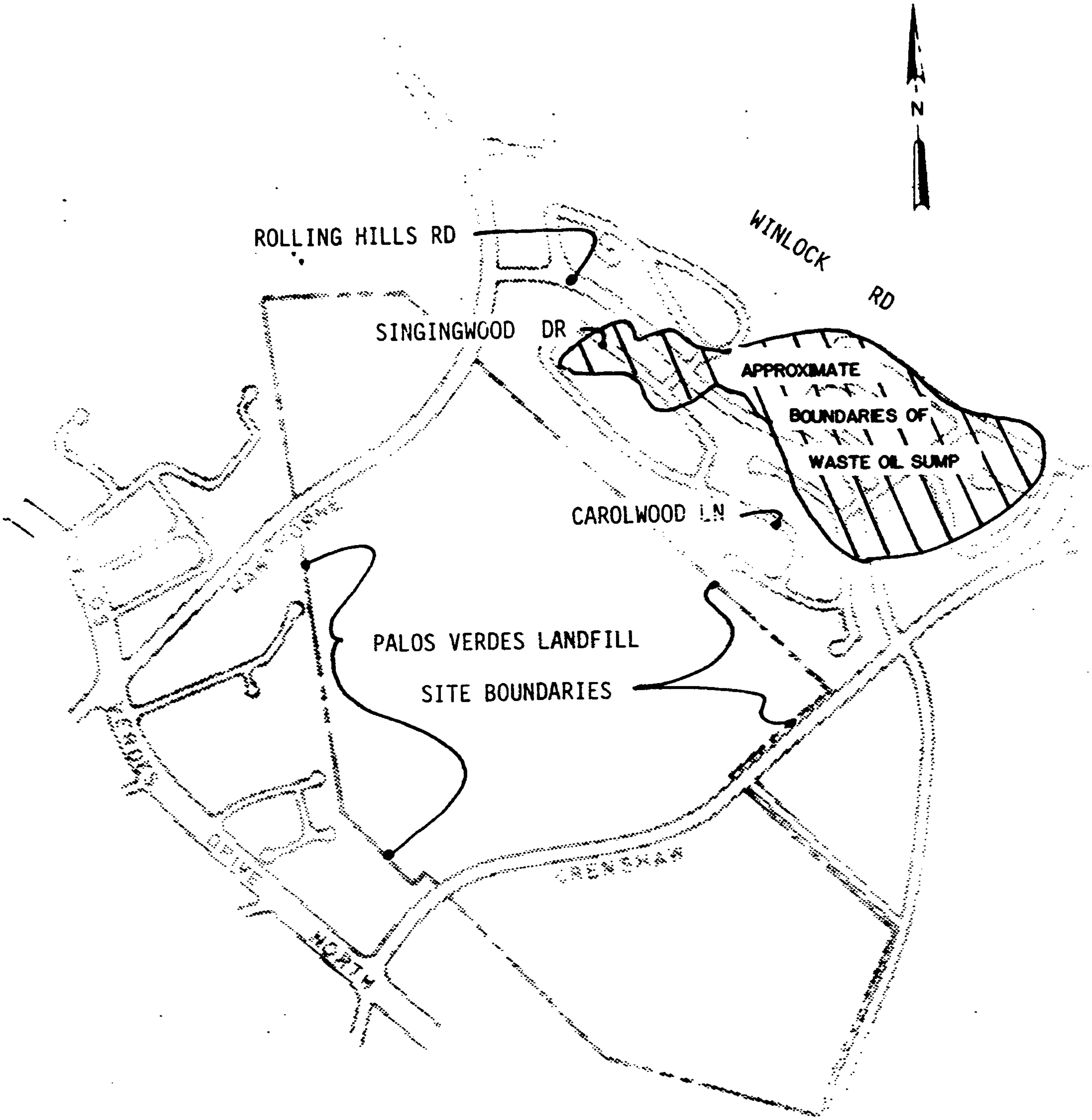
Traced from air photos taken in the 1920's.

FIGURE I

the drainage re-established itself, often flowing along the edge of the fill and one of the original canyon walls. It appears that no attempt was made to control drainage through the areas of active mining.

Immediately to the northeast of the main landfill site, sand and gravel from the San Pedro Sand and other units were mined by persons or organizations unknown to the Sanitation Districts in open pits. Mining apparently began in the early 1920's and continued as small-scale, sporadic operations until the early 1960's when the Torrance Sand and Gravel Company, according to records, began large scale mining operations that lasted until the early 1970's. Mining started just northeast of the landfill property line (Parcel 6) and progressed in a northeastern direction becoming larger and deeper, stopping just short of the residences on Winlock Road in the City of Torrance. Tailings were placed just beyond the landfill's property line and in the older pits as they were abandoned.

A review of various geologic reports indicate that these quarried pit areas immediately to the northeast of the main landfill site were also used for the disposal of oil wastes and crude oil sludges by persons or organizations unknown to the Sanitation Districts. These pits were up to 120 feet deep and are referred to in reports as the "large" and "small" pits. The approximate limits of these pits are shown in Figure 2. These operations were unrelated to the Sanitation Districts' disposal activities at the Palos Verdes Landfill and were not conducted by the Sanitation Districts. To the best of the Sanitation Districts' knowledge, these offsite activities occurred until the early 1970's just prior to the area's construction as a residential tract. According to a November 13, 1963 report by Converse Foundation Engineers "Geological and Soils Investigations, Torrance Sand and Gravel Pits Crenshaw Boulevard and Rolling Hills Road, Torrance, California" there was a failure of the north and east sides of the "large" pit in the Summer of 1963. The reports indicate the resulting release of oil and subsequent attempts to



MAP OF AREA NORTHEASTERLY OF PALOS VERDES LANDFILL

SHOWING APPROXIMATE BOUNDARIES OF WASTE OIL PITS

FIGURE 2

contain it, spread the waste oil over large areas. Although recommendations were made at the time to investigate further containment of the waste oil, no additional information is available about the waste oil until the area was proposed for development as a residential tract. An August 28, 1972, letter from Western Laboratories to Sunnyglen Construction Company describes a "blending proposal" to mix waste oil and sand deposits, presumably of the Palos Verdes Sand Formation used extensively as an aquifer, to dilute the concentrated pockets of the remaining pits. The concentrations of oil to sand in the pit areas were reported to be 40 percent oil and 60 percent sand. The proposal and recommendation was to obtain a diluted mix of 10 percent oil with 90 percent sandy soils. These blended fills were to be placed to no more than 20 feet below the finished grade of the proposed residential development. It must be assumed that the mixing of the waste oil and sand took place over a large area between Winlock Road and to just below the Palos Verdes Landfill boundaries. In-progress or as-built geologic maps of the residential tract development do not define the fill limits. Finish grading and landscaping further obscure the underlying nature of the soil.

3.0 GEOLOGY OF STUDY AREA

The present knowledge of the geology of the study area has been described in detail in the August, 1987 "Palos Verdes Groundwater Detection and Monitoring Well Program Report" by the Sanitation Districts. An abbreviated discussion of the general geology of the area follows in this section. However, insufficient information exists to accurately portray the subsurface geology including precise location of the formation contacts, bedding attitudes, structural features, depth of overburden, etc. As indicated in the Sanitation Districts' July 2, 1987 letter to the CRWQCB, lack of this information precludes an accurate positioning of investigative borings. Conduct of the proposed boring program will provide additional data necessary to assist in the placement of the proposed monitoring wells for the area.

Valmonte Diatomite (Tv) - The Valmonte Diatomite, a member of the Miocene age Monterey Formation, is the oldest rock unit exposed on the property. This unit, composed of grey-brown to white diatomite, diatomaceous claystone, siltstone and thin beds of altered ash underlies the entire property at depth. It varies from massive to very well-bedded.

Malaga Mudstone (Tm) - The Malaga Mudstone, the upper member of the Monterey Formation in this location, overlies the Valmonte Formation. The Malaga Mudstone consists predominantly of brown and dark grey diatomaceous mudstone and claystone transitioning to black where encountered in deeper, unoxidized zones. It is generally massive and, except locally, it lacks well-defined bedding. Most exposures show brown iron-stained fractures and minor slickensides.

One of the main criteria for the division between Malaga Mudstone and Valmonte Diatomite is the younger age of the radiolarian fossils in the Malaga Mudstone. The approximate contact between these formations, as shown on the site map (Exhibit 1), is based mainly on a difference in color, bedding and textural characteristics.

Undifferentiated Sand (Qus) - Sand deposits uncomformably overlie the Miocene bedrock units. These consist of two and possibly three Pleistocene-age predominantly marine deposits. These units, the Lomita Marl, the San Pedro Sand, and possibly the Palos Verdes Sand do not differ appreciably in their composition. They are combined into one unit for this report. This unit, originally present over most of the property is composed of uncemented, well to poorly sorted, fine to coarse grained, locally gravelly sand.

Although it averages about 40 feet thick along the southwest property line, this sand unit thickens markedly to the northeast. Originally it exceeded 150 feet in thickness along most of the northeast property boundary.

Over the years, large amounts of fill unassociated with the refuse disposal have been placed in the vicinity of the site. Most of this older fill consists of mine tailings produced from prior quarrying and mining activities in the area. They are described as being chiefly loose and uncompacted fragments of diatomite, diatomaceous claystone, and cherty shale in a powdery to sandy clay matrix. The tailings are found throughout the site but mostly in old canyon bottoms and along Hawthorne and Crenshaw Boulevards. Younger fill is present along Hawthorne Boulevard and northeast of the site along Rolling Hills Road. This fill is generally more compact and is composed of diatomaceous silts and fine sands mixed with other mudstones and siltstones and was likely obtained from local outcrops in the area.

Structurally, the site lies between the Palos Verdes and Cabrillo Faults. Deformation from the fault systems in the area have produced folding in the form of synclines and anticlines that trend in a general west to east direction, plunging easterly 25-35^{o}. Geologic relations and integration of various data infer the presence of an east-west trending fault crossing the northeastern corner of the landfill, however, insufficient data exists to confirm or deny this inference.

4.0 SUBSURFACE SOIL INVESTIGATION SITES

This section discusses the former monitoring well sites, M27A, M28A, and M29A, and the rationale for placement and target depths for the proposed investigative borings.

4.1 FORMER MONITORING WELL SITES

Monitoring wells M27A, M28A, and M29A were to be drilled in the area northeasterly of the Palos Verdes Landfill where extensive quarrying operations modified the site and resulted in deep pits up to 120 feet deep. Subsequent to selection of these proposed monitoring locations, a further review of geologic reports indicated that the pits were reported to be filled with waste oil by persons unknown to the Sanitation Districts. It was reported that over time the sides of the pits were extended to create more disposal volume. A reported failure of these pit walls in 1963 caused widespread oil contamination over the area. Additional reports indicated that prior to development as a residential tract, the waste oil was blended with sand and used as a general fill for the deep pits. An analysis of the waste oil and sand mixture, indicates metal and volatile compound contamination (see Table 1).

As a result of the potential for in-place contamination from the waste oil activities which were unrelated to the Sanitation Districts' operations, it was determined and recommended that placing monitoring wells at the M27A, M28A and M29A locations would not provide reliable downgradient monitoring points for the Palos Verdes Landfill. These recommendations were made in a May 4, 1987 meeting between staffs of the Sanitation Districts, the Department of Health Services - Toxics Division (DOHS) and the CRWQCB.

Although the CRWQCB did not necessarily concur with the Sanitation Districts' allegations regarding the offsite oil waste and sludge disposal activities, as an alternative it was agreed by the CRWQCB and DOHS that the Districts could elect alternate locations for these proposed detection points by conducting a subsurface soil investigation to find locations which might be outside the influence of this offsite disposal area. After additional review of various geologic reports, topographic maps, aerial photographs and other pertinent information, it was the

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781 EAST WASHINGTON BOULEVARD

LOS ANGELES 21, CALIFORNIA

FILE NO.: 10628-72
LABORATORY NO.: C-561857-58

DATE: AUGUST 29, 1972

WESTERN LABORATORIES
13626 NORMANDIE
GARDENA, CALIFORNIA 90248

RE: "OIL & SOIL MIXTURES"

ATTENTION: MR. DON VANDERBEEK

REPORT OF DETERMINATIONS

IN ACCORDANCE WITH YOUR REQUEST, THE SAMPLES OF SOIL & OIL MIXTURE WHICH YOU SUBMITTED TO US AUGUST 18, 1972, IDENTIFIED AS SHOWN BELOW, WERE ANALYZED WITH THE FOLLOWING RESULTS.

	SAMPLE NO. 1	SAMPLE NO. 2
OIL CONTENT, %	10.88	31.90
VOLATILE MATTER, %	10.35	17.30
MERCURY (HG), PPM	< 1.00	< 1.00
COBALT (CO), PPM	39.40	50.80
COPPER (CU), PPM	708.90	2590.00
MANGANESE (MN), PPM	63.00	55.90
ZINC (ZN), PPM	1024.00	2235.20
PHENOL CONTENT, PPM	< 0.10	< 0.10
CONDUCTIVITY, MILLIMHO/CM.	4.15	9.10
ODOR, THRESHOLD	2	4

RESPECTFULLY SUBMITTED,
SMITH - EMERY COMPANY

BY ______________
P. E. MATHENY

3-ADDRESSEE
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TABLE I

opinion of the Sanitation Districts' staff that the available information was insufficient to accurately position borings to achieve this goal without indiscriminately conducting a boring program in the residential tract immediately south of Rolling Hills Road. It was subsequently decided to proceed with the detection monitoring program as originally proposed and approved. On June 24, 1987, the Sanitation Districts' contractor for the well installation drilled an investigative boring at the proposed location of monitoring well M29A. This boring, which went to a depth of approximately 65 feet, indicated the presence of the oil waste based primarily on the detection of strong petroliferous odors emanating from the samples. A sample of water and soil is presently being tested to determine the cause and significance of the odor as detected. The test results, including an assessment of the confidence of the data, will be transmitted to the CRWQCB when available.

4.2 PROPOSED INVESTIGATIVE BORING SITES

Three investigative boring sites were selected between the locations of proposed monitoring wells M27A, M28A, and M29A along Rolling Hills Road, and wells M30B, M32B, M33B, M34B, and M35B along the northeast boundary of the Palos Verdes Landfill. This will result in nine primary data points from which to evaluate the optimum selection of potential sites for replacement of wells M27A, M28A, and M29A. The three proposed boring locations, SI-1, SI-2, and SI-3 are shown on Exhibit 1. Insufficient data exists to accurately construct geologic cross sections and supportive geologic data to indicate the anticipated soil and bedrock condition. Relying on existing information, however, the three sites can be generally characterized. SI-1 is located at the projected centroid of the axis of a syncline in the Palos Verdes Sandstone. The boring is to be drilled in a public right of way on Oakwood Lane. The anticipated target depth is 100 feet but may be deeper or shallower. The actual depth for this boring and all others is to be determined by the geologist evaluations. S1-2 is located near the junction of a projected fault in the Malaga Mudstone. Its target depth is 100 feet but may vary as indicated above. SI-3 is located in north dipping strata of the Malaga Mudstone and the depth is anticipated to be 100 feet. Procedures for drilling and investigation are to be indicated in Section 5.0.

5.0 EXPLORATION AND GEOLOGICAL SURVEY PROCEDURES

This section covers the methods and procedures to be utilized in the conduct of the borings for the study.

All of the procedures and methods that are used in the investigation are identical to that proposed in the August, 1987 "Palos Verdes Landfill Groundwater Detection and Monitoring Well Program." These procedures are listed in Attachment A to this proposal. Those procedures include:

A. Drilling Procedures
B. Geological Logging
C. Geophysical Logging
D. Soil and Water Sampling Procedures
E. Chain of Custody
F. Analytical Procedures for Soil and Water Quality Testing
G. Laboratory Tests for Soils
H. Comprehensive Safety Plan

The anticipated exceptions to these procedures concern the soil and water procedures listed. Additional screening and testing of the soil and water will include scans for hydrocarbon products and will include the procedures listed in EPA Document SW-846 for determination of hydrocarbons.

6.0 SCHEDULE FOR CONDUCT OF STUDY

Under Sections 4200 et. al. of the Government Code, from the California Administrative Code, Public Agencies, such as the County Sanitation Districts of Los Angeles County, must follow regulated bidding procedures in the performance of the above proposed study. Those procedures specify minimum time requirements for the bidding process. The following schedule proposes a schedule to meet the bidding procedures based upon a review and written approval of this plan by the CRWQCB.

PROPOSED SCHEDULE*

	ITEM	TIME REQUIRED
1.	Development of Request for Proposal	1 Month
2.	Advertisement and Receipt of Bids and Award	1 Month
3.	Contractor Mobilization/ Right of Way	1 Month
4.	Conduct of Boring Program	1 Month
5.	Analysis and Testing	1 Month
6.	Final Report	1 Month
	Total	6 Months

*Based upon receipt of written approval from CRWQCB. Time estimates do not include unforseen delays due to weather or other actions by other agencies or default by the Contractor.

ATTACHMENT A

IV. EXPLORATION AND GEOLOGICAL SURVEY PROCEDURES

This section of the report will discuss drilling procedures, geological logging, geophysical logging, sampling procedures, and chain of custody.

A. Drilling Procedures

The drilling method to be used in the investigation program for the Palos Verdes Landfill will be selected on the basis of the ability to collect investigative data, boring depth, minimization of introduction of fluids (or gases), ease of water and soil sampling, ability to conduct geophysical tests and potential for caving. Several drilling methods are available. These methods include the bucket auger, air rotary, and the hollow-stem auger. Fletcher Driscoll in his text Groundwater and Wells, by Johnson Division, 1986, gives some advantages and disadvantages of some of the more common drilling methods for investigation (see Appendix 10). The two most likely drilling methods that will be used in the investigation program are the air rotary method and the hollow-stem auger method. Both methods have a very low potential for contamination and allow for the ability to collect investigative data. The drilling and investigative procedures to be used will satisfy Sections 2552 and 2553 of Title 23, Chapter 3, Subchapter 15 of the California Administrative Code. The selection of one method over another will be determined primarily on the depth of the boring and the hardness of the geologic materials. The hollow-stem auger method will be used on borings less than 150 feet deep while the air rotary method will be used on borings greater than 150 feet. In order to minimize the potential for cross-contamination between drill holes, the augers or drill stem will be washed and steam cleaned to remove foreign debris, earth or other matter which might affect the results of the sampling program. In addition, the drill bit and drive samplers will be thoroughly cleaned with potable water after completion of each boring. Excess drilling spoils will be disposed of in compliance with the California Administrative Code, Title 22, Chapter 30.

B) Geological Logging

Geological logging is very important to the proposed investigation program. As new information is gathered about the subsurface, adjustments in depth, number, and placement of the monitoring wells will be conducted as required. The geologic logging of the monitoring wells will be performed by a geologist registered in the State of California according to Section 2555 of Title 23, Chapter 3, Subchapter 15 of the California Administrative Code. The geologic logs will describe in detail the lithologic and structural characteristics of the subsurface and will include the following:

1) Soil boring/monitoring well number.
2) Date(s) of exploratory drilling.
3) Times of day drilling began and ended.
4) Type of exploratory equipment being utilized (i.e. air rotary, hollow stem auger) including manufacturer make and model and any special modifications.
5) Name(s) of geologist(s) responsible for log description.
6) Name(s) of other personnel assisting in the logging.
7) Weather conditons.

8) Systematic descriptions of lithologic and microstructural changes in strata and soil horizons. Depth and elevation of changes will be recorded. Soil classification will be based upon the Unified Soil Classification System.
9) Measurement of soil moisture changes at five (5) foot minimum intervals will be taken. Preservation of samples for laboratory moisture analysis is acceptable, however, field determination by moisture meters or nuclear (in-situ) methods will be preferred.
10) Descriptions and identification of microfossils or macrofossils will be performed.
11) Any substructures or unusual subsurface features encountered.
12) Presence and depth to springs, seeps or groundwater will be identified.
13) Caving or sloughing of the hole including depth and elevations will be recorded.
14) Soil sampling interval(s), depths and elevations.
15) Any unusual odors of a chemical or waste origin.
16) A descriptive log sketch depicting representations of the subsurface conditions will be drawn.
17) Drilling advancement in feet per hour (average).
18) Other notes and descriptions as required.

In addition to the logging described above, detailed descriptions of the bedrock materials encountered will be performed. It is very important to fully characterize the nature of the bedrock in order to determine the potential for migration or flow of subsurface waters. In analyzing the bedrock materials the following items will be considered:

1) Degree of weathering of the bedrock.
2) The presence of extremely fractured rock.
3) The condition of any fractures.
4) The moisture content of the bedrock.
5) The presence of wetted bedrock fractures.
6) The degree of induration.

Complete descriptions of the analyses to be considered follows:

1) Degree of Weathering. Weathering can be defined as the group of processes, such as the chemical breakdown of rock due to the action of air and rain water and plant and bacteria action, and the mechanical action of exposure to temperature changes which lead to variable changes in character, strength, color, and content of the rock. A complete description of the weathering is important because the higher the degree of weathering, the more likely that water could migrate through it.

2) The Presence of Extremely Fractured Rock. As with weathered rock, areas of extreme fracturing must be carefully noted and described because of possible water migration. In describing the fracture spacings the following criteria will be used:

Samples will be collected by any one of the following: fluorocarbon resin or stainless steel bailers (provided they are equipped with double check valves and bottom emptying devices); gas operated, fluorocarbon resin or stainless steel squeeze pump; stainless steel or fluorocarbon syringe bailer; or single check valve fluorocarbon resin or stainless steel bailer. If bailers are used, an inert cable/chain will be used to pull the bailer such as fluorocarbon resin or stainless steel.

Samples collected are to be stored in borosilicate glass sample jars with teflon lined caps. Field analyses for the items listed in this Subsection 6.1 shall be performed. Samples are to be placed in ice immediately upon withdrawal and labeled according to instructions set forth in Part a. above. Sample preservation and sample holding times will follow Table 3.19 of the May, 1986 Edition of The California Site Mitigation Decision Tree, by the California Department of Health Services.

All water pumped from the wells before sampling will be handled by the procedures outlined in the California Administrative Code, Title 22, Chapter 30.

c. Water Level Measurement. To record all water level measurements of the completed wells, a surveyed reference point as located by the Sanitation Districts will be determined. In-situ water level measurements are to be taken to an accuracy of 0.01 of a foot and will use an electronic field instrument such as the Levelhead Model LH10 by In-Situ, Inc. or an approved equivalent. Measurements of water level are to be taken until two successive measurements are in agreement to the accuracy stated previously.

E. Chain Of Study

A written procedure will be maintained for the tracing of possession and handling of individual soil and water samples from the time of collection to the time of laboratory analysis. The chain of custody procedure will contain the following:

1. Sample Labels. To prevent misidentification of samples, legible labels will be affixed to each sample container. The labels should be sufficiently durable to remain legible even when wet and should contain the following types of information:

a. Sample identification number.

b. Name of collector.

c. Date and time of collection.

d. Place of collection.

e. Parameter(s) requested (if space permits).

f. Internal temperature of shipping container at time sample was placed.

g. Internal temperature of shipping container upon opening at laboratory.

h. Maximum and minimum temperature range that occurred during shipment.

2. Sample Seal. In cases where samples are shipped to a laboratory by a common carrier (e.g., air freight), a seal should be provided on the shipping container or individual sample bottles to ensure that the samples have not been disturbed during transportation.

3. Field Logbook. An up-to-date field logbook will be kept that documents the following:

a. Identification of well.

b. Well depth.

c. Static water level depth and measurement technique.

d. Presence of immiscible layers and detection method (if available).

e. Well yield - high or low.

f. Purge volume and pumping rate.

g. Time well purged.

h. Collection method for immiscible layers and sample identification numbers (if present).

i. Well evacuation procedure/equipment.

j. Sample withdrawal procedure/equipment.

k. Date and time of collection.

l. Well sampling sequence.

m. Type of sample containers used and sample identification numbers.

n. Preservative(s) used.

o. Parameters requested for analysis.

p. Field analysis data and method(s).

q. Sample distribution and transporter.

r. Field observations on sampling event.

s. Name of collector.

t. Climatic conditions including air temperature.

u. Internal temperature of field and shipping (refrigerated) containers.

4. Chain-of-Custody Record. To establish the documentation necessary to trace sample possession from time of collection, a chain-of-custody record will be filled out and accompany every sample. The record will contain the following information:

a. Sample number.

b. Signature of collector.

c. Date and time of collection.

d. Sample type (e.g., ground water, soil sample).

e. Identification of well.

f. Number of containers.

g. Parameters requested for analysis.

h. Signature of person(s) involved in the chain of possession.

i. Inclusive dates of possession.

j. Internal temperature of shipping (refrigerated) container (chest) when samples were sealed into the shipping container.

k. Maximum temperature recorded during shipment.

l. Minimum temperature recorded during shipment.

m. Internal temperature of shipping (refrigerated) container upon opening in the laboratory.

5. Sample Analysis Request Sheet. This document will accompany sample(s) on delivery to the laboratory and clearly identify which sample containers have been designated (e.g., use of preservatives) for each requested parameter. The record should include the following types of information:

a. Name of person receiving sample.

b. Laboratory sample number (if different from field number).

c. Date of sample receipt.

d. Analyses to be performed.

e. Internal temperature of shipping (refrigerated) container upon opening in the laboratory.

6. Laboratory Logbook. Once the sample has been received in the laboratory, the sample custodian and/or laboratory personnel will clearly document the processing steps that are applied to the sample. All sample preparation techniques (e.g., extraction) and instrumental methods must be identified in the logbook. Experimental conditions, such as the use of specific reagents (e.g., solvents, acids), temperatures, reaction times, and instrument settings, should be noted. The results of the analysis of all quality control samples should be identified to each batch of ground water samples analyzed. The laboratory logbook will include the time, date, and name of the person who performed each processing step.

F. Analytical Procedures For Soil And Water Quality Testing

The analytical laboratory performing the chemical testing will be a Hazardous Materials Laboratory certified by the California Department of Health Services. Proof of certification will be submitted to the Districts prior to the start of the job. The analytical procedures will include a pollutant scan using EPA Methods 601 and 602 and/or upon approval Methods 624 and 625. EPA Method 601 and 602 shall be employed for identification of acetone and methyl ethyl ketone. The following metals using ICP Metals Procedures will be scanned: Sb, As, Ba, Be, Cd, Ca, Cr (total and +6), Co, Cu, Fe, Pb, Mn, Hg, Mo. Ni, K, Ag, Se, Na, Tl, V, and Zn. The AA Method shall be used for detection of Hg and Se.

In addition the laboratory analysis will include:

pH
Conductivity
TDS
Magnesium hardness
Calcium hardness
Chlorides
Sulfate nitrates
Soluble COD
Soluble BOD
Proprionic acid
Isobutyric acid
Butyric acid
Isovaleric acid
Valeric acid

The laboratory will provide a full QA/QC program procedure indicating equipment, personnel, sample handling, instrument maintenance, operating training, and other procedures used. The QA/QC procedures will also include the use of standards, laboratory blanks, duplicators, and spiked samples.

G. Laboratory Tests For Soils

The following tests will be run in each borehole:

1. Sieve Analysis. For three(3) representative samples in each borehole, a sieve analysis based on the sieve size using the U.S. Standard Sieve Series will be taken. For sieve sizes above No. 200 Standard, the following designation will be used:

Description	Size
Boulder	Greater than 12 inches
Cobble	3 inches to 12 inches
Coarse Gravel	3 inches to 3/4 inch
Fine Gravel	3/4 inch to No. 4 sieve
Coarse Sand	No. 4 sieve to No. 10 sieve
Medium Sand	No. 10 sieve to No. 40 sieve
Fine Sand	No. 40 sieve to No. 200 sieve

For the quantitative determination of the particle size in soils, ASTM D-422 will be followed. Percentage passing will be graphically plotted and included in the final report. Hydrometer tests will be included for all sieve analyses.

2. Moisture Content. For each 10 foot interval in the borehole, the moisture content will be obtained and recorded. The moisture content should be determined in the field but may be tested in the laboratory if approved by the Districts.

3. Bulk Density. For three(3) representative samples in the borehole, the bulk density will be determined. The "Clod Method" may be used for determining the bulk density on disturbed samples as reviewed by Blake (1965). Blake, G.R., 1965. Bulk Density, in Methods of Soil Analyses, C.A. Black (ed), Agronomy No. 9, 374-390, Amer. Socs. Agron., Madison, Wisconsin.

4. Porosity. For three(3) representative samples in the borehole, the porosity will be determined. The total porosity may be calculated using the following expression by Vomicil (1965)

$$St = 100(1(D_b/P_b)$$

Where St = total porosity, the percentage of the bulk volume not occupied by solids

D_b = bulk density

P_b = particle density - as measured by the pycnometer method or equivalent

Vomicil, J.A., 1965. Porosity, in Methods of Soil Analyses, C.A. Black (ed), Agronomy No. 9, 229-314, Amer. Socs. Agron., Madison Wisconsin.

5. Organic Matter Content. For three(3) representative samples in the borehole, the organic matter content will be determined. The dry combustion method will be used to calculate the organic matter content as outlined in the California Site Mitigation Decision Tree prepared by the Department of Health Services.

6. Specific Gravity. For three(3) representative samples in the borehole, the specific gravity will be determined utilizing ASTM D-854.

7. Soil Pore-Liquid Content. The soil pore-liquid content will be obtained every 20 feet in boreholes designated for bedrock monitoring wells. A quick draw tensiometer by Soilmoisture Equipment Corporation or equivalent will be used as follows:

   1) Immediately after the core barrel has been brought to the surface, a coring tube is inserted into the open end of the core barrel.

   2) The tensiometer is then inserted into the core barrel and allowed to reach equilibrium with the soil suction.

   3) After equilibrium has been achieved, the soil pore-liquid content shall be determined. Since 10 to 30 minutes may be required for equilibrium, multiple core barrels shall be used so that drilling progress is not impaired.

H. Comprehensive Safety Plan

Prior to the start of construction, a written comprehensive safety plan to be implemented during the project will be submitted to the Districts for approval. The safety plan will protect workers from potential hazards during construction and other activities included in this project. The safety plan will generally follow CAL/OSHA regulations, but more specifically the regulations in 29 CFL Part 1910 Paragraph (O), and will include the use of standard ambient monitoring equipment such as photo ionization detectors, organic vapor analyzers, etc., and the use of Level "D" protective equipment. The safety plan will include identification of a Health and Safety Officer whose responsibility will be to administer the health and safety aspects of the drilling program. The plan will generally include all the approprite categories defined in 20 CFR Part 1910 including, but not limited to:

a. Site characterization

b. Training

c. Medical surveillance

d. Engineering controls

e. Work practices and site controls

f. Personnel protective equipment

g. Monitoring (including use to TWA's and evaluation of TLV's, PEL's and REL's)

h. Worker information and notification

i. Special handling of drilling spoil

j. Decontamination procedures

k. Emergency response

A copy of the Health and Safety Program prepared by J. H. Kleinfelder and Associates for the well installation and sampling has been included as Appendix 11.

Fracture Criteria

Fracture Description	Spacing of Fractures
Intensely Fractured (crushed)	Less than 2 inches
Highly Fractured	2 inches to 1 foot
Moderately Fractured	1 foot to 3 feet
Slightly Fractured	3 feet to 10 feet
Massive	Greater than 10 feet

3) Fracture Condition. The fracture surfaces will be exposed by the geologist by breaking open the rock during sampling. In this manner the spacing, the degree of tightness, and the "roughness" or "smoothness" of the fracture will be determined.

For separation of the fracture walls, the following criteria will be used:

Fracture Separation Criteria

Description	Separation in Millimeters
Closed	0
Very Narrow	0-0.1
Narrow	0.1-1
Wide	1-5
Very Wide	5-25+

As with fracture separation, the smoothness or roughness of the fractures could have a bearing on the ability of the fracture to transmit water. Rough fracture surfaces indicate irregular breaks whereas smooth surfaces indicate clean breaks. Clean breaks provide a freer flow path for pore water compared to rough breaks.

The amount of fracture filling could also have a bearing on the ability of the fracture to transmit water. The criteria for fracture filling is:

Description	Definition
Clean	No fracture filling
Stained	Discoloration of fracture
Filled	Fracture filled with recognizable material

4) Moisture Content of the Bedrock. The moisture content of the bedrock will be described by the geologist as dry, damp, moist, wet or saturated. It is important to know the moisture content of the bedrock because when the interstices are filled and can accept no more moisture (i.e. they are saturated), the water will move under a driving hydrostatic head.

5) Presence of Wetted Bedrock Fractures. Should the presence of wetted bedrock fractures be detected, the geologist will note them in his logs.

This information will be useful in determining the ability of the fractures to transmit water.

6) Degree of Induration. Induration has been defined as the process of hardening sediments through cementation, pressure, heat, or other causes. The degree of induration could affect the permeability and porosity of bedrock material and should be noted by the geologist.

C. Geophysical Logging

Geophysical logging methods will be used during the investigation as additional subsurface information is required and the techniques prove successful in gathering meaningful data. The geophysical technique or techniques to be used in the boreholes will be determined by the type of borehole (alluvial or bedrock) and any additional information that is needed. The geophysical methods that have been selected for this project are as follows:

1. Velocity Logging. Sonic logging will be used to correlate data, show changes in lithologic character, and reveal possible fault contacts. Sonic logging will be conducted in bedrock boreholes.

2. Neutron-Neutron Logging. Neutron-neutron logging will be used in all holes to determine porosity, correlate lithology, and record the moisture content of the geologic materials. In all boreholes, the Contractor will install temporary casing in which to run the neutron-neutron log.

3. Downhole Video Camera. In bedrock wells, a downhole camera will be used to determine lithology, bed thickness, and source and movement of water in the borehole.

4. Caliper Logging. In bedrock wells, caliper logging will be used to determine the diameter of the borehole and estimate quantities of materials to be used.

Per Section 3.4.11 of the DOHS Decision Tree Manual, the use of geophysical surveying in boreholes has been well documented in many landfill investigations. To ensure that the geophysical data collected provide reliable information to be used in the correlation process, the raw data will be documented in a final report. The equipment sensitivity, accuracy, limits of detection, and calibration methods will also be provided. The report will include a summary of the results including unqualified or rejected data and reasons. The results of the geophysical data collection will be reviewed with the RWQCB.

D. Soil and Water Sampling Procedures

Following are discussions on water and soil sampling to be conducted by the Sanitation Districts' contractor (J. H. Kleinfelder and Associates) during drilling, and water sampling methods following monitoring well installation. Both soil samples and samples of the first fracture water encountered while drilling will be collected. In order to minimize cross-contamination between holes, decontamination procedures such as found in Section 3.4.9d of the DOHS Decision Tree Manual will be employed. These procedures include the cleaning of all bits, drill stems, augers, or other equipment after drilling at each location by steam cleaning using potable water.

1. Soil Sampling Procedures

In each of the boreholes, during drilling, a Pitcher tube, Shelby tube, California Modified Sampler, or core barrel as appropriate will be used to obtain undisturbed samples. Samples for the alluvial wells are to be taken at every five foot interval or change in soil or lithology, whichever comes first. The bedrock wells will be continuously cored using a core barrel. A portion of the samples from each hole are to be laboratory tested under the provisions of the tests required in Subsection G.

A portion of each soil sample from the drive tube or core barrel will be screened at 5 foot intervals for volatile organics present using the procedures as outlined in the United States Environmental Protection Agency Volatile Organic Screening - Soil and Sediment or an approved equivalent method. The instrumentation for screening will include the use of the Photovac Model 10S-50. Instrumentation to be used will be submitted to the Sanitation Districts for approval including make, model, sensitivity, and other information as required. The Photovac unit will be onsite at all times during drilling. The operator will have previous experience on jobs involving hazardous waste sites. Each instrument will have a backup unit on call. The volatile organics to be screened for will include, but not be limited to, the following:

Benzene
Carbon Tetrachloride
Chlorobenzene
Chloroform
1,2 Dichlorobenzene
1,1 Dichloroethane
1,2 Dichloroethane
Methylene Chloride
Methyle Ethyl Ketone
Tetrachloroethylene
Toluene
1,1,1-Trichloroethane
Trichloroethylene
Vinyl Chloride

Field instrumentation will be calibrated on a daily basis with Laboratory Standards. A hard copy printout of each screening will be kept and submitted to the Sanitation Districts as part of the contractor's final report. In all of the boreholes, duplicate samples will be obtained for chemical analysis. One(1) sample will immediately be packed in ice and stored until it is transported to the laboratory or disposed of as directed by the Sanitation Districts. The second corresponding sample will be packed in ice until it is screened for VOC's with the Photovac. Each screened soil sample will be placed into a borosilicate glass sample jar with a mechanically crimped teflon-lined cap or equivalent. As each sample is tested for VOC's present, a statistical analysis of the daily data for that hole will be performed to include mean VOC value and standard deviation. At the end of the day, those samples with VOC values screened above one sigma (standard deviation value) for a particular volatile organic compound will be kept on ice and taken to a laboratory as identified in Subsection F for analysis by EPA method 8010 or 8240 within 24 hours. Proper chain of custody controls as outlined in Subsection E will be followed. The samples will be labeled with the following minimum information:

a. Sample identification number.

b. Boring number.

c. Depth sample taken.

d. Name of collector.

e. Date and time of collection.

f. Place of collection.

g. Parameters requested.

h. Internal temperature of storage container at time sample was placed.

i. Maximum and minimum temperature range that occurred during storage and shipment.

Blanks will be run on regular daily intervals to check accuracy. This information is to be duplicated in the logbook identified in Subsection E.

If cores have been taken, the cores will be stored in reinforced cardboard core boxes. The core boxes are to be labeled with the date, well number, and depth range of cores. Pictures will be taken of each core with prints, slides, and negatives turned over to the Sanitation Districts.

Drive samplers, core barrels, and other field equipment used to handle the soil shall be decontaminated after each use according to the procedures outlined previously.

2. Water Sampling Procedures

a. "First Water" Sample. During drilling, the first saturated zone that is encountered will be sampled. Drilling will be stopped so that a sample can be retrieved for screening. The water sample will be taken with a fluorocarbon resin or stainless steel sampler connected to a stainless steel or teflon coated line. Water samples for screening will be placed in a 180 ml brown tinted borosilicate glass vial or equivalent with fluorocarbon resin lined septa in a headspace free condition. The headspace in the vial will be screened according to the United States Environmental Protection Agency VOA Screening Procedure or an approved equivalent method. The compounds to be screened are as identified in this Subsection. If any of the screened compounds are detected by the field instrumentation a sample will be sent to the laboratory for analysis. If no VOC's are detected, the sample will be sent to the laboratory for confirmation analysis.

In addition, first water samples will be analyzed and recorded onsite using field methods to determine the following information:

Depth to water
Air temperature
Water temperature
Dissolved Oxygen (mg/l O_2)
Conductivity (umhos/cm)
Color
Odor
pH
Total Alkalinity
Redox potential
Dissolved Carbon Dioxide
H_2S (ppm)
Sample number and well number
Date
Person conducting the field analysis

Calibration of any in-situ monitoring equipment or field test probes and kits will be performed prior to each use according to the manufacturers recommendations and according to the United States Environmental Protection Agency Test Methods for Evaluating Solid Waste - Physical/Chemical Methods (SW-846), 2nd Edition, 1982.

Field instrumentation specifications will be submitted to the Sanitation Districts for approval prior to use.

b. Water Sample Collection of Completed Monitoring Wells. Following the development and completion of installation of each monitoring well, a water sample will be retrieved for analysis. Prior to sampling, the well will be evacuated with a positive-gas-displacement fluorocarbon resin bladder pump to remove stagnant water in the well and filter pack and replace it with formation water. The procedures for well evacuation will use as a basis the hydraulic yield characteristics of the well. When evacuating low-yield wells (wells that are incapable of yielding three casing volumes) the wells will be initially evacuated to the bottom of the screened interval. As soon as the well has recovered sufficiently, an initial water sample will be taken and tested for pH, temperature, and conductance to establish initial readings. The well should be allowed to fully recover with additional water samples taken every 30 minutes and field tested. The well will be purged and samples taken every 30 minutes and field tested until the sample water test variables (pH, temperature, etc.) reach equilibrium. If full recovery exceeds two hours, the sample should be extracted as soon as sufficient volume is available. At no time will a well be pumped to dryness if the recharge rate causes the formation water to vigorously cascade down the sides of the screen. For higher yielding wells, the removal of three well volumes prior to the collection of a sample will be required.