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Draft
Remedial Investigation and
Feasibility Study
Sampling and Analysis Plan

For

Fresno Sanitary Landfill
Fresno, California

Prepared For:

City of Fresno
2326 Fresno Street
Fresno, California 93721

Prepared By:

Camp Dresser & McKee Inc.
100 Pringle Avenue, Suite 300
Walnut Creek, California 94596

January 1991

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Section One

1.1 INTRODUCTION

This Sampling and Analysis Plan (SAP) has been prepared by Camp Dresser & McKee Inc. (CDM), as a requirement of the ongoing Remedial Investigation/ Feasibility Study (RI/FS) for the Fresno Sanitary Landfill (FSL) site. The City of Fresno (City) is conducting the RI/FS on the FSL site at the request of the U.S. Environmental Protection Agency (EPA) to investigate the nature and extent of contamination at the FSL site, to assess the potential risk to human health and the environment, and to develop and evaluate potential remedial alternatives. Overall guidance for the RI/FS process is provided by the project Work Plan, which has been prepared by CDM and previously submitted to EPA. The Work Plan describes all RI/FS tasks which are required to fulfill EPA guidance for site assessment. In contrast, the SAP provides a mechanism for planning field activities and consists of a Field Sampling Plan (FSP) component and a Quality Assurance Project Plan (QAPP) component.

The field sampling plan described in this document has been designed to address the activities involved in sampling and data gathering for the FSL field program. In addition, the SAP includes a Quality Assurance Project Plan (QAPP), which contains quality assurance and quality control protocols. The SAP has been prepared in accordance with appropriate EPA guidance documents.

1.2 PROJECT ORGANIZATION

The FSL RI/FS project organization is shown in Figure 1-1. Key personnel and their respective responsibilities for the implementation of the FSL RI/FS are identified below.

- . Mr. John Mitchell - City of Fresno (City) Environmental Program Manager.
- . Mr. George Slater - City of Fresno (City) Project Manager.

- . Mr. Bret Moxley - EPA Remedial Project Manager (RPM). As stated in the FSL Consent Decree, EPA will be performing the risk assessment for the FSL site.
- . Mr. John Burgh - CDM Officer-in-Charge, responsible for meeting overall project objectives.
- . Mr. Wayne Pickus - CDM Project Manager, responsible for day to day management and communication with the City of Fresno (City). Mr. Pickus will also be responsible for directing engineering and scientific efforts in the development of the FS report.
- . Ms. Sara Black - CDM Project Hydrogeologist. As the FSL Project Hydrogeologist, Ms. Black will be responsible for implementing and supervising the RI field programs.
- . Ms. Laurie Mann - CDM Quality Assurance and Quality Control (QA/QC). Ms. Mann is responsible for QA/QC development and reporting activities for the project.
- . Technical Review - The CDM technical review committee will be responsible for reviewing all deliverables prior to their submission to the regulatory agencies.
- . Field Personnel - CDM field personnel are responsible for data collection activities under the RI field programs.

1.3 OBJECTIVES OF THE SAMPLING AND ANALYSIS PLAN

The objectives of the SAP are to ensure that sample collection and analytical activities are performed in accordance with EPA criteria and technically acceptable protocols. The SAP describes the data collection methods, field procedures, analytical methods, and data quality objectives for all environmental investigations performed under the RI/FS for the FSL. The following sections describe the specific objectives of the field sampling plan component and the Quality Assurance Project Plan (QAPP) component of the FSL SAP.

1.3.1 Objectives of the Field Sampling Plan

The specific objectives of this field sampling effort are as follows:

1. Determine the pathways of subsurface migration of landfill gas.
2. Define the extent of off-site migration of the landfill gas.
3. Refine the hydrogeologic characteristics of the site.

4. Determine the extent of groundwater contamination.
5. Continue to monitor water quality of residential wells.
6. Determine impact of subsurface gas on ambient air quality.
7. Determine extent of off-site soil contamination.

In order to achieve these objectives, a number of field investigations are proposed and described in this SAP. These field activities include a soil gas investigation, a hydrogeologic investigation, a groundwater investigation, a residential well sampling program, an air investigation, and a surface and subsurface soil investigation. The results of these investigations will be incorporated into the Fresno Sanitary Landfill RI/FS.

1.3.2 Objectives of the Quality Assurance Project Plan (QAPP)

The objectives of a QAPP is to ensure that data collected during an RI/FS investigation is scientifically valid, are of known quality which meets established objectives, and are legally defensible, if necessary. The most important section of a QAPP are the Data Quality Objectives (DQOs) which are quantitative and qualitative statements of the type of data needed to support a decision, based on the level of uncertainty that a decision-maker is willing to accept and the resources available. DQOs for each field investigation are discussed in subsequent sections.

1.4 ORGANIZATION OF THE SAMPLING AND ANALYSIS PLAN

This document describes the specific quality assurance and field sampling procedures for each investigation described in Section 1.3.1. Each task discussed in Sections 4 through 10 is divided into three subsections consisting of data quality objectives (DQOs), sampling rationale, and analytical and quality control procedures. In this manner, both the FSP component and QAPP criteria are addressed for each investigation presented in this report, as recommended by EPA guidance.

The site history is presented in Section 2.0. All figures are contained in Section 3.0. Section 4.0 presents DQOs, sampling rationale, and analytical and quality control procedures for the soil gas investigation. The same

format is then followed for Section 5.0 - Hydrogeologic Investigation, Section 6.0 - Groundwater Investigation, Section 7.0 - Residential Well Sampling, Section 8.0 - Surface and Subsurface Soil Investigation, Section 9.0 - Ambient Air Sampling, and Section 10.0 - RI Derived Waste.

Section 11.0 presents field methods and procedures, and Section 12.0 discusses data quality management. Finally, Section 13.0 describes quality assurance oversight, and Section 14.0 presents the Site Health and Safety Plan.

Section Two

2.1 SITE LOCATION AND HISTORY

The Fresno Sanitary Landfill (FSL) is located four miles southwest of the City of Fresno in Fresno County, California, as depicted in Figure 3-1. The landfill consists of approximately 145 acres and is bounded on the north by Jensen Avenue, on the east by West Avenue, on the south by North Avenue and the west by agricultural fields. The area surrounding the landfill is primarily agricultural with several residences adjacent to the north and south boundaries.

The FSL is owned and was operated by the City of Fresno as a Class III municipal landfill, as defined in the current California Code of Regulations, Title 23, Chapter 3, subchapter 15 (Discharge of Waste to Land). The FSL is reported to be the oldest compartmentalized municipal landfill in the Western United States (CH2M Hill, 1989). Operations began in the north section of the landfill in 1937. Short trenches were dug to a depth of 3 feet (eventually increased to a depth of 25 feet); waste was dumped into the trench by collection trucks, the pile was leveled off and compacted; a second trench was dug adjacent to the first trench, and the dirt from the second trench was used to cover the waste fill. The landfill area was never lined.

According to the FSL Closure and Post-Closure Maintenance Plan prepared by Emcon in December 1989, from 1937 to 1964 the landfill received only domestic wastes from various sources. From 1964 until the site closed in 1989, the landfill received only municipal wastes collected by the City. The average waste stream consisted of 16,500 tons per month; the total waste quantity is approximately 4.7 million tons (assuming an in-place refuse density of 1,200 lbs/cubic yard), or 7.9 million cubic yards (Emcon, 1989). According to Emcon's report, the landfill accepted approximately 500 pounds per day of waste from local convalescent homes and the Fresno Dialysis Center, with approval from the County Health Department. The time periods that these wastes were received is not known.

At the time of its inception, the landfill was primarily located north of Annadale Avenue. The depth of the landfill was approximately 10 to 15 feet below the surrounding terrain. The City expanded the landfill to the south of Annadale in 1945. Prior to this expansion an irrigation canal extended in an east-west direction through what is now the south portion of the landfill. After expansion, this canal was replaced with a pipeline that is currently in use and is covered by landfill material. In June 1984, the edge of the pipeline was excavated and a video camera was drawn through the pipeline to check the pipe's integrity. This effort showed that the pipe sagged considerably. This sag is probably due to ground settling from the weight of the landfill overburden.

The City began the process of closing the landfill by filing a Negative Declaration with the California Regional Water Quality Control Board (RWQCB) in August 1981. The FSL was first evaluated by the Superfund program as a result of a CERCLA Section 103 (c) notification filed by the City of Fresno Solid Waste Management Division on May 27, 1981. The California Department of Health Services (DOHS) conducted a preliminary inspection of the site in June 1984 in response to complaint letters from nearby residents. The Preliminary Assessment determined that off-site migration of methane gas and a variety of volatile organic chemicals in the groundwater had been documented.

The problem of methane gas was first identified in June 1983, when the Fresno City Public Works Department and the County Health Department conducted a preliminary investigation using portable equipment. A methane monitoring system consisting of 17 methane monitoring wells have since been installed. In November 1984, the City installed methane migration barriers along the northern and southern boundaries of the landfill. The barriers are trenches 26 feet deep containing a vertical sheet of plastic and filled with rock, which have two horizontal perforated PVC pipes at depths of 12 and 19 feet which vent passively to the surface.

Groundwater monitoring efforts have included sampling domestic-private, irrigation, and monitoring wells near the landfill. Sampling has been conducted by the City, DOHS, and the RWQCB. Samples have been analyzed for general mineral constituents, physical parameters, anions/cations, trace

metals, EPA Method 601 and 602-volatile organics (VOCs), and pesticides. VOCs are reported to be in the shallow aquifer at levels reported to be in excess of ARARs (CH2M Hill 1989).

Most recently EPA's Technical Assistance Team has sampled soil gases beyond the methane barriers for VOCs including vinyl chloride. Recent data show that methane and other VOCs have migrated past the methane barrier on the south of the landfill. Additional information on the extent of contamination at the FSL site is discussed in Section 2.3.

2.2 SITE CHARACTERISTICS

2.2.1 Climate and Meteorology

The Fresno Sanitary Landfill (FSL) site is situated in the eastern San Joaquin Valley. Coastal mountain ranges to the west insulate the valley from the cooling effects of the Pacific Ocean. Thus, the area is subject to hot dry summers and moderate winters. Average monthly temperature extremes range from 36.3°F in December to a high of 97.9°F in July (EMCON, 1989).

The rainfall in the San Joaquin Valley is sparse. The State of California Department of Water Resources (DWR) reports a maximum annual precipitation of 19.14 inches recorded in 1969 at the Fresno weather station, located 8 miles northeast of the FSL. Average annual precipitation recorded from 1951 through 1980 at the Fresno station is 10.52 inches, 90 percent of which normally occurs between November and April. DWR has reported a mean annual precipitation at the FSL of approximately 9.5 inches (Emcon 1989).

The nearest wind monitoring station is at Chandler Field, located approximately 2 miles north of the landfill. The prevailing wind is reported to be from the northwest.

2.2.2 Regional Geology and Hydrology

The FSL is situated on the east side of the San Joaquin Valley. The San Joaquin Valley comprises the southern half of the Great Valley or Central

Valley of California, named for the river which drains it. The Central Valley is a large elongate northwest-trending asymmetric structural trough that has been filled with a thick sequence of sediments, in some areas up to 60,000 feet thick (Hackel, 1966). In the Fresno vicinity, granitic and metamorphic rocks of the Sierra Nevada foothills, which extend beneath the Central Valley, are found at a depth of about 4,500 feet.

In the vicinity of Fresno, the near-surface geologic units include Older Alluvium of Quaternary age, which extends to a depth of about 500 feet, according to Page and LeBlanc, 1969 (as referenced by EAS, 1988). There are also less extensive deposits of Younger Alluvium, flood-basin deposits, and sand dunes on the valley floor. These unconsolidated materials are underlain by undifferentiated continental deposits of Quaternary age, which overlie granitic basement. The Older Alluvium, which underlies the FSL, consists of interbedded layers and lenses of clay, silt, sand, and gravels, which increase in thickness and decrease in grain size toward the west or center of the valley, away from the source area of the Sierra foothills.

The Older Alluvium is the principal groundwater aquifer in the Fresno area, according to Page and LeBlanc, as reported in ESA (1988), groundwater beneath Fresno is unconfined. Regionally confined groundwater does not occur in the vicinity of the FSL, apparently because regional confining clay layers, such as the Corcoran Clay found in the central part of the Great Valley, do not extend eastward as far as Fresno.

Existing hydrogeologic data do not indicate any well-developed, continuous aquifers or aquitards at discrete depths. However, previous site investigators have identified three general hydrostratigraphic units: shallow, intermediate, and deep. These units do not appear to correspond to specific aquifer zones as permeable sand units, but were apparently selected for well completion intervals in order to vertically characterize what appears to be a single interconnected aquifer system.

In general, groundwater flow is from east to west, away from the foothills and toward the valley axis. However, ESA (1988) reports that pumping

depressions near the City of Fresno and to the west locally influence the direction of groundwater movement. At the FSL, groundwater flow is generally westward. USGS also reported that the permeability of the aquifer is between 1 and 3 feet per day, which yields an anticipated groundwater flow rate (disregarding irrigation pumping) of 1 foot per year (BSK 1987).

According to the County of Fresno Water Resources Management Plan, the Fresno area has been in a state of overdraft which has been reflected in a continuously falling water table. Hydrographs constructed with data from 1924 to the mid-1960's show a drop of 50 to 60 feet in the shallow groundwater table during that time period. The Water Management Plan indicates that groundwater levels in 1978 had fallen to the lowest level in recorded history but since that time, there has been a slight upward trend in the area (Emcon 1988).

2.2.3 Surface Water and Drainage

The surrounding terrain in the vicinity of the Fresno Sanitary Landfill is flat and contains large areas of surface-irrigated agricultural land. It is reported that previous ponding problems have occurred near the landfill. BSK (1987) reported that drain water accumulated near the landfill particularly on the north end of the western side.

The area along West Avenue, where Annadale Avenue would intersect, also is reported to have poor drainage during major precipitation events (BSK, 1987).

Finally, the Fresno Colony Canal passes in close proximity to the landfill. It is located east of West Avenue.

2.3 HISTORY AND EXTENT OF CONTAMINATION

Previous investigations of the FSL site found that groundwater beneath the site exhibited elevated concentrations of volatile organic compounds (VOCs). The extent of groundwater contamination was documented beyond the landfill boundary both up and downgradient of the site. Also reported in previous investigations was the presence of methane gas beneath the

landfill surface. The methane gas was reported to have migrated offsite to the east and west of the site affecting nearby vineyards.

Twenty four monitoring wells (13-shallow, 5-intermediate, and 5-deep) have been installed at the FSL site. Also, 10 private wells (5-intermediate, 5-deep) located on the north and south perimeter of the landfill have also been monitored. The location of each well or well cluster is shown on Figure 3-2 in Section 3.

Between 1974 and 1990 the monitoring and private wells were sampled and analyzed for various constituents including VOCs, pesticides, metals, and water quality parameters. The existing analytical data on the FSL site indicate that volatile organic compounds (VOCs), namely trichloroethene (TCE), tetrachloroethene (PCE), vinyl chloride (VC), and dichlorodifluoromethane (CCl_2F_2) were consistently detected in groundwater samples collected from on-site wells. With the exception of CCl_2F_2 , the level of these compounds detected in the groundwater of the site present a potential human health risk as reflected by their maximum contaminant level (MCLs). The MCLs for TCE, PCE, and VC are 5, 2, and $0.5 \mu\text{g}/\text{l}$, respectively. Figures 3-3, 3-4, and 3-5 in Section 3.0 show the concentrations of the above four compounds, as well as other VOCs detected in the shallow, intermediate, and deep wells. A complete analytical data summary is included in the RI/FS Work Plan.

Figure 3-3 shows the shallow well locations at the FSL site and presents existing analytical data on the VOC compounds of interest. A review of the data shows that the reported VOCs have been found at concentrations exceeding MCLs both up and downgradient of the FSL site. Some of the highest concentrations are reported for wells MW-1, W-4, DW-1A, and EW-1, located downgradient of the FSL site.

Figure 3-4 shows the intermediate monitoring well locations and selected private wells, and presents existing data on the four VOC compounds. A review of the data shows that the reported VOCs have been found at concentrations exceeding MCLs both up and downgradient of the FSL site. However, the concentrations reported are lower than those reported in the

shallow wells. Again the highest concentrations are found in wells located on the downgradient or western perimeter of the landfill.

Figure 3-5 shows the deep well locations and presents existing data on the VOC compounds reported on the figure. Private wells are also reported on the figure. A review of the data shows that the VOC concentrations are lower than those found in both the intermediate and shallow wells. Also, only PCE and CCl_2F_2 are detected in the private wells, located to the north and south of the site; TCE and VC are not detected in the deep-private wells. For the upgradient deep wells UW-1C and UW-2C, no VOCs were detected in the 1990 data. However, VC, TCE, and PCE and were detected in these wells in 1989, with VC the only compound exceeding its MCL.

A review of VOC data collected and analyzed between 1974 and 1990 for all the wells reported on Figures 3-3, 3-4, and 3-5 shows that other VOC compounds besides the ones reported in the figures have been detected in the wells on and near the FSL site. The compounds, namely dichloroethylene (DCE), dichloroethane (DCA), dichloropropane (DCPA), dichloropropene (DCPE), dichlorobenzenes (DCBS), trichlorofluoromethane, and methylene chloride have been reported at concentrations above instrument detection limits.

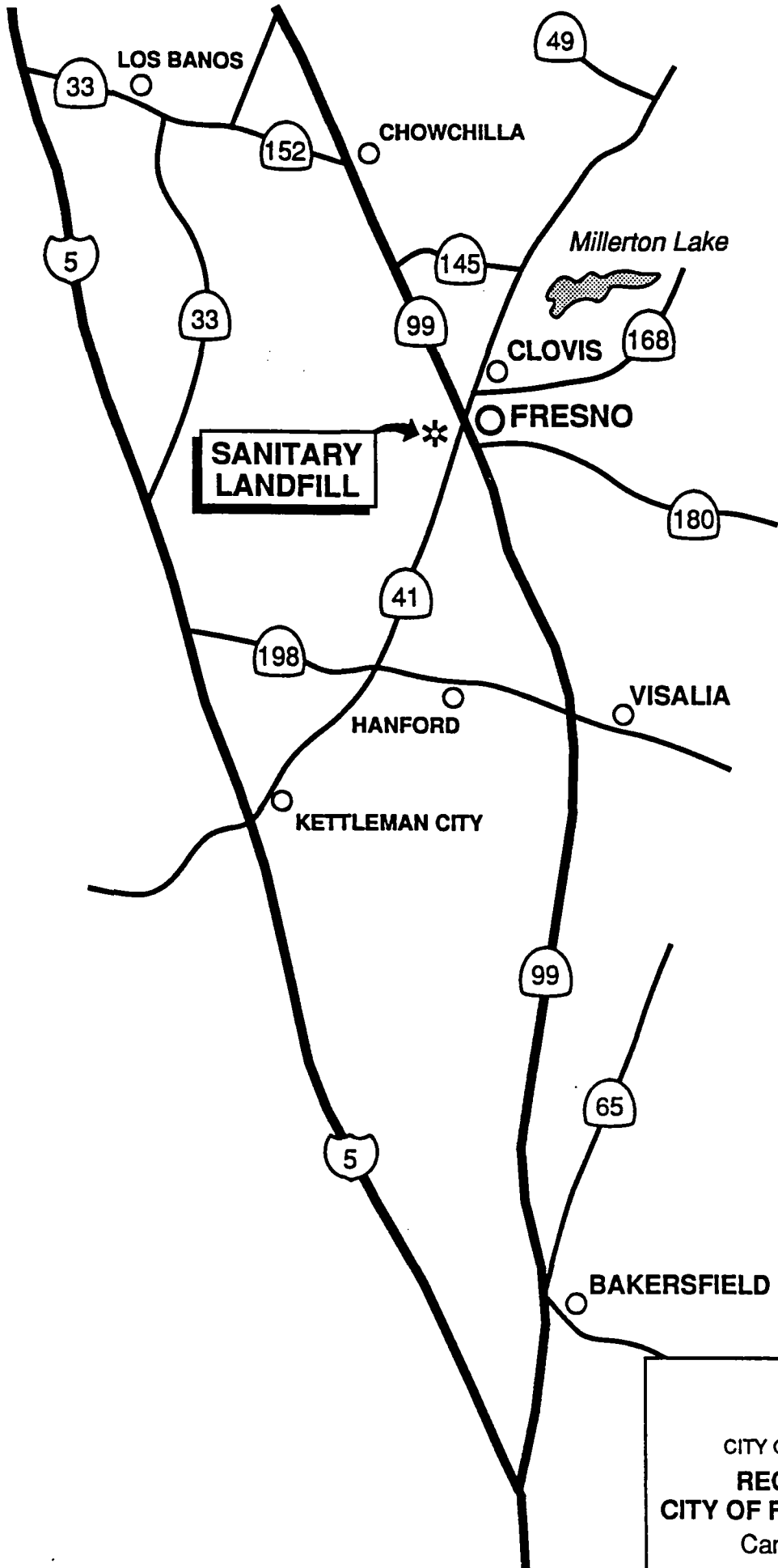
Also, existing analytical data on the FSL site show a number of purgeable aromatic compounds detected above instrument detection limits. These compounds include benzene, chlorobenzene, 1,2-dichlorobenzene (1,2-DCB), and 1,4-dichlorobenzene (1,4-DCB). Benzene was detected in wells OW-1 and EW-1 at concentrations exceeding its MCL of $1 \mu\text{g}/\text{l}$. The MCL for 1,4-dichlorobenzene is $75 \mu\text{g}/\text{l}$. This compound was detected in well DW-1B, DW-2A, and W-2 at concentrations below 1 ppb. Existing analytical data on the FSL site for pesticide compounds show no pesticides were detected above instrument detection limits.

There is limited available groundwater analytical data for metals. A number of metals were detected below MCL levels. These metals include arsenic, barium, fluoride, selenium, lead, and zinc. Nitrate was the only compound detected above MCLs. Private wells 1304 Jensen and 2121 Jensen are reported to have nitrate concentrations in excess of the MCL standard

(45,000 $\mu\text{g}/\text{l}$). In addition, monitoring wells W-2 and W-4 also had nitrate concentrations exceeding MCLs. Previous investigations have attributed the nitrate levels to the extensive agriculture in the vicinity of the FSL site.

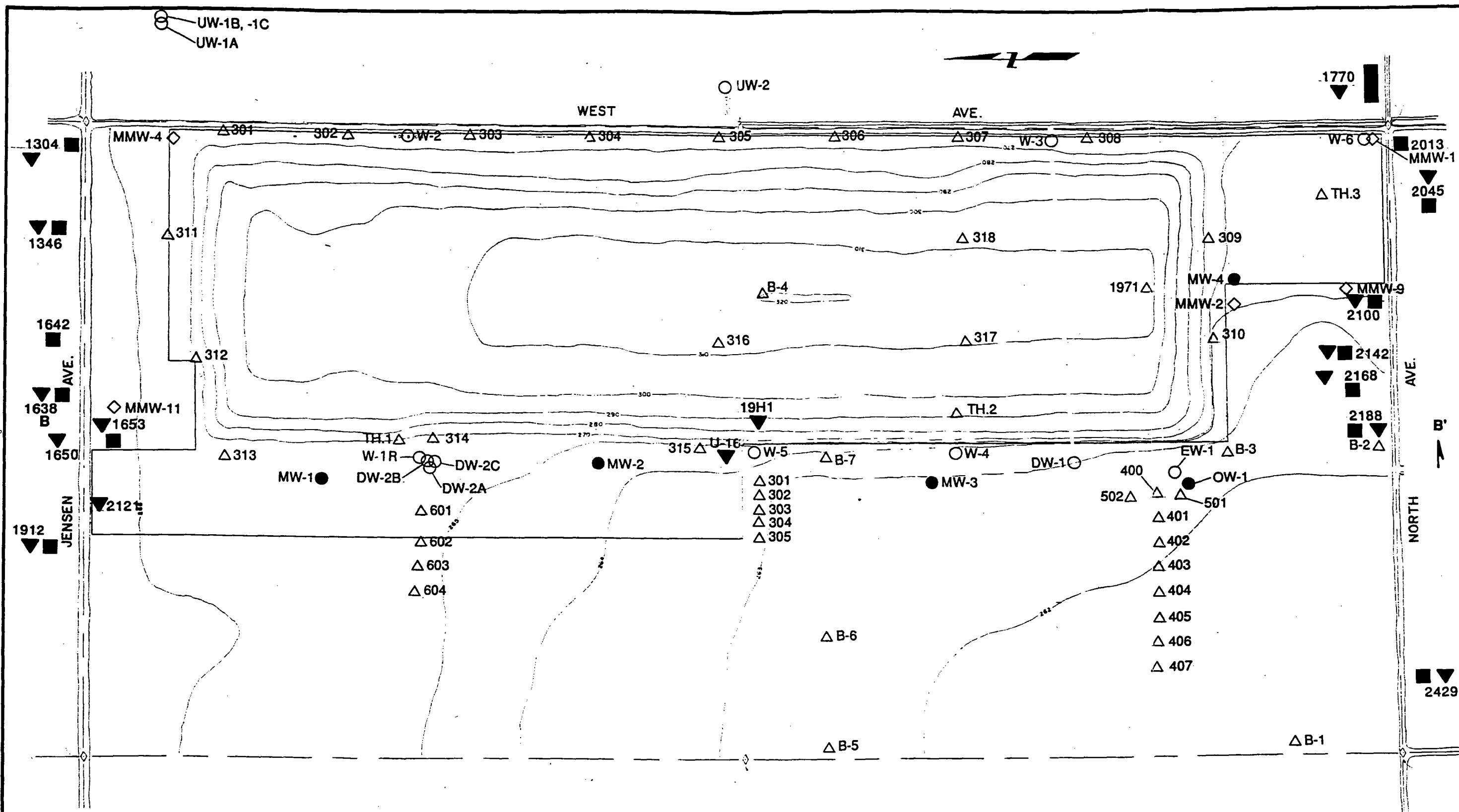
Finally, existing groundwater analytical data for general water quality parameters show a general trend of higher dissolved solids (TDS) and hardness values in shallow wells than in the deep wells. The pH levels ranges from 6 to 8 for the majority of monitoring wells sampled. Also, iron is detected above its secondary MCL of 300 $\mu\text{g}/\text{l}$ (0.3 mg/l) in a number of monitoring wells.

Section Three



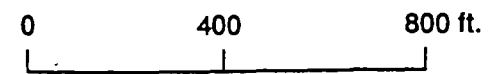

 north
 not to scale

Figure 3-1
 CITY OF FRESNO SANITARY LANDFILL
REGIONAL MAP SHOWING
 CITY OF FRESNO SANITARY LANDFILL
 Camp Dresser & McKee Inc.



LEGEND

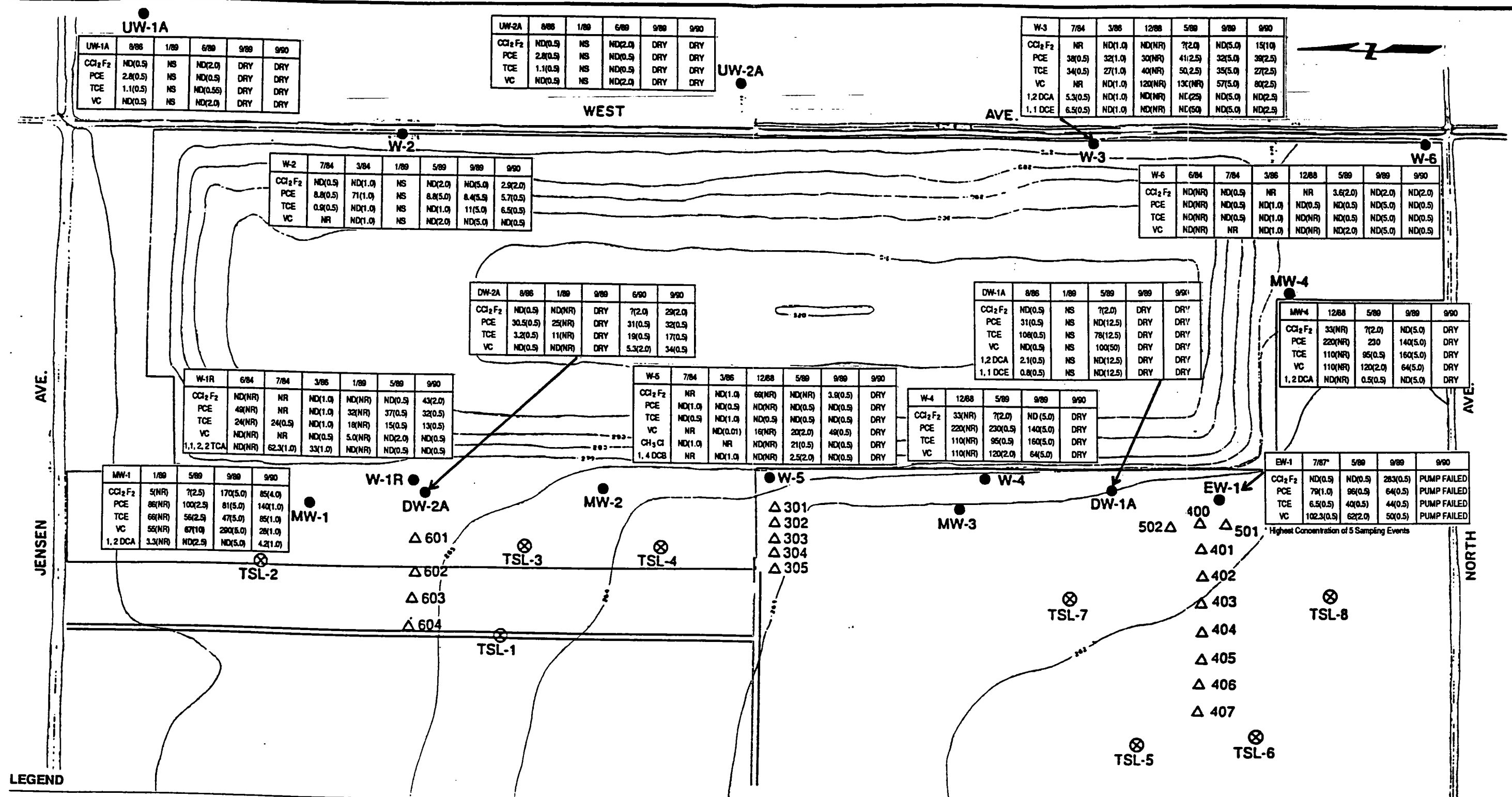
- Ground-water monitoring well established during ESA investigation
- Ground-water monitoring well established by others
- ◇ Methane monitoring well established by others
- ▼ Approximate locations of private wells
- △ Sealed test boring by others (approximate location)
- Approximate location of private residence



Base map and locations of existing wells from City of Fresno Department of Public Works, June 1988. Original map scale is 1 in. = 200 ft.

Figure 3-2
CITY OF FRESNO SANITARY LANDFILL
SITE LOCATION MAP
 Camp Dresser & McKee Inc.

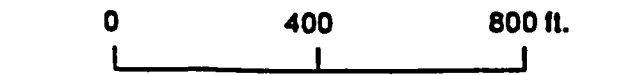
Reference: ESA, 1989



LEGEND

CCl ₂ F ₂	Dichlorodifluoromethane	MCL = None	ND	Not Detected at Indicated Detection Level
CH ₃ Cl	Chloromethane	MCL = 2ug/l	NR	Not Reported
1, 2 DCA	1, 2 Dichloroethane	MCL = 0.5ug/l	NS	Not Sampled
1, 1 DCE	1, 1 Dichloroethene	MCL = 6ug/l	()	Method Detection Level
1, 4 DCB	1, 4, Dichlorobenzene	MCL = 75ug/l	?	Undetermined Concentration
PCE	Tetrachloroethene	MCL = 2ug/l	●	Groundwater Monitoring Well by ESA
TCE	Trichloroethene	MCL = 5ug/l	⊗	Temporary Sampling Locations by ESA
VC	Vinyl Chloride	MCL = 0.5ug/l	△	Temporary Sampling Locations by BSK

Note: Concentration of Compounds Reported in ug/l (ppb)



Notes: Numerous methane monitoring wells exist within landfill boundary (not shown).

Base map and locations of existing wells from City of Fresno Department of Public Works June 1988. Original map scale is 1 in. = 200 ft.

Figure 3-3
CITY OF FRESNO SANITARY LANDFILL
DATA SUMMARY OF
SHALLOW WELL LOCATIONS
(UP To 70 Ft.)
 Camp Dresser & McKee Inc.

Reference: ESA, 1988

● UW-1B

UW-1B	8/88	1/89	5/89	9/89	9/90
CCl ₂ F ₂	ND(0.5)	ND(NR)	ND(2.0)	ND(0.5)	ND(2.0)
PCE	ND(0.5)	ND(NR)	ND(0.5)	ND(0.5)	ND(0.5)
TCE	ND(0.5)	ND(NR)	ND(0.5)	ND(0.5)	ND(0.5)
VC	ND(0.5)	7.1(NR)	ND(2.0)	ND(0.5)	ND(0.5)

● UW-2B

UW-2B	8/88	1/89	5/89	9/89	9/90
CCl ₂ F ₂	ND(NR)	ND(NR)	7(0.5)	ND(0.5)	21(2.0)
PCE	ND(NR)	ND(NR)	ND(0.5)	ND(0.5)	ND(0.5)
TCE	ND(NR)	ND(NR)	ND(0.5)	ND(0.5)	ND(0.5)
VC	ND(NR)	7.1(NR)	3.5(2.0)	33(0.5)	2.5(0.5)

1770 NORTH

1770 NORTH	5/89
CCl ₂ F ₂	ND(2.0)
PCE	ND(0.5)
TCE	ND(0.5)
VC	ND(2.0)

1346 JENSEN

1346 JENSEN	4/88	5/89
CCl ₂ F ₂	ND(1.0)	ND(2.0)
PCE	ND(1.0)	ND(0.5)
TCE	ND(1.0)	ND(0.5)
VC	ND(1.0)	ND(2.0)

1642 JENSEN

1642 JENSEN	4/88	5/89
CCl ₂ F ₂	ND(1.0)	ND(2.0)
PCE	ND(1.0)	ND(0.5)
TCE	ND(1.0)	ND(0.5)
VC	ND(1.0)	ND(2.0)

1912 JENSEN

1912 JENSEN	5/89
CCl ₂ F ₂	ND(2.0)
PCE	ND(0.5)
TCE	ND(0.5)
VC	ND(2.0)

DW-2B

DW-2B	8/88	1/89	5/89	9/89	9/90
CCl ₂ F ₂	ND(NR)	28(NR)	27(2.0)	220(1.0)	37(2.0)
PCE	6.7(NR)	18(NR)	19(0.5)	17(1.0)	20(0.5)
TCE	10.2(NR)	4.3(NR)	4.6(0.5)	2.5(1.0)	4.4(0.5)
VC	ND(NR)	ND(NR)	ND(2.0)	ND(1.0)	ND(0.5)

2188 NORTH

2188 NORTH	7/84	8/86	1/89	4/89	5/89	9/89	12/89	3/90	6/90	9/90
CCl ₂ F ₂	NR	ND(NR)	ND(NR)	24(0.5)	6.0(2.0)	23(0.5)	5.8(0.5)	5.8(2.0)	3.2(1.0)	13(2.0)
PCE	ND(1.0)	ND(1.0)	ND(NR)	ND(NR)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)
TCE	ND(1.0)	ND(1.0)	ND(NR)	ND(NR)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)
VC	NR	ND(1.0)	ND(NR)	ND(NR)	ND(2.0)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)

DW-1B

DW-1B	8/88	1/89	5/89	9/89	9/90
CCl ₂ F ₂	ND(NR)	ND(NR)	ND(2.0)	ND(0.5)	ND(2.0)
PCE	26(NR)	37(NR)	48(0.5)	54(0.5)	69(0.5)
TCE	13.5(NR)	21(NR)	26(0.5)	36(0.5)	38(0.5)
VC	ND(NR)	2.3(1.0)	33(2.0)	3.1(0.5)	14(0.5)

OW-1

OW-1	1/89	5/89	9/89	9/90
CCl ₂ F ₂	47(NR)	95(1.0)	23(0.5)	6.5(2.0)
PCE	6(NR)	100(2.5)	61(0.5)	ND(0.5)
TCE	11(NR)	18(2.5)	16(0.5)	ND(0.5)
VC	3.1(NR)	ND(1.0)	17(0.5)	ND(0.5)

EW-1

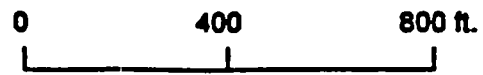
EW-1	7/87	5/89	9/89	9/90
CCl ₂ F ₂	ND(0.5)	ND(0.5)	283(0.5)	PUMP FAILED
PCE	79(0.5)	96(0.5)	64(0.5)	PUMP FAILED
TCE	6.5(0.5)	40(0.5)	44(0.5)	PUMP FAILED
VC	102(0.5)	62(2.0)	50(0.5)	PUMP FAILED

* Highest Concentration of 5 Sampling Events

LEGEND

- | | | | | |
|---------------------------------|---|---------------|-----|---|
| CCl ₂ F ₂ | Dichlorodifluoromethane | MCL = None | () | Method Detection Level |
| PCE | Tetrachloroethene | MCL = 2ug/l | ? | Undetermined Concentration |
| TCE | Trichloroethene | MCL = 5ug/l | ● | Groundwater Monitoring Well by ESA |
| VC | Vinyl Chloride | MCL = 0.5ug/l | ▼ | Private Well |
| ND | Not Detected at Indicated Detection Level | | ■ | Private Residence |
| NR | Not Reported | | ⊙ | Private Wells, Well Log Data Not Reported |
| NS | Not Sampled | | | |

Note: Concentration of Compounds Reported in ug/l (ppb)



Notes: Numerous methane monitoring wells exist within landfill boundary (not shown).

Base map and locations of existing wells from City of Fresno Department of Public Works June 1988. Original map scale is 1 in. = 200 ft.

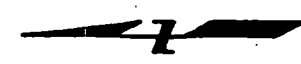
Figure 3-4
CITY OF FRESNO SANITARY LANDFILL
DATA SUMMARY OF
INTERMEDIATE WELL LOCATIONS
(70 To 110 Ft.)
Camp Dresser & McKee Inc.

UW-1C

UW-1C	8/86	1/89	5/89	9/89	9/90
CCl ₂ F ₂	ND(0.5)	ND(NR)	ND(2.0)	ND(0.5)	ND(2.0)
PCE	ND(0.5)	ND(NR)	2.8(0.5)	ND(0.5)	ND(0.5)
TCE	ND(0.5)	ND(NR)	1.1(0.5)	ND(0.5)	ND(0.5)
VC	ND(0.5)	7.1(NR)	ND(2.0)	ND(0.5)	ND(0.5)

UW-2C

UW-2C	8/86	1/89	5/89	9/89	9/90
CCl ₂ F ₂	ND(NR)	ND(NR)	ND(2.0)	ND(0.5)	ND(2.0)
PCE	ND(NR)	ND(NR)	ND(0.5)	ND(0.5)	ND(0.5)
TCE	ND(NR)	ND(NR)	ND(0.5)	ND(0.5)	ND(0.5)
VC	ND(NR)	ND(NR)	ND(2.0)	5.9(0.5)	ND(0.5)



1304

1304 JENSEN	4/86	5/89
CCl ₂ F ₂	ND(1.0)	3.7(2.0)
PCE	ND(1.0)	ND(0.5)
TCE	ND(1.0)	ND(0.5)
VC	ND(1.0)	ND(2.0)

2100 NORTH	7/84	4/86	8/88	1/89	4/89	5/89	9/89	12/89	3/90	6/90	9/90
CCl ₂ F ₂	NR	ND(1.0)	ND(NR)	14(NR)	56(NR)	10(2.0)	54(0.5)	12(0.5)	12(2.0)	63(1.0)	20(2.0)
PCE	ND(1.0)	ND(1.0)	ND(NR)	ND(NR)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)
TCE	ND(1.0)	ND(1.0)	ND(NR)	ND(NR)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)
VC	NR	ND(1.0)	ND(NR)	ND(NR)	ND(0.5)	ND(2.0)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)

2142 NORTH	7/84	4/86	1/89	4/89	5/89	9/89	12/89	3/90	6/90	9/90
CCl ₂ F ₂	NR	ND(1.0)	24(NR)	25(0.5)	4.4(2.0)	85(0.5)	19(0.5)	9.9(2.0)	12(1.0)	17(2.0)
PCE	4.8(1.0)	ND(1.0)	ND(NR)	ND(NR)	ND(0.5)	0.8(0.5)	1.0(0.5)	0.6(0.5)	ND(0.5)	1.1(0.5)
TCE	1.5(1.0)	ND(1.0)	ND(NR)	ND(NR)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)
VC	NR	ND(1.0)	ND(NR)	ND(NR)	ND(2.0)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)

19H1	5/89
CCl ₂ F ₂	ND(2.0)
PCE	ND(0.5)
TCE	ND(0.5)
VC	ND(2.0)

JENSEN AVE.

JENSEN AVE.

NORTH AVE.

1635 JENSEN	7/84	4/86	5/89
CCl ₂ F ₂	ND(0.5)	ND(1.0)	3.3(2.0)
PCE	ND(0.5)	ND(1.0)	1.4(0.5)
TCE	ND(0.5)	ND(1.0)	ND(0.5)
VC	NR	ND(1.0)	ND(2.0)

DW-2C

DW-2C	8/86	1/89	5/89	9/89	9/90
CCl ₂ F ₂	ND(NR)	ND(NR)	ND(2.0)	ND(0.5)	ND(2.0)
PCE	ND(NR)	1.4(NR)	1.2(0.5)	2.5(0.5)	1.7(0.5)
TCE	ND(NR)	ND(NR)	ND(0.5)	ND(0.5)	ND(0.5)
VC	ND(NR)	ND(NR)	ND(2.0)	ND(0.5)	ND(0.5)

DW-1C

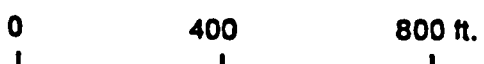
DW-1C	8/86	1/89	5/89	9/89	9/90
CCl ₂ F ₂	ND(NR)	5.5(NR)	7(2.0)	72(0.5)	33(2.0)
PCE	2.6(NR)	4.5(NR)	22(0.5)	6.6(0.5)	7.9(0.5)
TCE	1.0(NR)	0.9(NR)	1.4(0.5)	1.4(0.5)	1.6(0.5)
VC	ND(NR)	ND(NR)	12(2.0)	0.6(0.5)	ND(0.5)

2168 NORTH	7/84	4/86	1/89	4/89	5/89	9/89	12/89	3/90	6/90	9/90
CCl ₂ F ₂	ND(NR)	ND(NR)	26(NR)	57(0.5)	24(2.0)	170(0.5)	22(0.5)	22(2.0)	110(1.0)	36(2.0)
PCE	ND(1.0)	ND(1.0)	ND(NR)	0.6(0.5)	.73(0.5)	1.3(0.5)	1.1(0.5)	1.6(0.5)	2.1(0.5)	2.3(0.5)
TCE	ND(1.0)	ND(1.0)	ND(NR)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)
VC	ND(1.0)	ND(NR)	ND(0.5)	ND(2.0)	ND(2.0)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)

LEGEND

- CCl₂F₂ Dichlorodifluoromethane MCL = None
- PCE Tetrachloroethene MCL = 2ug/l
- TCE Trichloroethene MCL = 5ug/l
- VC Vinyl Chloride MCL = 0.5ug/l
- ND Not Detected at Indicated Detection Level
- NR Not Reported
- NS Not Sampled
- () Methane Detection Level
- ? Undetermined Concentration
- Groundwater Monitoring Well by ESA
- ▼ Private Well
- Private Residence

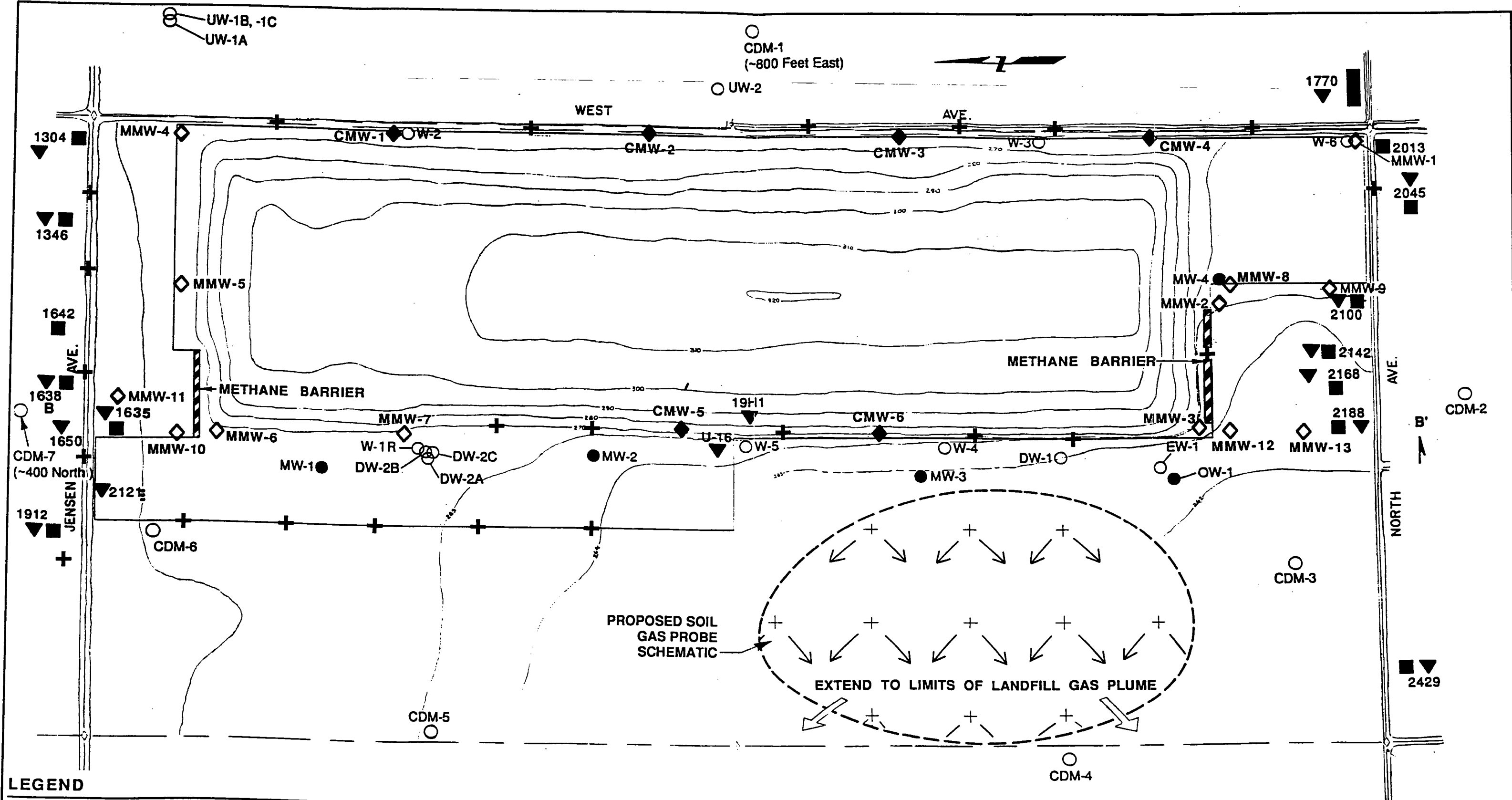
Note: Concentration of Compounds Reported in ug/l (ppb)



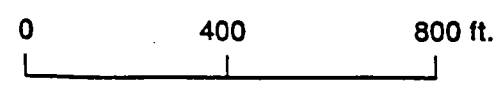
Notes: Numerous methane monitoring wells exist within landfill boundary (not shown).

Base map and locations of existing wells from City of Fresno Department of Public Works June 1988. Original map scale is 1 in. = 200 ft.

Figure 3-5
CITY OF FRESNO SANITARY LANDFILL
DATA SUMMARY OF
DEEP WELL LOCATIONS
(Greater Than 110 Ft.)
Camp Dresser & McKee Inc.



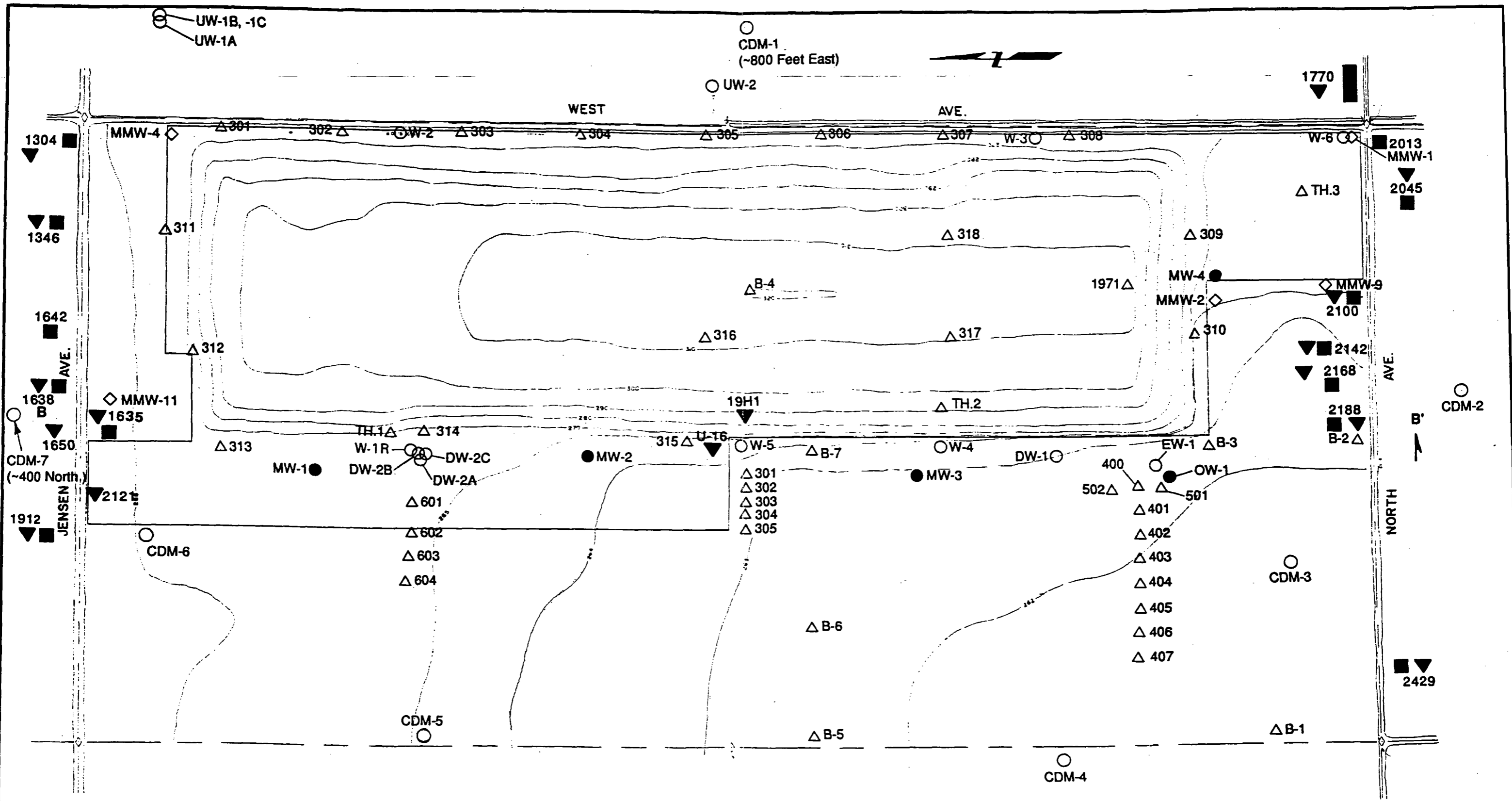
- LEGEND**
- Ground-water monitoring well established during ESA investigation
 - Ground-water monitoring well established by others
 - Proposed ground-water monitoring wells (CDM-1)
 - ◇ Methane monitoring well established by others (MMW-1)
 - ◆ Proposed methane monitoring wells (CMW-1)
 - Approximate location of private residence
 - ▼ Approximate locations of private wells
 - + Temporary Soil Gas Probe



Base map and locations of existing wells from City of Fresno Department of Public Works, June 1988. Original map scale is 1 in. = 200 ft.

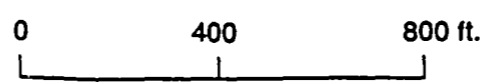
Reference: ESA, 1989

Figure 4-1
 CITY OF FRESNO SANITARY LANDFILL
SOIL-GAS INVESTIGATION
PROPOSED BORING LOCATIONS
 Camp Dresser & McKee Inc.



LEGEND

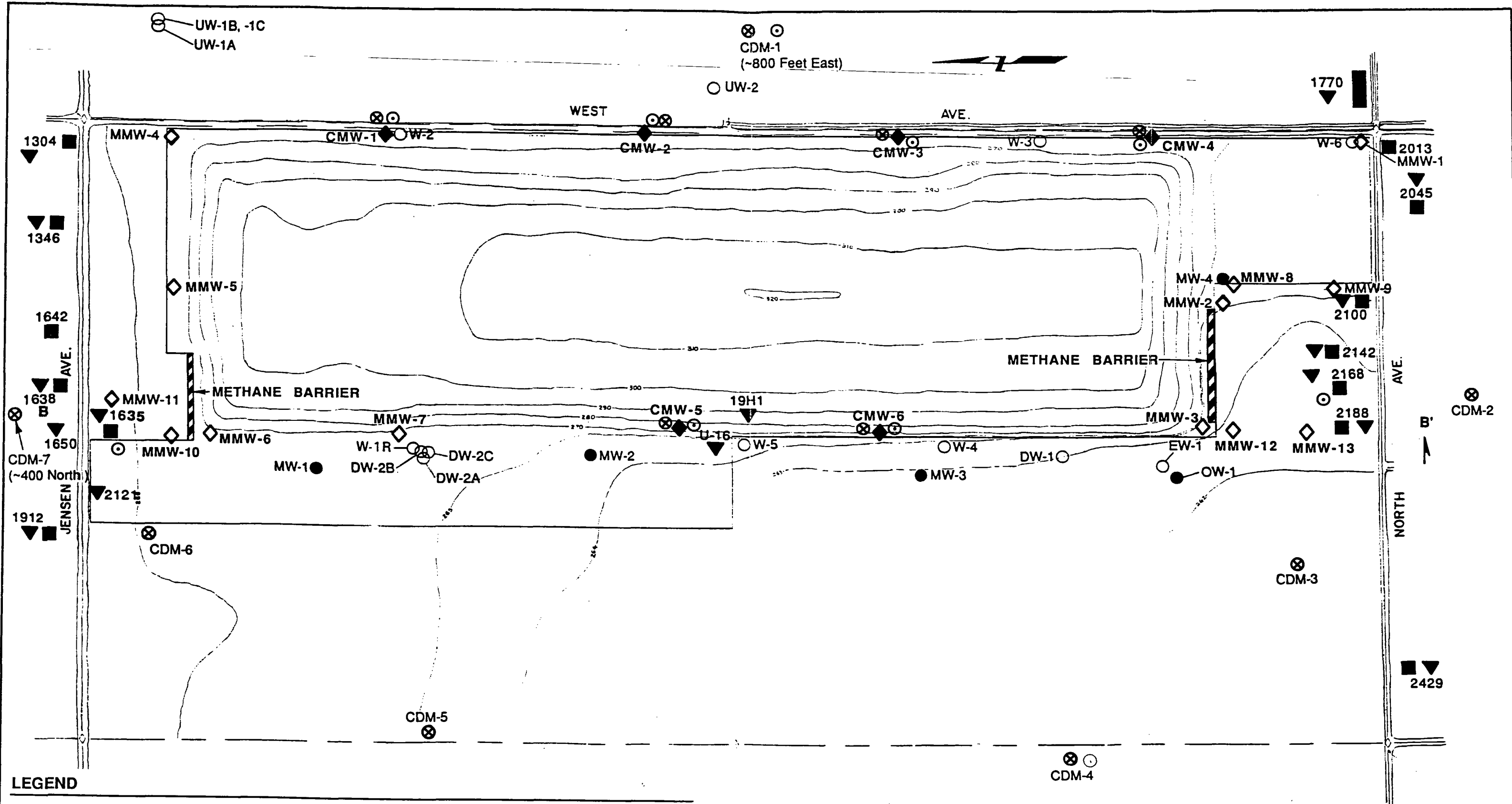
- Ground-water monitoring well established during ESA investigation
- Ground-water monitoring well established by others
- ◇ Methane monitoring well established by others
- ▼ Approximate locations of private wells
- △ Sealed test boring by others (approximate location)
- Approximate location of private residence
- CDM-1 Proposed Ground-water Monitoring Well



Base map and locations of existing wells from City of Fresno Department of Public Works, June 1988. Original map scale is 1 in. = 200 ft.

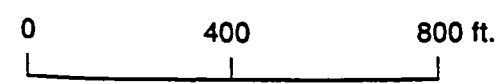
Reference: ESA, 1989

Figure 5-1
CITY OF FRESNO SANITARY LANDFILL
BORING/WELL LOCATIONS
Camp Dresser & McKee Inc.



LEGEND

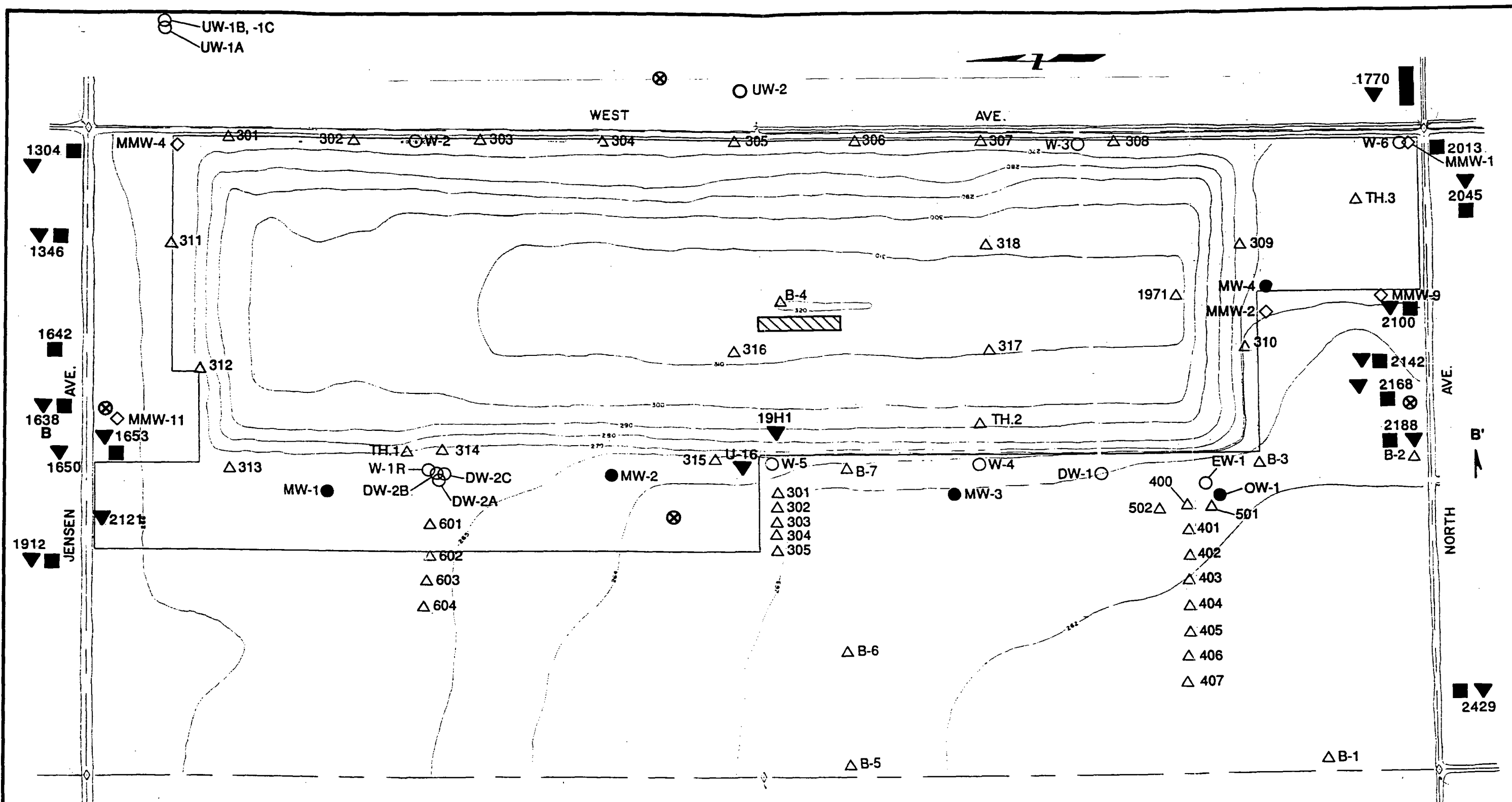
- | | |
|---|---|
| ● Ground-water monitoring well established during ESA investigation | ◆ Proposed methane monitoring wells (CMW-1) |
| ○ Ground-water monitoring well established by others | ⊙ Proposed Surface Soil Sampling Location |
| ⊗ Proposed Subsurface Sampling Location | ■ Approximate location of private residence |
| ◇ Methane monitoring well established by others (MMW-1) | ▼ Approximate locations of private wells |



Base map and locations of existing wells from City of Fresno Department of Public Works, June 1988. Original map scale is 1 in. = 200 ft.

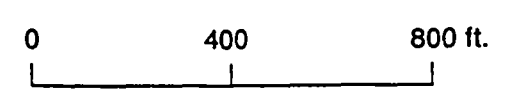
Reference: ESA, 1989

Figure 8-1
 CITY OF FRESNO SANITARY LANDFILL
SURFACE AND SUBSURFACE PROPOSED SAMPLING LOCATIONS
 Camp Dresser & McKee Inc.



LEGEND

- Ground-water monitoring well established during ESA investigation
- Ground-water monitoring well established by others
- ◇ Methane monitoring well established by others
- ⊗ Proposed Ambient Air Sample Location
- ▼ Approximate locations of private wells
- △ Sealed test boring by others (approximate location)
- Approximate location of private residence
- ▨ Proposed Weather Station Location



Base map and locations of existing wells from City of Fresno Department of Public Works, June 1988. Original map scale is 1 in. = 200 ft.

Reference: ESA, 1989

Figure 9-1
 CITY OF FRESNO SANITARY LANDFILL
AMBIENT AIR -
PROPOSED SAMPLE LOCATIONS
 Camp Dresser & McKee Inc.

Section Eight

8.0 SURFACE AND SUBSURFACE SOIL INVESTIGATION

A surface and subsurface soil investigation will be performed as part of the FSL remedial investigation. The following sections describe data quality objectives and sampling rationale.

8.1 DATA QUALITY OBJECTIVES

Data quality objectives (DQOs) are qualitative and quantitative statements of the quality of data needed to support specific decisions or regulatory actions. DQOs for the soil investigation have been developed based on intended data uses as well as sampling and analytical capabilities, specific data uses, PARCC (precision, accuracy, representative, completeness, and comparability) parameters, analytical methods, and detection limits. DQOs for surface and subsurface soil are discussed in this section.

8.1.1 Prioritized Data Uses and Decisions

Soil samples will be collected during the hydrogeologic and soil gas investigations. Surface soil data will be used to determine if an exposure pathway exists for ingestion or dermal contact due to soils contaminated by the landfill. Surface soil data will also be used to determine background concentrations. Subsurface soil data will be used to characterize the aquifer material, and help determine groundwater contaminant pathways and extent of contamination. This information will assist in development of remedial alternatives for the treatment of groundwater.

Analytical Level IV data as defined by "Data Quality Objectives for Remedial Response Activities" (EPA 540.G-87/003A) are needed for the investigation. Surface soil samples will be analyzed for volatile organics, BNAs, pesticides/PCBs, herbicides, dioxin, and metals. Subsurface samples will be analyzed for volatile organics; in addition, subsurface samples will be analyzed for grain size and TOC.

Section Four

4.0 SOIL GAS INVESTIGATION

A soil gas investigation is proposed for the Fresno Sanitary Landfill (FSL) RI/FS. This investigation will involve the installation of permanent soil gas monitoring wells and performance of an off-site soil gas survey. The purpose of this investigation is to determine the pathways of subsurface migration of landfill gas, define the extent of off-site landfill gas migration, and determine if vinyl chloride is present in off-site landfill gas. The first two objectives are established to guide the formulation of both on and off-site gas control remedial actions, with the vinyl chloride investigation performed to develop the risk assessment.

4.1 DATA QUALITY OBJECTIVES

Data Quality Objectives (DQOs) are qualitative and quantitative statements of the quality of data needed to support specific decisions or regulatory actions. DQOs for the soil gas investigation have been developed based on intended data uses as well as sampling and analytical capabilities. Specific data uses, PARCC (precision, accuracy, representativeness, completeness, and comparability) parameters, analytical methods, and detection limits for soil gas sampling are discussed in this section.

4.1.1 Prioritized Data Uses and Decisions

Soil gas data collected from the FSL site will be used to determine the pathways of subsurface migrations of landfill gas, and to define the extent of off-site landfill gas migration and consequent contaminant migration. Level II quality data as defined by "Data Quality Objectives for Remedial Response Activities" (EPA 540/G-87/003A) is needed for the soil gas investigation. Soil gas data is also needed to quantify the concentration of vinyl chloride in the gas which has migrated off-site. Level IV quality data is needed to achieve this goal.

4.1.2 Quality Assurance Objectives

The quality assurance objectives for measurement data in terms of PARCC are discussed in Appendix A.

4.2 RATIONALE FOR SAMPLE LOCATIONS, NUMBER OF SAMPLES, AND ANALYSES

A system of thirteen multiple-depth monitoring wells exist at the FSL site (Figure 4-1). Previous data indicates that landfill gas has migrated off-site. It is proposed that the existing gas monitoring network be expanded to include an additional six permanent gas wells. Also proposed is an off-site soil gas survey using temporary probes to define the extent of gas migration. The following paragraphs describe the rationale for sample location, number, and analyses.

Six additional gas monitoring wells are proposed for this investigation. These wells shall consist of permanent installations constructed in accordance with State requirements for landfill gas control and monitoring at closed disposal sites (CAC Title 14, Chapter 3, Article 7.8). The six additional wells are proposed at the locations depicted on Figure 4-1. Monitoring locations were selected to meet the requirement of CAC Title 14 that a maximum of 1000 feet exists between adjacent monitoring wells.

The well bore depth shall be approximately 30 feet which corresponds with the general maximum depth of refuse of 25 feet. Landfill records will be reviewed to determine if large areas of the facility have refuse placed at depths less than 25 feet. If areas can be clearly identified, the depth of the wellbores in those areas will be the approximate depth of refuse. Two probes will be installed in each wellbore. The shallow probe will be placed approximately five feet below the ground surface in an attempt to monitor soil layers above any hardpan layer. The second probe will be installed to the full depth of the borehole, to monitor deeper horizons. Details on the construction of the gas monitoring wells are described in Section 11.1.

The second portion of the soil gas investigation will be to track the off-site landfill gas plume through the use of a screening-level soil gas survey. Soil gas survey procedures involve driving a hollow probe 5 to 10 feet into the soil and collecting soil vapors for analysis of specific volatile compounds. The soil gas survey will be performed by a qualified subcontractor and analyzed for methane and vinyl chloride.

The extent of existing gas migration off-site will be determined by initial sampling of temporary soil probes located at the perimeter of the landfill. Initial sampling points will be approximately 100 feet away from the landfill perimeter and 400 feet apart. Figure 4-1 shows the location of the initial soil gas sampling points. Initially, approximately 20-25 soil gas samples will be collected, and sampling points will be added away from the landfill perimeter at 100 foot spacing until the presence of landfill gas is no longer detected.

Points identified on Figure 4-1 are somewhat diagrammatic for purposes of illustration. The actual field locations will be strategically located based on field conditions. For example, sampling locations will take into consideration the presence of structures and agricultural systems such as pumps, ditches, and pipelines. The on-site technician will be responsible for analyzing the data from the initial soil gas survey and determining the location of the additional points. The objective is to define the lateral limits of the soil-gas plume.

Soil Gas Sampling and Analysis Approach

The methods for analyses to be conducted include the following:

<u>Parameter</u>	<u>Method</u>	<u>Level</u>
Methane	OVA, HPK-2	II
Vinyl Chloride	Modified 8010	II
Vinyl Chloride	EPA T0-14	IV

The proposed approach is to analyze for methane in all gas monitoring well and temporary probes. The assumption is that the presence of methane is a reliable indicator of the presence of landfill gas in the soil. A combustible gas meter and an organic vapor analyzer (OVA) will be employed in conjunction with a vapor extraction pump to take direct readings of the permanent gas wells. For the temporary probes an on-site mobile lab will analyze methane by a Thermal Conductivity Detector (TCD).

As mentioned previously, vinyl chloride will also be analyzed for risk assessment purposes. Soil vapor samples collected near private residences will be analyzed for vinyl chloride. Temporary soil borings with vinyl

chloride detected by the soil gas survey will be resampled using a Summa canister and submitted to a fixed-base laboratory for analysis.

Soil vapors collected in a Summa canister for Level IV analysis will be analyzed by EPA Method T014. For the soil gas survey vinyl chloride will be analyzed using EPA Modified 8010; methane will be analyzed using a thermal conductivity detector. A detection limit of 1 ppb is provided by the mobile lab for vinyl chloride; 1 ppm is provided for methane. It should be noted that at this time there are no EPA Methods for conducting a temporary, screening-level soil gas survey. Analytical procedures utilized by the on-site mobile lab are described in Appendix E.

4.3 ANALYTICAL AND QUALITY CONTROL PROCEDURES

Analysis of Air Samples for Volatile Organic Compounds by EPA Method TO-14

Analytes:

	<u>Detection Limits (ppbv)</u>
Vinyl Chloride (VC)	1
Benzene (0)	0.5
Methylene Chloride (MeCl ₂)	20
Chloroform (ChCl ₃)	.02
1,2-Dichloroethane (1,2-DCA)	50
1,1,1-Trichloroethane (1,1,1-TCA)	0.1
Carbon Tetrachloride (CCR4)	.05
Trichloroethylene (TCE)	0.1
Tetrachloroethylene (PCE)	0.1
1,2-Dibromoethane (EDB)	0.05

Matrices: Ambient air samples collected in 6-liter Summa canisters. Canister cleaning and verification of cleanliness is also required.

Analytical Method: EPA Method TO-14. If the laboratory proposes to use GC-Selective detectors (ECD, FID, PID, Hall), a confirmational analysis is required for detected target compounds. This could be accomplished using GC/MS-Full Scan, GC/MS in the Selected Ion Monitoring mode using the ions listed in Table 2 of TO-14, using another selective detector with the necessary sensitivity, or by second column confirmation. Ten percent of the samples from a sample delivery group (SDG) containing detectable analytes will require confirmation. In addition, all samples containing detectable quantities of vinyl chloride will require confirmation for this compound only. If GC/MS-Full Scan is used for confirmation, up to 10 non-target peaks should be tentatively identified.

Canister Cleaning and Verification: Canister cleaning and verification is a requirement. After cleaning, it is considered acceptable if no individual analyte is present at a concentration greater than 0.2 ppbv.

After cleaning, ten percent (10%) of the canisters will be analyzed for verification of the cleaning procedure. The canister selected for verification will be the one from the sample delivery batch that had previously contained the highest overall concentration of analytes. If all analytes are determined to be below 0.2 ppbv, the entire batch is suitable for shipment. Otherwise, the canisters must either be individually verified, cleaned as necessary and then verified again by the previously mentioned criteria or by recleaning the entire batch and then the canister that had previously failed will be verified following the previously mentioned criteria.

The canister cleaning deliverables are as follows:

- . Form I results.
- . Raw data/chromatograms.
- . Low standard at 0.5 ppbv for the compounds of interest.
- . System blank showing those compounds to be less than 0.2 ppbv.

Canister cleaning guidelines are described below:

1. EPA Method TO-14 outlines the most desirable method of cleaning.
2. Any method used must be capable of evacuating the canister to less than 0.05 mm Hg (50M Torr).
3. Any method not utilizing an evacuation/pressure cycle must include heating of the canister to no greater than 160°C but no less than 100°C during evacuation.
4. Any method not utilizing an evacuation/pressure cycle must maintain an evacuation of less than 0.05 mm Hg (50m Torr) for no less than 12 hours.
5. All vacuum pumps utilized in this procedure must include a suitable trap for the prevention of backstreaming.
6. All connections to canisters must be made with brass compression fittings to avoid damage to the canister inlet fitting.

QA/QC Requirements: Holding Time < 72 hours from sample collection.

Initial Calibration: A five (5) point calibration at 0.5, 1.0, 3.0, 5.0, and 10 ppbv. Percent coefficient of variation (%CV) or percent relative standard deviation (%RSD) of the response factors (RF) must be less than 5.0%.

Retention Time Windows: See Method TO-14, Section 10.3.2.

Continuing Calibration: Daily continuing calibration at 1.0 ppb in triplicate. If the response value of the 1.0 ppb calibration analysis differs significantly from the initial calibration response factor (RF) mean at the .05 level of significance of a 2-tailed t test, a new initial calibration is to be analyzed.

After any change to the system that may alter the signal response which includes but is not limited to: column or carrier gas change, bakeout, or detector cleaning, a daily continuing calibration must be run. If this calibration fails to meet the previously mentioned criteria for daily calibration, a new initial calibration must be run.

Surrogate Standards: Fifty microliters of approximately 5 ppm in zero grade air of p-Bromochloromethane and 1,3-Dibromochloropropane will be spiked into all blanks, standards, samples, and sample duplicates. Other surrogates may also be used. The laboratory must ensure that surrogates do not co-elute with analytes.

System Blank: A system blank will be run after any calibration. For blank analysis use humidified Zero Grade air from a known and consistent source. Identify source on Form 4. The blank must be free of interfering peaks and of volatile organics greater than 0.2 ppbv. To prevent carryover, a system blank must be run after any analysis in which any analyte saturates the detector.

Duplicates: In each batch, one sample for duplicate analysis will be designated. The maximum allowable relative percent difference for each analyte whose concentrations are 3 times greater than the LOD will be 10.0 percent. The maximum allowable relative percent difference for each analyte whose concentrations are less than 3 times the LOD will be 20.0 percent. Failure to meet this criteria will require a reanalysis of the sample.

Identification Criteria: Analytes will be qualified by matching the retention time windows of the sample and the standard. In the unlikely event of overlapping retention time windows, the laboratory will use the peak whose retention time most closely matches that of the sample. Confirmational analysis will be required for all identified peaks with overlapping RT windows.

Standard Operating Procedures (SOP): All methods and procedures related to the analysis and cleaning of SUMMA passivated canisters should be documented in a logical, step-wise manner. These should include but not be limited to: assembly, calibration, maintenance, and operation of specific systems and equipment, preparation, storage, shipment and handling of samples; canisters cleaning and verification; and all aspects of data recording and processing including hardware and software documentation.

Gas Chromatography/Mass Spectrometry - Full Scan:

All QA/QC requirements for gas chromatography are applicable to GC/MS--full scan analysis (except GC sections on confirmational analysis, detection limits, and identification criteria). In addition, the following QA/QC requirements are applicable to GC/MS analysis:

Instrument Tuning: Each day, prior to initiating any analysis, the gas chromatograph/mass spectrometer (GC/MS) will be tuned with 50 ng. direct column injection of p-Bromofluorobenzene (BFB) as outlined in Section 10.2.2 of TO-14. The main exception to the indicated procedures is the frequency of tuning, which will be performed once in 24 hours or the total period of analysis, whichever is more frequent. Tuning information will be provided on Form 5.

Detection Limits: Instrument detection limits are established by demonstrating the ability of the instrument to detect and produce a complete enhanced or unenhanced mass spectrum in which fragmentation ions greater than 20 percent of base peak must be present from a 500 ml sampling of 5 ppbv standard (approximately 2.0 μ g depending on the analyte). Determination of detection limits should follow the guidelines in CFR 40, Part 136, Appendix B.

Identification Criteria: Criteria for identification of the compounds found in Attachment #3 is based upon retention time (RT) matching and mass spectrum matching with the standard. The relative retention time (RRT) must be within ± 0.06 RRT of the calibration standard, where RRT is the RT of the hit compound in relation to the RT of the corresponding internal standard. Mass spectra must match according to the following criteria:

1. All m/e greater than 15 percent in the standard spectrum must be present in the sample spectrum.
2. The relative intensities of ions must agree within 20 percent between standard and sample spectra.
3. Fragmentation ion greater than 15 percent in the sample spectrum but not in the standard spectra must be accounted for (background, co-eluting peak, etc.).

The laboratory will also perform NIST (NBS) library searches on all peaks that are greater than 10 percent in height than the previous closest internal standard. The searches will be based on relative fit. The analyst will use the criteria established for spectral matching for TCL compounds to identify TIC (Tentatively Identified Compounds), with the exception that the comparison will be made with the NIST Library searches. A certain amount of flexibility is allowed for professional judgment and interpretation of spectra by the analyst. Those peaks which cannot be identified by the above criteria are reported as unknown. The quantitation is expressed as the percent of peak height of target compound in reference to the peak height of the closest previous internal standard.

Deliverables:

Narrative:

Date samples arrived at the lab.
Sample numbers.
Sampling/analytical problems.
Discussion of any QA/QC outside of the acceptance criteria.

Results:

Report on a Form I equivalent in ppbv analyte/sample.
Volume of sample analyzed.
Include all raw data, chromatograms/mass spectra and quantitation reports for each sample.

Calibration:

Initial calibration with 5 points: 0.5, 1.0, 3.0, 5.0, and 10 ppbv.
Report the calculated: RF, mean retention time, standard deviation,
% coefficient of variation and the RT window ($\pm 3\%$).
Daily continuing calibration.
All raw data for the initial and continuing calibrations.
Calculate %D.
Chromatograms and area results/quantitation report.
Date and time of analysis.
Report on CLP forms 6 and 7 equivalent.

Blanks:

Method - daily.
Date and time of analysis.
Report on CLP Form 4 equivalent.
Include all raw data.

Duplicate:

Each batch will contain one sample for duplicate analysis.
Date and time of analysis.
Calculate and report the RPD.
Report on CLP Form 3 equivalent.

Surrogates:

Spike into all blanks, standards, samples, and sample duplicates.
Surrogate retention times.
Report the area and the % recovery.
Report on CLP Form 2 equivalent.

Documentation:

Copy of chain of custody.
Copy of airbill.

Section Five

5.0 HYDROGEOLOGIC INVESTIGATION

A hydrogeologic study will be conducted as part of the RI/FS, which will involve the determination of subsurface stratigraphy using drilling and downhole geophysical techniques, and the installation of additional groundwater monitoring wells. The objectives of the investigation are to (1) continue to develop a hydrogeologic model of the site, building on information collected by previous investigators, and (2) to identify to the extent possible the vertical and lateral extent of off-site contaminant migration in groundwater. The installation of additional wells will provide a means of defining the extent of the groundwater plume through water quality sampling (Section 6.0).

5.1 DATA QUALITY OBJECTIVES

Data Quality Objectives (DQOs) are qualitative and quantitative statements of the quality of data needed to support specific decisions or regulatory actions. DQOs for the groundwater investigation have been developed based on intended data uses as well as sampling and analytical capabilities. Specific data uses, PARCC (precision, accuracy, representativeness, completeness, and comparability) parameters, analytical methods, and detection limits for the groundwater investigation are discussed in this section.

5.1.1 Prioritized Data Uses and Decisions

Data collected for the hydrogeologic task will be used to select monitoring well completion intervals; to refine the understanding of site hydrogeology (the hydrogeologic model); to determine pathways of contaminant migration in groundwater; and to better understand the physiochemical characteristics of the site water-bearing zones. Geologic data including lithologic descriptions of borings and downhole geophysical logs are by definition field screening-level data, collected by on-site observation or portable instruments. As such, Level II quality data, as defined by "Data Quality Objectives for Remedial Response Activities" (EPA 540/G-87/003A) are acceptable. However, samples of subsurface soils collected for analysis of

Total Organic Carbon (TOC), grain-size analysis, and volatile organics may be used to support the Feasibility Study regarding groundwater treatment design, or the risk assessment. Level IV quality will be maintained for these data.

Analytical methods, discussed in Section 5.3, were selected based on their ability to provide appropriate quantitation. The specific compounds and detection limits required for each of these analytical methods are discussed in Section 5.3.

5.1.2 Quality Assurance Objectives

The quality assurance objectives for measurement data in terms of precision, accuracy, completeness, representativeness, and comparability are discussed in Appendix A.

5.2 RATIONALE FOR SAMPLE LOCATIONS, NUMBER OF SAMPLES, AND ANALYSES

As described previously in the RI/FS Work Plan, the hydrogeologic investigation will be a focused program to supplement and expand on existing information that has been developed at the site by previous investigators. Several previous investigators have conducted studies and installed monitoring wells (Figure 3-2) in an effort to determine the site hydrogeology. The near surface (< 500 feet) geology has been generally characterized as consisting of interbedded clays, silts, sands, sandy clays, and sandy silts. The existing data do not appear to indicate any well-developed, continuous aquifers or aquitards at discrete depths. It appears, based on the water level data collected since 1987, that the site hydrogeology is comprised of a single aquifer system, at least to the depths investigated to date (approximately 170 feet). Previous site investigators have identified three general hydrostratigraphic units: shallow, intermediate, and deep. These units do not appear to necessarily correspond to specific aquifer zones or permeable sand units, but were apparently selected for well completion intervals in order to vertically characterize what appears to be a single interconnected aquifer system.

In order to accomplish the objectives of the hydrogeologic task, a program of drilling, downhole geophysical logging, and well installation will be conducted. The locations of borings and wells are shown on Figure 5-1. Pilot borings will be drilled using mud rotary techniques; monitor wells will be installed using an air rotary casing driver rig. At each selected location, a small-diameter pilot boring will be advanced to a total depth of about 250 feet using mud rotary drilling, and will be lithologically logged by the field geologist. The purpose of the pilot boring will be to characterize the subsurface stratigraphy, and allow selection of well completion intervals. Lithologic information including grain size, texture, color, USCS soil classification, and drilling characteristics will be recorded in the field log book.

Downhole geophysical logging will then be conducted by a qualified contractor. Spontaneous potential, resistivity, and gamma logs will be run in each pilot hole. These logs will assist in establishing the stratigraphy at the new locations, and will allow correlation with existing gamma logs and descriptions. This approach will provide a means of geologic correlation across the site, in order to recognize potential migration pathways for groundwater. At the conclusion of logging, the pilot hole will be immediately grouted from the bottom of the hole to the surface using a tremie system; holes will not be allowed to remain open overnight. Details of grouting are discussed in Section 11.0.

The proposed well locations have been chosen to define the lateral and vertical boundaries of the contaminant plume, either downgradient of areas of known contamination, or further upgradient of the landfill. Each location has been numbered starting at the upgradient or east side of the landfill; the rationale for each location follows. The need for remote upgradient or background wells at varying depths at Location CDM-1 is evident since organic compounds have been detected at each of the existing upgradient locations (UW-1 and UW-2), east of the FSL. Groundwater flow appears to be to the west. The transport mechanism to explain the presence of organics at upgradient wells will be investigated during the RI, but may be due to partitioning from landfill gas. It is anticipated that a 3-well cluster will be installed at CDM-1 about 1200 feet east of West Avenue, or beyond the influence of migrating landfill gas. The exact location will be

dependent on the results of the soil gas survey. The three wells will be installed at varying depths, roughly corresponding to the shallow, intermediate and deep zones of the previous investigators; actual completion depths will be dependent on the location of permeable aquifer material as shown by the geophysical log and lithologic description of the pilot boring. Each well will be installed in a separate boring, not in a single boring as was done in the past. This will eliminate the potential for cross-contamination between wells sharing a common borehole. The background wells will characterize the groundwater away from the influence of the landfill.

Location CDM-2 is proposed to define the lateral and vertical extent of the plume south of the landfill boundary, based on the detected dichlorofluoromethane in the residences along North Avenue. A 3 well cluster is proposed for this location, again to correspond to the general completion intervals identified by others. The actual completion depths will depend on the results of the geophysical logging in the pilot hole at that location. Location CDM-3 is downgradient of wells MW-4, OW-1 and EW-1, with detected organics. Two wells are proposed at this location, to characterize the shallow and intermediate zones. The completion zones will be dependent on the geophysical log at this location.

Location CDM-4 will be a far downgradient monitor location outside the limit of the plume. The results of the soil gas survey will be reviewed to assist in locating these wells beyond the plume boundary. Three wells are anticipated, including a deep well to define the vertical extent of contamination. Location CDM-5 has been located in the same manner as CDM-4, downgradient of observed organics in MW-1 and W-1R.

Location CDM-6 is proposed to define the northwestern extent of the plume. One shallow well is anticipated at this location. Finally, Location CDM-7 will be placed downgradient of observed, although very low, levels of organics in residential wells found north of the landfill. Two wells are anticipated at this location, which will function as a far offsite monitor beyond the plume. As above, completion intervals will be dependent on the results of the geophysical logging.

Proposed locations may change, depending on whether access agreements with landowners can be obtained from the City. Details of well installation and handling of drilling/ development wastes will be presented in Section 10.0.

At each pilot hole location, in situ core samples of the subsurface material will be obtained at selected depths dependent on field conditions. These samples will be analyzed for grain size, total organic carbon (TOC), and volatile organics using EPA Method 8010/8020. The purpose of these analyses is to characterize the aquifer material and achieve an understanding of contaminant transport by groundwater. Approximately 2 samples per boring are anticipated. Depth of sampling will be dependent on the identification of permeable aquifer material.

5.3 ANALYTICAL AND QUALITY CONTROL PROCEDURES

See Section 6.3 for analytical and quality control procedures for analysis of soil samples for VOCs by SW846 Method 8010/8020.

Geotechnical Analysis for Grain Size Distribution Using ASTM-C136

Analytes: Not applicable.

Sample Matrices: Soil samples for grain size distribution.

Analytical Procedure and Detection Limits: ASTM-C136 will be followed.

Holding Time: Not applicable.

Calibration Procedure and Criteria: Calibration will be executed according to methods described in ASTM-C136.

Internal Quality Control Checks, Control Limits, and Corrective Actions: The quality control samples and frequency specified in the ASTM-C136 will be utilized for this task.

Data Calculation and Reporting Units: The equations in ASTM-C136 will be used for calculation and reporting units.

Documentation and Deliverables: The report generated will be in accordance with the ASTM-C136 Method.

Analysis of Total Organic Carbon Using ASTM-D4129 and D5136

Analytes: Total Organic Carbon by ASTM-D4129. Carbonate carbon by ASTM-D5136.

Sample Matrices: Low concentration soil samples.

Detection Limits: Detection limit of 0.01% will be specified.

Holding Time: Not applicable.

Calibration Procedure and Criteria: Calibration will be executed according to Methods ASTM-D4124 and D5136.

Internal Quality Control Checks, Control Limits, and Corrective Actions: The quality control samples and frequency specified in ASTM-D4129 and D5136 will be utilized for this task.

Data Calculation and Reporting Units: The equations in ASTM-D4129 and D5136 will be used for calculation. The sample results will be reported in concentration units of mg/l.

Documentation and Deliverables: Method-specified documentation.

Section Six

6.0 GROUNDWATER INVESTIGATION

The groundwater investigation will involve sampling of existing and newly-installed site monitoring wells, to monitor the extent of organic chemicals in groundwater and to provide data for the health risk assessment and feasibility study. The data quality objectives, sampling rationale, and analytical methods for the groundwater investigation are discussed in this section. Field procedures are discussed in Section 11.3.

6.1 DATA QUALITY OBJECTIVES

Data Quality Objectives (DQOs) are qualitative and quantitative statements of the quality of data needed to support specific decisions or regulatory actions. DQOs for the groundwater investigation have been developed based on intended data uses as well as sampling and analytical capabilities. Specific data uses, PARCC (precision, accuracy, representativeness, completeness, and comparability) parameters, analytical methods, and detection limits for the groundwater investigation are discussed in this section.

6.1.1 Prioritized Data Uses and Decisions

Data collected during the groundwater investigation will be used for risk assessment; to evaluate the potential health threat to residents; to identify the nature and extent of groundwater contamination; and to assist in development of remedial alternatives. Level IV quality data, as defined by "Data Quality Objectives for Remedial Response Activities" (EPA 540/G-87/003A) is therefore needed for all on-site well data.

The analyses to be conducted on groundwater samples will include the volatile organic compounds, BNAs, pesticides/PCBs, herbicides, dioxin, and total metals.

Analytical methods, discussed in Section 6.3, were selected based on their ability to provide quantitation or detection limits below the relevant

federal and state action limits. Potential ARARs for FSL are discussed in the CDM Fresno Sanitary Landfill Work Plan.

The specific compounds and detection limits required for each of these analytical methods are outlined in Section 6.3.

6.1.2 Quality Assurance Objectives

The quality assurance objectives for measurement data in terms of precision, accuracy, completeness, representativeness, and comparability are discussed in Appendix A.

6.2 RATIONALE FOR SAMPLE LOCATIONS, NUMBER OF SAMPLES, AND ANALYSES

Twenty-four existing and seventeen new on-site wells will be sampled as part of the groundwater investigation. As discussed in Section 2.3, many of the existing wells have previously been sampled for volatile organic compounds (VOCs), pesticides, metals, and water quality parameters. A review of these data indicates that VOCs, namely TCE, PCE, VC and dichlorodifluoromethane, were consistently detected throughout the reported sampling events. PCE was detected at levels between 100 and 150 $\mu\text{g}/\text{l}$ at 3 wells; VC was detected at levels between 50 and 100 $\mu\text{g}/\text{L}$ at 6 wells.

The objective of the groundwater investigation is to collect data for the development of a risk assessment database, for the delineation of the extent of groundwater contamination, and for the evaluation of feasible remedies for water treatment. These goals will be accomplished through annual sampling of forty-one on-site wells, and quarterly sampling of 14 on-site wells for the following:

<u>Parameter</u>	<u>Method</u>
Volatile Organics	EPA 8240, 8010/8020
BNAs	EPA 8270
Pesticides/PCBs	EPA 8080
Herbicides	EPA 8150
Dioxin	EPA 8280
Metals	EPA 6010, 7061, 7471, 7741

The specific compounds and detection limits required for each of these analytical methods are outlined in Section 6.3.

EPA Methods 8010/8020 have been selected for analysis of VOCs for all on-site wells because they provide quantitation limits below state and federal action limits (e.g., MCL for vinyl chloride is 0.5 ppb). Because all site contaminants may not have been identified, GC/MS sampling by EPA Method 8240 will be conducted on 10 percent of the samples (5 wells) during the first round of sampling. GC/MS has a capability for identifying unknown compounds that is far superior to the GC 8010/8020 method. GC/MS analysis will be performed at the following locations: DW-1B, DW-1C, OW-1, CDM-1B, and DW-2A. The downgradient wells DW-1B, DW-1C, and OW-1 are selected for GC/MS analysis because "unidentified peaks" have been previously detected during 601 analysis. CDM-1B and DW-2A are upgradient and downgradient locations also chosen for GC/MS analysis. In the event that GC/MS analysis reveals the presence of compounds not detected by 8010/8020, the locations and numbers of samples analyzed by 8240 will be reevaluated.

Since dioxin is relatively immobile and insoluble in water, it is not a common groundwater contaminant. During the first round of sampling, analysis for polychlorinated dibenzo-p-dioxin and polychlorinated dibenzofuran homologs by EPA Method 8280 is planned for 10 percent of the samples (5 wells). Five wells that have previously been found to contain VOCs have been chosen: DW-1B, W-3, W1R, MW-1, and W-2.

In addition to annual sampling of the 41 on-site wells, quarterly sampling of 14 on-site wells is planned (see Table 11-1). These well locations have been chosen in order to closely monitor the lateral and vertical boundaries of the contaminant plume. The on-site wells selected for quarterly sampling are listed in Table 11-1.

The locations of the wells are shown in Figure 5-1. Actual sampling procedures and pertinent completion data for each well are presented in Section 11.0.

6.3 Analytical and Quality Control Procedures

Analysis of Volatile Organic Compounds in Water by SW846 Method 8240

Analytes: Compounds listed on Table 2 in SW846 Method 8240.

Sample Matrices: Low concentration groundwater samples.

Analytical Procedure and Quantitation Limits: Follow SW846 Method 8240 for GC/MS analysis. Quantitation limits are 5 or 10 $\mu\text{g}/\text{l}$, as listed in Table 2 of the method.

Analytical Holding Times: The analytical holding time is 14 days from the date of sample collection.

Calibration Procedure and Criteria: Follow the calibration procedure specified in the method.

Internal Quality Control Checks, Control Limits, and Corrective Action: Follow the QC requirements specified in the method.

Documentation and Deliverables:

1. Report documentation for sample and blank results, date and time of analysis, surrogate recovery, MS/MSD recovery, blank summary, analytical sequence, initial and continuing calibrations (including retention time windows), and compound identification. Use forms equivalent to CLP Forms I, II, III, IV, VI, IX and X.
2. Provide all raw data, including chromatograms and area printouts/quantitation reports.
3. Raw data and summary forms are to be organized systematically and each page is to be numbered.

Analysis of Purgeable Halocarbons in Water and Soil by SW846 Method 8010:

Analytes: Compounds listed on Table 1 of SW846 Method 8010.

Sample Matrices: Low concentration groundwater and soil samples.

Analytical Procedure and Quantitation Limits: Follow SW846 Method 5030 for sample introduction by purge-and-trap and SW846 Method 8000 and 8010 for GC analysis. Contract required quantitation limits (CRQL) are 1.0 ug/kg for soil samples. For water samples, quantitation limits less than 0.5 are required for vinyl chloride and 1,3 dichloropropene.

1. The use of halogen-specific detectors, such as Hall Electrolytic Conductivity Detector (HECD), is required.
2. Whenever an unusually concentrated sample is analyzed, it should be followed by an analysis of reagent water to check for contamination by carry-over.

Analytical Holding Times: The analytical holding time is 14 days from the date of sample collection.

Calibration Procedure and Criteria: Calibrate according to Sections 5.4 and 7.3 of Method 8010 and Sections 7.4.2 and 7.5 Method 8000, with the following specifications:

1. Five-point initial calibration curve with a low standard at 1.0 ng/mL is required.
2. A continuing calibration at the concentration of 10 ng/mL for each analyte is to be analyzed at the beginning of each day and after each group of 10 samples.

Internal Quality Control Checks, Control Limits and Corrective Actions:

1. Analyze method blanks after each continuing calibration analysis and after the analysis of unusually concentrated samples. The method blanks must contain less than 5 times the CRQL of methylene chloride and must be free of other purgeable halocarbons and any interfering peaks at or above the detection limits.
2. One or more purgeable halocarbon surrogates (such as bromochloromethane, 2-bromo-1-chloropropane, 1,4-dichlorobutane, trifluorotoluene and bromofluorobenzene) must be spiked into the standards, samples, method blanks and QC samples (see Sections 5.6 and 8.3 of Method 8010). Recoveries of 75-125% are required. The samples are to be re-analyzed if the surrogate recoveries are outside the QC limits.
3. Second column confirmation is required for all positive results reported.
4. Samples containing one or more analytes at concentrations above the initial calibration range are to be diluted and re-analyzed. Report the results and documentation for both analyses.

5. Analyze matrix spikes and matrix spike duplicates (MS-MSD) at a frequency of one per group of 20 or fewer samples. Use Table 3 in Method 8010 as a guidance on acceptable spike recoveries. The matrix spike solution must contain all the analytes listed above, at concentrations of 1 to 5 time the sample level or 3 to 5 times the CRQL for non-detected samples, whichever is higher.
6. If these control limits are exceeded, take appropriate actions to correct the problems and re-analyze the affected samples.

Data Calculations:

1. Calculate the CF and the concentration of individual analytes using the equations in Sections 7.4.2 and 7.8.1 of Method 8000. The sample results are to be reported in the concentration units of micrograms per liter (ug/l) for water samples and micrograms per kilogram (ug/Kg) on a dry weight basis for soil samples.
2. All records of analysis, dilutions and calculations must be legible and sufficient to recalculate all sample concentrations and QC results. Include an example of the calculations in the data package.

Documentation and Deliverables:

1. Report documentation for sample and blank results, date and time of analysis, surrogate recovery, MS/MSD recovery, blank summary, analytical sequency, initial and continuing calibrations (including retention time windows), and compound identification. Use forms equivalent to CLP Forms I, II, III, IV, VI, IX and X.
2. Provide all raw data, including chromatograms and area printouts/quantitation reports.
3. Raw data and summary forms are to be organized systematically and each page is to be numbered.

Analysis of Purgeable Aromatics in Water and Soil by SW846 Method 8020:

Analytes: Benzene, Toluene, Chlorobenzene, Ethylbenzene, Total Xylenes, 1,4-Dichlorobenzene, 1,3-Dichlorobenzene and 1,2-Dichlorobenzene.

Sample Matrices: Low concentration groundwater and soil samples.

Analytical Procedure and Quantitation Limits: Follow SW846 Method 5030 for sample introduction by purge-and-trap and SW846 Method 8000 and 8020 for GC analysis. Contract required quantitation limits (CRQL) are 1.0 ug/l for water samples and 1.0 ug/Kg for soil samples.

1. The use of aromatic-specific detectors, such as PID, is required.
2. Whenever an unusually concentrated sample is analyzed, it should be followed by an analysis of reagent water to check for contamination by carry-over.

Analytical Holding Times: The analytical holding time is 14 days from the date of sample collection.

Calibration Procedure and Criteria: Calibrate according to Sections 5.4 and 7.3 of Method 8020 and Sections 7.4.2 and 7.5 Method 8000, with the following specifications:

1. Five-point initial calibration curve with a low standard at 1.0 ng/mL is required.
2. A continuing calibration at the concentration of 10 ng/mL for each analyte is to be analyzed at the beginning of each day and after each group of 10 samples.
3. Less than 10% relative standard deviation (%RSD) in calibration factors (CF) for the initial calibration standards and less than +15% difference (%D) in CF for the daily continuing calibrations are required.

Internal Quality Control Checks, Control Limits and Corrective Actions:

1. Analyze method blanks after each continuing calibration analysis and after the analysis of unusually concentrated samples. The method blanks must contain less than 5 times the CRQL of toluene and must be free of other purgeable aromatics and any interfering peaks at or above the detection limits.
2. One or more purgeable halocarbon surrogates (such as trifluorotoluene and bromofluorobenzene) must be spiked into the standards, samples, method blanks and QC samples (see Sections 5.6 and 8.3 of Method 8020). Recoveries of 75-125% are required. The samples are to be re-analyzed if the surrogate recoveries are outside the QC limits.
3. Second column confirmation is required for all positive results reported.

4. Samples containing one or more analytes at concentrations above the initial calibration range are to be diluted and re-analyzed. Report the results and documentation for both analyses.
5. Analyze matrix spikes and matrix spike duplicates (MS-MSD) at a frequency of one per group of 20 or fewer samples. Use Table 3 in Method 8020 as a guidance on acceptable spike recoveries. The matrix spike solution must contain all the analytes listed above, at concentrations of 1 to 5 times the sample level or 3 to 5 times the CRQL for non-detected samples, whichever is higher.
6. If these control limits are exceeded, take appropriate actions to correct the problems and re-analyze the affected samples.

Data Calculations and Reporting Units:

1. Calculate the CF and the concentration of individual analytes using the equations in Sections 7.4.2 and 7.8.1 of Method 8000. The sample results are to be reported in the concentration units of micrograms per liter (ug/l) for water samples and micrograms per kilogram (ug/Kg) on a dry weight basis for soil samples.
2. All records of analysis, dilutions and calculations must be legible and sufficient to recalculate all sample concentrations and QC results. Include an example of the calculations in the data package.

Documentation and Deliverables:

1. Report documentation for sample and blank results, date and time of analysis, surrogate recovery, MS/MSD recovery, blank summary, analytical sequence, initial and continuing calibrations (including retention time windows), and compound identification. Use forms equivalent to CLP Forms I, II, III, IV, VI, IX and X.
2. Provide all raw data, including chromatograms and area printouts/quantitation reports.
3. Raw data and summary forms are to be organized systematically and each page is to be numbered.

Analysis of Semivolatile Organics in Water and Soil by SW846 Method 8270

Analytes: Compounds listed on Table 1 in SW846 Method 8270.

Sample Matrices: Groundwater and soil samples.

Analytical Procedure and Quantitation Limits: Follow SW846 Method 8270 for GC/MS analysis. Quantitation limits are 10 or 50 $\mu\text{g}/\text{l}$, as listed in Table 2 of the method.

Analytical Holding Times: The analytical holding time is 7 days for water and 14 days for soil from the date of sample collection.

Calibration Procedure and Criteria: Follow the calibration procedure specified in the method.

Internal Quality Control Checks, Control Limits, and Corrective Action: Follow the QC requirements specified in the method.

Documentation and Deliverables:

1. Report documentation for sample and blank results, date and time of analysis, surrogate recovery, MS/MSD recovery, blank summary, analytical sequence, initial and continuing calibrations (including retention time windows), and compound identification. Use forms equivalent to CLP Forms I, II, III, IV, VI, IX, and X.
2. Provide all raw data, including chromatograms and area printouts/quantitation reports.
3. Raw data and summary forms are to be organized systematically and each page is to be numbered.

Analysis of Organophosphorus Pesticides in Water and Soil by SW846 Method 8080

Analytes: The compounds listed on Table 1 of SW846 Method 8080.

Sample Matrices: Low concentration groundwater and soil samples.

Analytical Procedure and Quantitation Limits: Follow SW846 Method 8080 for extraction and analyses. Quantitation limits are 10 $\mu\text{g}/\text{l}$ or lower for water samples and 100 $\mu\text{g}/\text{kg}$ or lower for soil samples.

Contract Holding Time: Water samples must be analyzed 7 days after collection. Soil samples must be extracted 14 days after collection; extracts must be analyzed within 40 days.

Calibration Procedure and Criteria: Calibrate according to Method 8080 and Sections 7.4.2 and 7.5 of Method 8000, with the following specifications:

1. Five-point initial calibration curve with a low standard at the concentrations of the quantitation limit or lower is required.
2. Continuing calibrations at the mid-point concentration for each parameter are to be analyzed daily.

Internal Quality Control Checks, Control Limits, and Corrective Actions:

1. Analyze method blanks at a frequency of one per group of 20 or fewer samples.
2. Surrogates must be spiked into the standards, samples, method blanks, and QC samples as discussed in Section 5.5. The amount of surrogate added must be at least 10 times the instrument detection limit. Recoveries of 75 to 125 percent are required.
3. Second column confirmation is required for all positive results reported.
4. Analyze matrix spikes and matrix spike duplicates (MS/MSD) at the frequency of one per group of 20 or fewer samples. Concentration of matrix spike solution should be such that the final extracts contain amounts at the mid-range of the calibration curve.
5. If above control limits are exceeded, take appropriate actions to correct the problems and re-analyze the affected samples.

Data Calculations and Reporting Units:

1. Calculate the RF and the concentrations of individual analytes using the equations in SW846 Method 8080. The sample results are to be reported in the concentration units of microgram per liter ($\mu\text{g}/\text{l}$) for water samples, and milligram per kilogram (mg/kg) on a dry weight basis for soil samples.
2. All records of analysis, dilutions, and calculations must be legible and sufficient to recalculate all sample concentrations and QC results. Include an example of the calculations in the data package.

Documentation and Deliverables:

1. Report documentation for sample and blank results, sample duplicate results, surrogate recovery, MS recovery, blank summary, analytical sequence, initial and containing calibrations (including retention time windows), and compound identification. Use forms equivalent to the CLP RAS pesticides Forms I, II, III, IV, VI, VII, VIII, IX, and X. Indicate date and time of extraction/analysis.
2. Provide all raw data, including chromatograms and area printouts/quantitation reports.
3. Raw data are to be organized systematically and each page is to be numbered.

Analysis of Purgeable Halocarbons in Water and Soil by SW846 Method 8150:

Analytes: 2,4-D; Dalapon; 2,4-DB; Dicamba; Dichloroprop; Dinoseb; MCPA; MCPP; 2,4,5-T; 2,4,5-TP.

Sample Matrices: Low concentration groundwater and soil samples.

Analytical Procedure and Quantitation Limits:

1. Follow SW846 Method 8150 for extractions and analyses. Contract required quantitation limits (CRQL) are 1.0 ug/L or lower for water samples and 10 ug/Kg or lower for soil samples.
2. Diazomethane is a carcinogen and can explode under certain conditions. Refer to Section 7.3.1 of Method 8150 for precautions.
3. Capillary columns may be used for this analysis, as long as the laboratory demonstrates that the analysis meets all the performance and QA/QC criteria specified in Method 8150 and in this contract.

Analytical Holding Times: Analytical holding times are 7 days for the extraction of water samples, 14 days for the extraction of soil samples and forty (40) days for the analysis of extracts, from the date of sample collection.

Calibration Procedure and Criteria: Calibrate according to Sections 5.11 and 7.5 of Method 8150 and Sections 7.4.2 and 7.5 Method 8000, with the following specifications:

1. Five-point initial calibration curve with a low standard at the concentrations of the CRQL or lower is required.
2. A continuing calibration at the mid-point concentration for each analyte is to be analyzed at the beginning of each day and after each group of 10 samples.

Internal Quality Control Checks, Control Limits and Corrective Actions:

1. Analyze method blanks at a frequency of one per group or fewer samples. The method blanks must be free of herbicides and any interfering peaks at or above the detection limits.
2. A herbicide surrogate (e.g., a herbicide that is not expected to be present in the samples) must be spiked into the standards, samples, method blanks and QC samples (see Section 5.13 and 8.3 of Method 8150). The amount of surrogate added must be at least 10 times the instrument detection limit. Recoveries of 75-125% are required.
3. Second column confirmation is required for all positive results reported.
4. Samples extracts containing one or more analytes at concentrations above the initial calibration range are to be diluted and re-analyzed. Report the results and documentation for both analyses.

5. Analyze matrix spikes and matrix spike duplicates (MS-MSD) at a frequency of one per group of 20 or fewer samples. Concentration of matrix spike solution should be such that the final extracts contain amounts at the mid-range of the calibration curve. Recoveries of 75-125% are required.
6. If above control limits are exceeded, take appropriate actions to correct the problems and re-analyze the affected samples.

Data Calculations and Reporting Units:

1. Calculate the CF and the concentration of individual analytes using the equations in Sections 7.4.2 and 7.8.1 of Method 8000. The sample results are to be reported in the concentration units of micrograms per liter (ug/l) for water samples and micrograms per kilogram (ug/Kg) on a dry weight basis for soil samples.
2. All records of analysis, dilutions and calculations must be legible and sufficient to recalculate all sample concentrations and QC results. Include an example of the calculations in the data package.

Documentation and Deliverables:

1. Report documentation for sample and blank results, date and time of analysis, surrogate recovery, MS/MSD recovery, blank summary, analytical sequence, initial and continuing calibrations (including retention time windows), and compound identification. Use forms equivalent to CLP Forms I, II, III, IV, VI, IX and X.
2. Provide all raw data, including chromatograms and area printouts/quantitation reports.
3. Raw data and summary forms are to be organized systematically and each page is to be numbered.

Analysis of Polychlorinated Dibenzo-p-dioxins and Polychlorinated Dibenzofurans Homologs:

Analytes: Total tetra through octa chlorinated dibenzofurans and dibenzo-p-dioxins.

Sample Matrices: Groundwater and soil samples.

Analytical Procedure and Quantitation Limits:

1. Contract required detection limits (CRDL):

	<u>Water, ng/L</u>	<u>Soil, ug/Kg</u>
Tetra & penta CDFs and CDDS	1.0 - 5.0	0.1 - 0.5
Hexa CDFs and CDDs	5.0 - 10.0	0.5 - 1.0
Hepta & octa CDFs and CDDs	10.0 - 50.0	1.0 - 5.0

Calculate and report the detected results or estimated sample detection limits (SDLs, see page 3 for calculation) for the dioxin/furan homologous series.

To achieve the specified detection limits, a final volume of 100 uL or less for the extracts is recommended.

II. Analytical Methodology:

Follow the SW-846 Method 8280 or Method 8290 with the following specifications:

1. Analyze samples by a DB-5 fused silica capillary column or the equivalent. If dioxins/furans are detected in the samples, confirmatory analyses using a SP-2331 fused silica capillary column or the equivalent must be performed. Report all dioxins/furans identified and quantified by both columns. To achieve the chromatographic peak resolution criteria of <25% between 2,3,7,8-TCDD and 1,2,3,4-TCDD in the column performance check mixture, 60-meter columns are recommended for both DB-5 and SP-2331.
2. The quantitation ions, confirmation ions, and M- COCl ions used for selective ion monitoring (SIM) are specified in Table 2 of the Method 8280. Ions to be monitored are as follow:

Descriptor 1: 243, 304, 306, 316, 318, 257, 320, 322, 332, 334, 376.
Descriptor 2: 277, 340, 342, 293, 356, 358, 410.
Descriptor 3: 311, 374, 376, 327, 390, 392, 402, 404, 446.
Descriptor 4: 345, 408, 410, 418, 420, 361, 424, 426, 480.
Descriptor 5: 379, 442, 444, 395, 458, 460, 470, 472, 514.

Analytical Holding Times: Analytical holding times are 30 days from the date of sample collection.

Calibration Procedure and Criteria: Calibrate according to Sections 6.0 of Method 8280, with the following specifications:

- Internal standards and recovery standards required are as follow:

<u>Recovery Standard (RStd)</u>	<u>Daily Std Amount</u>	<u>Sample Amount</u>
13C-1,2,3,4-TCDD	0.5 ng/uL	50 ng
13C-1,2,3,7,8,9-HxCDD	0.5 ng/uL	50 ng
<u>Internal Standard (IStd)</u>		
13C-2,3,7,8-TCDF	0.5 ng/uL	50 ng
13C-2,3,7,8-TCDD	0.5 ng/uL	50 ng
13C-1,2,3,6,7,8-HxCDD	0.5 ng/uL	50 ng
13C-1,2,3,4,6,7,8-HpCDF	0.5 ng/uL	50 ng
13C-OCDD	1.0 ng/uL	100 ng

Compound Quantification:

13C-TCDF and 13C-TCDD against 13C-1,2,3,4-TCDD
 13C-HxCDD, 13C-HpCDF, and 13C-OCDD against 13C-1,2,3,7,8,9,-HxCDD
 TCDF and PeCDF against 13C-2,3,7,8-TCDF
 TCDD and PeCDD against 13C-2,3,7,8-TCDD
 HxCDD and HpCDD against 13C-1,2,3,6,7,8-HxCDD
 HxCDF and HpCDF against 13C-1,2,3,4,6,7,8-HpCDF
 OCDF and OCDD against 13C-OCDD

Results are to be calculated using the relative response factors (RRF) from the continuing calibration. The percent recoveries of each internal standard are to be calculated and reported. The samples with one or more internal standard recoveries of less than 40% or greater than 120% must be re-extracted and re-analyzed.

- A column performance check mixture containing the isomers listed in Method 8280 Paragraphs 6.3 must be analyzed at the beginning and end of a 12-hour period, as described in Paragraph 6.9.1. The QA/QC criteria as described in Paragraph 6.3 must be met.
- Initial calibration using standard solutions at concentrations of 200, 500, 1000, 2000, and 5000 ng/mL is required. Percent relative standard deviations (%RSD) of the relative response factors (RRF) for the calibration standards must not exceed 15%. A minimum signal-to-noise (S/N) ratio of 50:1 for the m/z 320 ion of 2,3,7,8-TCDD must be achieved from the 100 ng/mL standard.
- A calibration standard solution at concentration of 500 ng/mL must be analyzed at the beginning of a 12-hour period. The measured RRFs of all analytes must be within +30% of the mean values established by initial analyses of the calibration standard solutions. A minimum S/N ratio of 150:1 for the m/z 320 ion of 2,3,7,8-TCDD must be achieved.

5. Samples and method blanks are not to be analyzed until acceptable calibration criteria as described in Paragraphs 6.3, 6.4, 6.6, and 6.7 of Method 8280 are demonstrated and documented.

Internal Quality Control Checks, Control Limits and Corrective Actions:

1. Alumina/silica column clean-up procedure is required for water and soil samples and chemical wastes. Additional cleanup (such as carbon column) may be needed for highly contaminated samples.
2. Analyze method blanks at a frequency of one per group of 20 or fewer samples. The method blanks must be free of chlorinated dibenzofurans and dibenz-p-dioxins and free of any interfering peaks.
3. Analyze a sample duplicate and a native spike (NS) at the frequency of one per group of 20 or fewer samples. The NS solution must contain at least one x,2,3,7,8 isomer from each of the tetra through octa polychlorinated dibenzofuran and dibenzo-p-dioxin homologous series. Concentrations of NS solutions should be such that the final extracts contain amounts at the mid-range of the calibration curve. Recoveries of 40-140% for tetra through octa polychlorinated dibenzofurans and dibenzo-p-dioxins are required. If the recovery limits are not met, the NS must be re-extracted and re-analyzed, unless a re-injection gives acceptable recoveries.
4. For samples in which the concentration of any isomer in a homologous series is above the five-point initial calibration range, the extracts are to be diluted in such a way that the measured concentration of that particular isomer lies within the calibration range. All computed results and raw data for both the undiluted and the diluted samples analyses are to be submitted.
5. The laboratory will be expected to analyze performance evaluation samples as provided by the EPA on a periodic basis.
6. If above control limits are exceeded, take appropriate actions to correct the problems and re-analyze all affected samples.

Data Calculations and Reporting Units: Follow the calculations specified in Section 11.0 of Method 8280, with the following specification:

Estimated sample detection limit, SDL:

$$SDL = \frac{2.5 * H_x * Q_{is}}{H_{is} * RRF * W}$$

Q_{is} - quantity, in pg, of the internal standard added to sample before extraction.

H_x - peak height for the quantitation ion of the compound of interest.

H_{is} - peak height for the appropriate ion characteristic of the internal standard.

W - weight (in g) of soil or waste sample or volume of water (in mL) extracted.

The sample results are to be reported in the concentration unit of microgram per litre (ug/L) for water samples and microgram per kilogram (ug/Kg) expressed on a dry weight basis for soil/waste samples. All records of analysis and calculations must be legible and sufficient to recalculate all sample concentrations and QC results. Include an example of the calculations in the data package.

Documentation and Deliverables: Submit the documentation for sample and blank results, sample duplicate results, internal standard recovery, NS recovery, blank summary, analytical sequence, initial calibrations, and continuing calibrations.

1. Document the sample data summary, raw sample data, quality control data and calibrations on the equivalents of EPA Method 8280 forms 8280-1 to 8280-6. Indicate the scan number of each peak that was identified as dioxins/furans.
2. Provide reconstructed total ion chromatograms (RICs) and selective ion chromatograms (SICs) for all calibrations, blanks, samples and quality control samples.
3. Provide example calculations of estimated SDLs and sample results.
4. For soil/waste samples, all detected results and estimated SDLs are to be reported on dry weight basis.

Analysis of Metals by SW846 Methods 6010, 7061 (Arsenic), 7471 (Mercury), and 7741 (Selenium):

Analytes:	Detection Limits:	
	Water (ppb)	Soil (ppm)
Aluminum (6010)	50	5
Antimony	50	5
Barium	5	1
Beryllium	5	0.5
Cadmium	5	0.5
Calcium	1	100
Chromium	5	0.5
Cobalt	5	0.5
Copper	5	0.5
Iron	50	5
Lead	20	5
Magnesium	1,000	100
Manganese	5	0.5
Nickel	20	2
Potassium	1,000	100
Silver	10	2
Sodium	1,000	100
Thallium	50	5
Vanadium	5	1
Zinc	20	1
Arsenic (7061)	5	0.5
Mercury (7471)	0.5	0.025
Selenium (7741)	0.001	0.25

Sample Matrices: Groundwater and soil samples.

Analytical Procedure and Quantitation Limits: EPA Methods 6010 (ICP analysis), 7061, 7471, and 7741 procedures and detection limits will be followed.

Analytical Holding Times: Holding time prior to analysis is 6 months from the date of sample collection.

Calibration Procedure and Criteria: Calibration will be executed according to methods described in EPA Methods 6010, 7061, 7471, and 7741.

Internal Quality Control Checks, Control Limits and Corrective Actions: The quality control samples and frequency specified in the EPA Methods 6010, 7061, 7471, and 7741 will be utilized for this task. The following QC samples will be analyzed, as appropriate:

- . Method blanks.
- . Blank/spikes.
- . Matrix spikes and matrix spike duplicates.

- . Laboratory duplicates.
- . Initial and continuing calibration checks.

Data Calculations and Reporting Units: The equations in EPA Method 6010 will be used for calculation. The sample results will be reported in concentration units of ug/L.

Documentation and Deliverables: The full CLP data package.

Section Seven

7.0 RESIDENTIAL WELL SAMPLING

Residential well sampling is described in this section. Ongoing quarterly sampling of five residential wells has been carried out by the City since mid-1989. A total of 14 nearby residential wells have been sampled by previous investigators. The objective of this task is to continue the ongoing residential well monitoring in order to fully investigate the potential range of contaminants present. The data will be input to the risk assessment, and will also be used in the feasibility study.

7.1 DATA QUALITY OBJECTIVES

Data quality objectives (DQOs) are qualitative and quantitative statements of the quality of data needed to support specific decisions or regulatory actions. DQOs for residential well sampling have been developed based on intended data uses as well as sampling and analytical capabilities. Specific data uses, PARCC (precision, accuracy, representativeness, completeness, and comparability) parameters, analytical methods, and detection limits for residential well sampling are discussed in this section.

7.1.1 Prioritized Data Uses and Decisions

Data collected at residential wells will be used to evaluate the potential health threat to residents; to identify the nature and extent of groundwater contamination; and to assist in development of remedial alternatives. Level IV quality data, as defined by "Data Quality Objectives for Remedial Response Activities" (EPA 540/G-87/003A) is therefore needed for all residential well data. The analyses to be conducted on residential well samples will include volatile organic compounds, BNAs, pesticides/PCBs, herbicides, dioxin, and total metals.

Analytical methods, discussed in Section 7.3, were selected based on their ability to provide quantitation or detection limits below the relevant federal and state action limits. Potential ARARs for FSL are discussed in the CDM Fresno Sanitary Landfill Work Plan.

The specific compounds and detection limits required for each of these analytical methods are outlined in Section 7.3.

7.1.2 Quality Assurance Objectives

The quality assurance objectives for measurement data in terms of precision, accuracy, completeness, representativeness, and comparability are discussed in Appendix A.

7.2 RATIONALE FOR SAMPLE LOCATIONS, NUMBER OF SAMPLES, AND ANALYSES

Fourteen residential wells have been identified in the vicinity of the FSL (see Figure 5-1). As part of previous investigations, each of the 14 residential wells has been sampled for analysis of volatile organic compounds; 5 of these wells have been sampled quarterly by the City for the analysis of volatile organic compounds. In addition, most of the residential wells have been sampled for pesticides, metals, and water quality parameters. A review of the data indicates that concentration levels for pesticides and the majority of VOCs were below the detection limit. PCE was detected at levels above the detection limits but below federal and state action limits at numerous wells; PCE was detected at levels slightly above the action limit in 2 wells (2168 and 2429 North Avenue).

Water level and well depth information gathered from previous reports is presented in Table 11-1. A list of the well owners contacted prior to previous sampling efforts is included in Table 11-2. The vertical extent of gravel pack around the outside of the well casing is unknown for all 15 wells. Previous reports have indicated, however, that it was not uncommon years ago for wells to have extensive gravel pack intervals which sometimes extended up to the ground surface.

The objective of the residential well sampling program is to collect data for the development of a risk assessment database, for the delineation of groundwater contamination, and for the evaluation of feasible remedies. These goals will be accomplished through annual sampling of 14 residential wells and quarterly sampling by the City of five residential wells. All residential well samples will be analyzed for the following:

<u>Parameter</u>	<u>Method</u>
Volatile Organics	EPA 8240
	EPA 8010/8020
BNAs	EPA 8270
Pesticides/PCBs	EPA 8080
Herbicides	EPA 8150
Dioxin	EPA 8280
Metals (total)	EPA 6010, 7061, 7471, 7741

The specific compounds and detection limits required for each of these analytical methods are outlined in Section 7.3.

EPA Methods 8010/8020 have been selected for analysis of VOCs for all residential wells because they provide quantitation limits below state and federal action limits (e.g., MCL for vinyl chloride is 0.5 ppb). GC/MS analysis by EPA Method 8240 will also be conducted on 10% of the samples (2 wells) during the first round of sampling in order to more thoroughly characterize the nature of contamination in the groundwater. Residential wells 2168 and 2429 North have been selected for GC/MS analysis since these are the two residential wells at which PCE was detected at levels above the action limit. In the event that GC/MS analysis reveals the presence of compounds not detected by 8010/8020, the location and percentage of samples analyzed by 8240 will be re-evaluated. Also, 8240 analysis will be performed on all samples in which "unidentified peaks" were detected in the 8010/8020 analysis.

Since dioxin is relatively immobile and insoluble in water, it is not a common groundwater contaminant. During the first round of sampling analysis, EPA Method 8280 for polychlorinated dibenzofuran homologs is planned for 10% of the residential well samples (2 wells). Private wells at 2168 and 2429 North Avenue have been selected for dioxin analysis since previous data indicates they have higher levels of contamination than the other residential wells. In the event that any residential or on-site wells reveals the presence of dioxin homologs, the percentage of samples, location, and analytical method for dioxin will be re-evaluated.

7.3 ANALYTICAL AND QUALITY CONTROL PROCEDURES

The discussion of analytical and quality control methods for residential well sampling is identical to the on-site groundwater sampling procedures in Section 6.3.

The method of analyses are described in Section 8.2. The specific compounds and detection limits required for each of these analytical methods are outlined in Section 8.3.

8.1.2 Quality Assurance Objectives

The quality assurance objectives for measurement data in terms of precision, accuracy, completeness, representativeness, and comparability are discussed in Appendix A.

8.2 RATIONALE FOR SAMPLE LOCATIONS, NUMBER OF SAMPLES, AND ANALYSES

Figure 8-1 shows proposed soil sampling locations for the FSL soil investigation. Both surface and subsurface soil samples will be collected. A total of 30 soil samples are proposed consisting of 10 surface samples and 15 to 20 subsurface samples. Soil samples will be collected during the soil gas (Section 4.0) and hydrogeologic (Section 5.0) investigations. The following paragraphs describe the rationale for sample location, number, and analyses.

A total of ten surface soil samples will be collected for risk assessment purposes and to determine background. Figure 8-1 shows the location of the sampling points. Surface samples will be collected along the perimeter of the landfill at proposed soil gas monitoring locations CMW-1 through CMW-6. Upgradient and downgradient sample locations are also proposed; these are identified on Figure 8-1, near proposed CDM monitoring well locations CDM-1 and CDM-4. Finally two surface samples are proposed near private residences at 2168 North Avenue, located south of the FSL, and 1635 Jensen Avenue, located north of the FSL.

A total of 15 to 20 subsurface soil samples are proposed under this investigation. The sample locations correspond with CDM monitoring wells CDM-1 through CDM-7 (Figure 8-1). Approximately two subsurface soil samples will be collected from seven pilot borings proposed in the hydrogeologic investigation. Samples will be collected at a depth to be determined in the field. The sampling is described in Section 5.0.

Subsurface soil samples will also be collected during the soil gas investigation. The locations of these sampling points are shown on Figure 8-1 and correspond to proposed CDM gas monitoring wells CMW-1 through CMW-6. A total of six subsurface soil samples, which will consist of a composite of the 2- to 5-foot interval of each boring, are proposed. The 5-foot depth corresponds with the level at which a clay hardpan has been observed around the site. It is anticipated that the hardpan impedes transport of material downward.

The analyses to be conducted for the soil investigation include the following:

<u>Parameter</u>	<u>Method</u>
Grain Size	ASTM C136
Total Organic Carbon	ASTM D4129/D5136
Volatile Organics	EPA 8010/8020
BNAs	EPA 8270
Pesticides/PCBs	EPA 8080
Herbicides	EPA 8150
Dioxin	EPA 8280
Metals	EPA 6010, 7061, 7471, 7741

The purpose of the analyses is to characterize the extent of soil contamination at the perimeter of the site due to the landfill and to determine contaminants of concern for the risk assessment. Subsurface samples to be collected under the hydrogeologic investigation will be analyzed for volatile organics, total organic carbon (TOC), and grain size. These analytes will assist in determining the characteristics of aquifer material and ascertain if off-site subsurface soil is contaminated. It is anticipated that landfill gas is the mechanism for contaminant migration; therefore, analyses for other organics and metals are not being performed. The grain size results will also assist in selecting appropriate screen slot size for monitoring wells.

8.3 ANALYTICAL AND QUALITY CONTROL PROCEDURES

The analytical and quality control procedures for grain size and TOC analysis are presented in Section 5.3. Analytical and QA procedures for volatile organics, BNAs, pesticides/PCBs, herbicides, dioxin and metals are presented in Section 6.3.

Section Nine

9.0 AMBIENT AIR SAMPLING

There is a potential at the FSL site that landfill gas may be emanating from the landfill surface into the ambient air, which could pose a potential health risk to nearby residents. The inclusion of this task in the RI is to provide data on ambient air at the landfill so that a risk assessment can be completed for the inhalation pathway.

9.1 DATA QUALITY OBJECTIVES

Data quality are qualitative and quantitative statements of the quality of data needed to support specific decisions or regulatory actions. DQOs for ambient air sampling have been developed based on intended uses as well as sampling and analytical capabilities. Specific data uses, PARCC (precision, accuracy, representativeness, completeness, and comparability) parameters, analytical methods, and detection limits for ambient air sampling are discussed in this section.

9.1.1 Prioritized Data Uses and Decisions

Data collected for the ambient air investigation will be used to evaluate the potential health threat to residents. Data gathered under this task will meet the objectives of the risk assessment source modeling to be performed by EPA's contractor. Level IV quality data, as defined by "Data Quality Objectives for Remedial Response Activities" (EPA 540/C-87/003A) is therefore needed for ambient air analysis.

9.1.2 Quality Assurance Objectives

The quality assurance objectives for measurement data in terms of precision, accuracy, completeness, representativeness, and compatibility are discussed in Appendix A.

9.2 RATIONALE FOR SAMPLE LOCATION, NUMBER OF SAMPLES, AND ANALYSES

The proposed air sampling program consists of ambient air sampling and installation of a weather station to monitor and record wind speed. The rationale for sample location, number of samples, and analyses is described in the following paragraphs.

It is proposed that four air sampling locations be established, one for each side of the landfill. Figure 9-1 shows the proposed locations for air sampling. Previous weather monitoring data indicate a prevailing wind direction from the west-northwest. The upwind sampling location is proposed to be located on Jensen Avenue, in the vicinity of private residence. A downwind location is proposed near North Avenue, also in the vicinity of private residence. The two additional locations are required to provide a complete coverage of the landfill facility. These locations are somewhat diagrammatic and may be changed based on weather data from the met station.

It is proposed that the weather station be located in the center of the landfill. At this location wind speed and direction can be recorded and related specifically to the landfill.

At a minimum, each sampling location would be sampled twice over a 24-hour period. During this time the meteorological station would be operating continuously, recording wind speed and direction. Each 24-hour air sample will be collected with a Summa cannister with a critical orifice to control the sampling rate. Sample collection and standard operating procedures for the Summa cannister and weather station are described in Section 10.6.

The analyses to be conducted on ambient air samples will include the following:

<u>Parameter</u>	<u>Method</u>
Volatile Organics	EPA 7014 TO-14

Specifically, ambient air samples will be analyzed for vinyl chloride; benzene; methylene chloride; chloroform; 1,2-dichloroethane; 1,1,1-trichloroethane; carbon tetrachloride; trichloroethylene; tetrachloroethylene; 1,2-dibromoethane. Vinyl chloride and benzene pose the highest risk, due to their ambient air standard, for the inhalation pathway. Therefore, these two compounds will have the greatest impact on development of the risk assessment. The eight additional compounds requested for analysis have been identified in the Calderon legislation (CA HSC Section 41805.5). These compounds have been identified due to their presence in landfill gas and their potential toxicity.

9.3 ANALYTICAL AND QUALITY CONTROL PROCEDURES

See Section 4.3 for analytical and quality control procedures for analysis of air samples by EPA TO-14.

Section Ten

10.0 RI DERIVED WASTES

This section describes the approach to disposition of waste materials that will be generated during the RI investigation. The procedures for handling and disposing of RI derived wastes are described in detail for each task in Section 11.0. To summarize, all drill cuttings and excess soil sample material will be contained onsite, on the upper surface of the landfill. A shallow depression will be created using the onsite earthmoving equipment and lined with plastic sheeting, to contain the soils produced during the hydrogeology and surface/subsurface soil investigations. Waters produced during well development and purged from the wells during sampling will be contained temporarily in a portable poly tank and/or transferred directly to a vacuum tanker truck, for disposal at the Fresno sewage treatment plant located 3 miles west of the site. No wastes will be produced during the residential well sampling tank. Wastes such as discarded protective clothing, used respirator cartridges, and other materials related to personnel protection will be contained in plastic and clearly labeled; ordinary paper/putrescible trash will be contained in separate plastic garbage bags, and bags will be disposed of in the City's municipal trash system. Waters generated by decontamination procedures at the decon station will be contained and pumped into a portable poly tank, then transferred to a vacuum truck for disposal at the Fresno sewage treatment plant. Any collected or excess solvent material used in equipment decontamination will be contained and stored in a 55-gallon drum, clearly labeled, for disposal as hazardous waste.

10.1 DATA QUALITY OBJECTIVES

Since samples of derived waste will not be required, this section is not applicable.

10.2 RATIONALE FOR SAMPLE LOCATION, NUMBER OF SAMPLES, AND ANALYTICAL PROCEDURES

Not applicable.

10.3 ANALYTICAL AND QUALITY CONTROL PROCEDURES

Not applicable.

Section Eleven

11.0 FIELD METHODS AND PROCEDURES

This section presents the methods and procedures that will be used to collect samples and conduct measurements in the field. The methods are presented in the general order of field implementation. Included in this section are methods for:

- . Soil gas testing.
- . Soil borings.
- . Groundwater monitoring well installation.
- . Water level measurements.
- . Soil gas monitoring probe installation.
- . Sample collection.
- . Sample identification.
- . Sample containers, preservation, and shipping.
- . Sample report forms and chain-of-custody records.
- . On-site laboratory analytical procedures.
- . Quality assurance/control samples.
- . Documentation.
- . Disposal of contaminated materials.
- . Equipment decontamination.

This section is accompanied by a series of appendices that provide further detail for field procedures. The contents of the appendices are listed below:

Volume II

Appendix A - Quality Assurance Goals

Appendix B - Field Forms

- . Field Equipment Log
- . Unified Soil Classification System
- . Sample Boring Log
- . Boring Log
- . Sample Monitoring Well Construction Log - Standard Flush Mount
- . Monitoring Well Construction Log - Standard Flush Mount
- . Well Development Log
- . Sample Label Example
- . Chain of Custody Record
- . Custody Seal
- . Field Change Request Form

Appendix C - Standard Operating Procedures

- . Investigation-Derived Waste
- . Environmental Sample Shipping
- . Weather Station
- . Summa Canister
- . Soil Gas Probe Monitoring

Appendix D - Calibration and Operating Procedures

- . Calibration for the Hnu PI 101
- . YSI Model 33 Conductivity Meter
- . Orion SA 250 pH meter
- . Photovac 10S55 Gas Chromatograph
- . Foxboro Century 128 OVA Flame Ionization Detector

Appendix E - Laboratory Quality Assurance Manuals

- . Agriculture & Priority Pollutant Laboratories (APPL)
- . Coast-to-Coast Analytical Services
- . Tracer Research

11.1 SOIL GAS INVESTIGATION

A soil gas investigation will be conducted on the FSL site. The following is a summary of procedures for soil gas sampling. A qualified subcontractor will perform the soil gas investigation, including placement of probes and analysis of soil vapor. The subcontractor's equipment consists of a field van equipped with a gas chromatograph powered by gasoline-powered generators. A hydraulic drive mechanism is used to drive and withdraw the sampling probes.

11.1.1 Summary of Field Procedures and Sample Collection for Soil Gas Survey

Prior to the placement of the soil gas probe at each investigation point, all equipment which will come in contact with the soil will be decontaminated following the general procedures in Section 11.7. Probes consist of 7- to 10-foot lengths of 3/4-inch diameter hollow steel pipe fitted with detachable drive points.

The soil gas probe is placed in the hydraulic drive mechanism and then pushed in the ground approximately 10 to 15 feet deep; lengths of pipe are added as necessary. The probe is then withdrawn several inches to remove the open end of the probe from the drive point and expose the probe to the soil gas.

A reducer and a length of tubing is attached to the soil gas probe and a vacuum pump is used to purge the air in the probe. Based on the relatively granular soil in the vicinity of the landfill, it is anticipated that the probe evacuation time will be approximately 30 seconds. It is estimated that an evacuation pressure of approximately one to three inches of mercury will be required. The vacuum pump is capable of pulling up to 25 inches of mercury.

While the vacuum pump is running, a syringe and needle are inserted through the tubing and down into the probe. The syringe is purged with soil gas; then, without removing the syringe and needle from the adaptor, a 2-10 Ml soil gas sample is collected. Once the sample is collected, the syringe and needle are removed and the needle is capped. The sample of soil gas is then analyzed for methane; at the locations adjacent to residential housing, samples will also be analyzed for vinyl chloride. If vinyl chloride is detected by the soil gas subcontractor, another sample of soil gas will be obtained using a Summa canister, for analysis by the laboratory. Procedures for obtaining a canister sample are described in Section 11.6, Ambient Air Sampling.

11.1.2 Summary of Field Procedures and Sample Collection for Permanent Soil Gas Wells

Soil gas well borings will be installed with a hollow stem auger rig in accordance with the drilling methods for a hollow stem auger as described in "A Compendium of Superfund Field Operation Methods" EPA/540/P-87/001, Section 8.1.6.13, Hollow Stem Augers. Drilling and installation of the gas monitoring wells will be performed by a qualified subcontractor. The following is a summary of methods and procedures to be used:

Soil Gas Borings

- . An experienced contractor with knowledge of the local geologic conditions will be selected. The hollow stem auger system will be a Central Mine Equipment (CME)-75 or equivalent capable of reaching the required depths.
- . The rig and the hollow stem augers will be decontaminated following the procedures in Section 11.7 prior to drilling the first boring and after each boring is completed. The washdown will be performed at the on-site decontamination facility.
- . The hollow stem auger will either be a hydraulically or mechanically powered drill rig which simultaneously rotates and axially advances a hollow stem auger column. Each of the joints between auger sections will be properly connected.
- . Samples from the soil material will be collected from each boring using a continuous coring device. A CME continuous core sampler consisting of 5-foot long split sampling tube with basket retainer and shoe will be employed. The continuous core sampler is advanced at the same time as the drill hole, collecting a relatively undisturbed sample. One twelve-inch (12") brass sleeve will be placed inside the continuous sampler so that an analytical sample can be obtained from each 5-foot interval drilled. The material not captured by the brass sleeve in each boring will be logged by the on-site geologist. Geologic observations will be recorded on the Boring Log. The Unified Soil Classification System (USCS) will be used to describe lithologies, and symbols will be consistent with those in Appendix B.
- . After the continuous coring device is removed from the hole, it will be opened, exposing the brass sleeve and the soil material. The depth interval for each sleeve will be marked in the logbook, and the sleeve labeled using an indelible pen. Intervals which exhibit anomalous HNu readings (when

compared to other intervals in the same hole) will have analytical preference. One sleeved sample will be selected for analysis from each boring. The selected sleeve will be immediately capped by first covering the exposed ends with aluminum foil, then capping the ends with plastic caps. The caps can then be taped in place.

Samples for shipment will be prepared following procedures in Section 11.10.

- . Selected samples will be analyzed for volatiles, metals, BNAs, pesticides/PCBs, herbicides, and dioxin. Section 11.5 describes the analytical requirements.
- . In addition to completing the Boring Log for each boring, the on-site geologist will maintain a Field Logbook. The Site Logbook maintained by the field supervisor, will document the following: day, date, time entered site, temperature, weather conditions, names, and titles of personnel present; names and titles of any visitors on site; arrival time of driller and other subcontractors, feet drilled, materials used, references to the Boring Logs, decontamination iterations; any potential problem areas or incidents, and how those may impact the project; any telephone calls made and how those affected the decision-making process.

Permanent Soil Gas Well Installation and Monitoring

Six permanent gas monitoring wells will be installed at the FSL site. In each boring, a shallow probe and deep probe will be installed at depths of approximately 5 feet and 25 feet, respectively. Soil gas probes consist of 1/4" polyethylene tubing connecting the ground surface to gravel packs at specific depths. Soil gas probes will be installed in Schedule 40 PVC casing. A stopcock is located at the end of each probe.

The soil gas monitoring wells are monitored directly for methane utilizing the Bacharach HPK-2 combustible gas and oxygen indicator. The HPK-2 is capable of measuring methane at the percent levels. These levels are anticipated in the wells at the perimeter of the landfill.

Methane Measurement

Turn the HPK combustible gas indicator to ON. Perform the HPK startup procedures. Attach the probe to the stopcock with a length of 1/4" Tygon^R

tubing. The pump should almost stop. If it does not, there is a leak in the sample line. Locate and repair the leak before proceeding.

Open the stopcock, watch closely for water in the sampling line. Turn the HPK off quickly if water enters the liquid trap. Read the combustible and oxygen meters when the needle on the oxygen meter reaches its low point. Close the stopcock. Disconnect the Tygon^R tubing at the stopcock. Let the HPK vent with the pump running until the oxygen meter reads 21 percent again.

Bag Sample Collection

If the direct measurement of the gas well with the HPK does not indicate the presence of methane, a bag sample will be collected to analyze the well for lower methane concentrations. Use the HPK-2 to determine whether the air in the vicinity of the probe is flammable. Turn the HPK combustible gas indicator to ON. Perform the HPK start up procedure. Survey the areas near the probes. Read the combustible meters as you survey. If you find any reading over 2%, don't use the generator or electric pump.

Turn the generator to ON. Attach the power cord of the vacuum pump to the generator. Attach 1/4" Tygon^R tubing to the inlet and outlet of the pump with 1/2" Tygon^R tube couplings. Run the outlet tubing downwind. Attach the inlet tubing to the stopcock of the probe. Turn the pump to ON. Open the stopcock. Purge each probe for at least one minute with the pump. Observe the liquid trap of the pump closely. Turn the pump off quickly if water enters this trap.

For each probe in each gas well, in turn:

Attach the specifically marked tedlar bag marked for that probe to the bag nozzle on the inside of the vacuum trap bucket lid with a short piece of 1/4" teflon tubing. Open the bag by rotating it counterclockwise on its valve. Close the lid on the bucket with the bag. Connect the vacuum trap inlet nozzle to the appropriate port of the vacuum trap bucket to the vacuum pump inlet house with 1/4" Tygon^R tubing. Turn the pump on. Watch

the bag fill through the sight glass. When the bag is 1/2 full, turn the pump off and remove the lid from the bucket. Close the bag by rotating it clockwise on its valve. Remove the bag from the nozzle. Disconnect the Tygon^R tubing at the probe stopcock. Close the bucket. Draw a vacuum on the empty vacuum trap for 20 to 30 seconds to purge the tubing.

Place the bag in the picnic cooler to protect the gas from ultraviolet light. Analyze the bags as soon as possible, but no later than three hours after their collection. No more than 8 bags should be placed into the picnic cooler at one time.

Methane Measurement

Determine the gas quality using the organic vapor analyzer. Perform the following procedures outdoors.

Turn the OVA to ON and perform the OVA startup procedures provided in Appendix D. Perform the calibration procedure using a 100 ppm methane standard. Allow the instrument to stabilize a minute after calibration. Set the needle to zero. Gas bag testing may be done with the alarm volume turned off.

Set the range switch to x 100. Attach the OVA probe to the Tedlar gas sample bag with a short piece of Tygon^R tubing. Open the valve on the bag. Change the range setting to the lowest range that yields a reading below full scale. Record the gas concentration on the data sheet. Close the valve on the bags and disconnect the tubing from the bag.

11.1.3 Disposal of Contaminated Material

Drill cuttings will be generated during the drilling of borings for permanent gas wells. These cuttings will be transported to the upper surface of the landfill. At this location, a depression will be constructed for disposal of contaminated material. At a maximum, the depression will be 3 feet deep and 100 feet by 100 feet in area. A liner

of visqueen will be placed within the depression prior to any disposal of soil material.

11.2 HYDROGEOLOGIC INVESTIGATION

A hydrogeologic investigation will be performed on the FSL site. The following paragraphs describe the method and procedures to be used.

11.2.1 Summary of Field Procedures and Sample Collection Methods

Two types of drill rigs will be used in the hydrogeologic investigation. These include a mud rotary rig and air rotary casing hammer rig. A mud rotary rig will be used to drill pilot boreholes for downhole geophysical surveys. Based on the geophysical characteristics of the pilot borings, the completion intervals of the monitoring wells will be determined. The borings drilled with the mud rotary drilling method will be drilled as described in "A Compendium of Superfund Field Operations Methods" EPA/540/P-87/001, Section 8.1.6.1.7, Mud and Water Rotary Drilling. Mud rotary drilling is required in order to run geophysical logs, to adequately characterize the subsurface. The following is a summary of the methods and procedures to be used:

- . A drilling contractor shall be selected with experience in the local area, if possible. The rigs shall be of a design adequate to reach the depths anticipated. Two contractors may be required to supply both mud rotary and air rig equipment.
- . The mud rotary rig and all drill pipe will be decontaminated prior to drilling the first hole and between holes. A decontamination facility will be established on the site to allow rig washdown and drill pipe decontamination between borings. Decontamination procedures are discussed in Section 11.7.1.
- . Only pure bentonite mud will be used during drilling. No drilling additives or synthetic polymers will be used. During drilling, mud will be contained in a portable mud tank and recirculated. When drilling is complete, mud will be pumped into a dump truck or other properly designed vehicle and hauled to the upper surface of the landfill and placed in the lined depression, discussed in Section 11.1.3. Disposal of drilling muds are also discussed in Section 11.2.2.

- . Each boring will be logged by examining the cuttings brought to the surface by the circulating mud. Geologic observations will be recorded on the Boring Log; a sample form is included in Appendix B. The USCS will be used to describe lithologies, and symbols will be consistent with those in Appendix B. Borings will be advanced to approximately 250 feet below ground surface.
- . Downhole geophysics will be run in each boring by a qualified geophysical contractor. Spontaneous potential, resistivity, and gamma ray logs will be requested. Logs will be run at a scale of 1-inch to 20 feet, at an appropriate sensitivity to clearly show formational contacts. Field prints and reproducible mylars or computer disc copies will be obtained from the contractor.
- . Subsurface samples of aquifer material will be collected at selected depths from the pilot borings. In zones of suspected permeable aquifer material, the driller will collect a split-spoon sample using the drill string to drive and retrieve the sampler. Brass sleeves will be placed inside the sampler. Samples will be collected for volatile organics, total organic carbon (TOC), and particle size distribution. Sample preservation and handling are discussed in Section 11.10.
- . At the completion of geophysical logging and sampling, the pilot borings will be grouted to the surface as quickly as possible. No pilot borings will remain open overnight, to minimize any intercommunication.
- . In addition to completing the Boring Log for each boring, the on-site geologist will maintain a Field Logbook. The Site Logbook will be maintained by the field supervisor.

The boreholes for monitoring well installation will be drilled using an air rotary drill rig. The boreholes will be drilled in accordance with procedures described in "A Compendium of Superfund Field Operations Methods" EPA/540/P-87/001, Section 8.1.6.1.8, Air Rotary Method. Monitor well depths will be determined based on the geophysical logs obtained from the pilot borings.

The air rotary casing driver combination is particularly efficient where drilling through unconsolidated materials. In areas of heaving or running sands, unstable zones are supported by the outer casing. Reliable lithologic samples are collected from the interval that is being drilled because the overlying formation is cased off. The casing also minimizes

the potential for inter-aquifer cross-contamination. The following is a summary of the methods and procedures to be used:

- . A drill rig and contractor shall be selected with experience in the local area, if possible. The rig shall be of a design adequate to reach the depths anticipated.
- . The rig and all drill pipe will be decontaminated prior to drilling the first hole and between holes. A decontamination facility will be established to allow washdown and drill pipe decontamination between borings. Decontamination procedures are discussed in Section 11.7.1.
- . No drilling additives will be used.

During drilling, cuttings will be contained in a portable tank or drums. When drilling is complete, the containers will be placed into a truck and transported to the landfill as discussed in Section 11.1.4.

- . Geologic observations will be recorded on the Boring Log; a sample form is included in Appendix B. The USCS will be used to describe lithologies, and symbols will be consistent with those in Appendix B.
- . In addition to completing the Boring Log for each boring, the on-site geologist will maintain a Field Logbook. The Site Logbook will be maintained by the field supervisor.

Monitoring Well Installation

After drilling of the boreholes, monitoring wells will be installed. The following is a description of installation procedures.

- . All casing material will be decontaminated by the driller prior to use. Casing will be steam cleaned and allowed to air dry.
- . Casing for shallow and intermediate depth wells will be 4-inch, Schedule 40 PVC (per ASTM D1875) with flush-threaded joints. Deep wells will be completed with 4-inch Schedule 80 PVC. The general locations and planned depths are described in Section 4.0. The completion intervals will be selected in the field based on the results of the geophysical logs.
- . Two-foot sections of blank riser and screen will be retained for evidence of material used. The samples will be wrapped in aluminum foil and retained for the length of the project.

After the well screen and casing are installed through the drill casing, the annulus around the well screens will be filled with a formation stabilizer consisting of inert Monterey silica sand or equivalent that is well rounded and sorted, with the sand size based on a sieve analyses performed in the field, and/or a review of the soil grain size analyses conducted on samples collected from the pilot borings. Appendix B contains the procedure for sieve analysis. A sample of the formation stabilizer will be retained for evidence of materials used. The formation stabilizer will be placed in the annulus and brought up five feet above the top of the screen.

An annular seal will be placed above the sand pack, consisting of three feet of pure bentonite, which will be hydrated according to manufacturer instructions, followed by a grout mixture of cement and bentonite to the ground surface. During material installation, the drill casing will be continuously withdrawn. The cement/bentonite grout will be emplaced using a tremie system. The cement/bentonite grout will be mixed according to the following ratios: 7.0 gallons potable water, 94 pounds of Type I/II Portland Cement, and 3-4 pounds pure bentonite additive, yielding 1.55 cubic feet per sack of cement. Grout will be tremied into all wells where open boreholes are present. Samples of the bentonite pellets, cement, bentonite used in the grout mixture, and water used in the grout will be retained as evidence of materials used in well construction. Two pounds of the dry material, prior to mixing, and one liter of water will be retained.

Screen lengths will be a maximum of 10 feet for all monitoring wells, to minimize dilution of water quality samples. If thicker aquifer materials are encountered, additional wells may be required.

The surface completion will consist of a steel protective casing set 3 to 4 feet above the ground surface. Three posts, 3 to 4 feet in height, will be cemented into the ground around each monitoring well. The posts will prevent damage to the well from vehicular traffic. Each well will be locked with a padlock to prevent unauthorized access. All of the locking devices will be keyed alike.

A concrete apron will be constructed around the protective casing, and will be sloped away from the well. The well number will be inscribed in the concrete apron with a scribing tool. A metal plate will be affixed to the inside of the protective casing, containing the following information permanently inscribed: (1) well number, (2) date installed, (3) completed depth, and (4) screen interval.

Well Development

Following well installation, the completed wells will be developed to promote aquifer flow into the well. The following general procedures will be followed:

- . Wells will be developed using a combination of surge block, bailing, or submersible pump methods. Development water will be contained in a vacuum truck or portable tank.
- . Wells will be developed until a water sample tests less than 5 Nephelometric Turbidity Units (NTU) of turbidity (described below) and is relatively free of suspended material, or until the well has been purged for a total of 4 hours. At least three casing volumes of water will be removed. The bailer, surge block, and/or submersible pump will be decontaminated at the central decontamination facility prior to and following each use.
- . The development water will be monitored periodically for temperature and conductivity with a YSI Model 33 S-C-T meter and for pH with an Orion SA 250 pH meter (calibration and operating procedures are included in Appendix C). Measurements will be recorded in the field logbook. The rate of water level recovery will be monitored immediately following well development using a freshly decontaminated water level probe, and the measurements recorded on the appropriate form in Appendix A. Quality control procedures for monitoring instruments as described in the QAPP and in the manufactures' SOPs will be followed and recorded in the logbook.
- . After development, all wells will be equipped with dedicated bladder pumps and inflatable packer assemblies similar to those in existing wells to facilitate well sampling. Pumps and packers will be obtained from QED Environmental Systems or equivalent.
- . All well construction and development information will be recorded in the field logbook. Monitoring well construction log forms will be completed and will be referenced in the field logbook. A sample monitoring well construction form is included in Appendix A. Well development data will be recorded in the field logbook. All development water will be containerized and disposed of following procedures discussed in the following section.

11.2.2 Disposal of Contaminated Material

Drill cuttings generated during the drilling of pilot and monitor well borings will be disposed of as discussed in Section 11.1.3. Development water generated from the new monitoring wells will be pumped into a vacuum truck and disposed of in the Fresno sanitary treatment plant which is located 3 miles west of the site.

11.3 GROUNDWATER INVESTIGATION

Forty-one on-site wells will be sampled as part of the groundwater investigation. Installation of new monitoring wells is discussed above and in Section 5. The annual and quarterly sampling schedule for these wells is outlined on Table 11-1. Well construction details for existing wells are included in Table 11-2. Table 11-3 includes the analytical methods, sample containers, and sample collection points for annual sampling. The following is a summary of the field procedures for groundwater sampling.

11.3.1 Summary of Field Procedures and Sample Collection for the Groundwater Investigation

The twenty-four existing and seventeen new on-site monitoring wells will be equipped with operable dedicated bladder pumps. Well construction details for existing wells are listed in Table 11-2.

- . A decontamination, sample preparation, and support area will be set up at the wellhead. All equipment and instruments that will be placed into the well casing or come in contact with water samples will be decontaminated. Decontamination procedures are described in Section 11.7.1. All decontamination procedures will be recorded in the field logbook.
- . The depth to water will be measured using the water level indicator device. Water levels will be measured to an accuracy of 0.04 feet and a precision of 0.01 feet. The probe will be decontaminated before and after each use. The water level will be recorded in the field logbook. Depth to water will be recorded as measured from the top of the well casing.
- . Calculate the volume of water in casing storage within the packed-off interval. The casing storage volume is calculated

**TABLE 11-1
GROUNDWATER SAMPLING SCHEDULE**

One-Time Sampling During RI	Subsequent Quarterly Sampling	Yearly Sampling (Every 4th Quarter)
UW-1A	UW-2A	UW-1A
UW-1B	UW-2B	UW-1B
UW-1C	UW-2C	UW-1C
W-2	CDM-1A	W-2
UW-2A	CDM-1B	UW-2A
UW-2B	CDM-1C	UW-2B
UW-2C	DW-1A	UW-2C
CDM-1A	DW-1B	CDM-1A
CDM-1B	DW-1C	CDM-1B
CDM-1C	CDM-4A	CDM-1C
W-3	CDM-4B	W-3
W-6	CDM-4C	W-6
MW-4	W-1R	MW-4
CDM-2A	CDM-6A	CDM-2A
CDM-2B		CDM-2B
CDM-2C		CDM-2C
CDM-3A		CDM-3A
CDM-3B		CDM-3B
OW-1		OW-1
EW-1		EW-1
DW-1A		DW-1A
DW-1B		DW-1B
DW-1C		DW-1C
CDM-4A		CDM-4A
CDM-4B		CDM-4B
CDM-4C		CDM-4C
W-4		W-4
MW-3		MW-3
W-5		W-5
19-H1		19-H1
MW-2		MW-2
CDM-5A		CDM-5A
CDM-5B		CDM-5B
CDM-5C		CDM-5C
DW-2A		DW-2A
DW-2B		DW-2B
DW-2C		DW-2C
W-1R		W-1R
MW-1		MW-1
CDM-6A		CDM-6A
4-16		4-16
CDM-7A		CDM-7A
CDM-7C		CDM-7-C

TABLE 11-2

ELEVATION AND COMPLETION DATA FOR EXISTING
ON-SITE MONITORING WELLS
FRESNO SANITARY LANDFILL

Well	Elevation At Well Datum (ft)	Total 2" PVC Casing Length (ft) ³	Top of Pump (ft) ³	Top of Packer (ft) ³	Depth of Screened Interval (ft)	Elevation of Water Surface (ft above MSL)
W-1R	267.90 ¹ **	72.92	67.00	-	50-60	210.85
W-2	266.40 ¹	69.50	64.00	-	50-60	210.62
W-3	266.40 ¹	71.83	66.00	-	50-60	211.65
W-4	264.00 ¹	68.87	63.00	-	50-60	208.21
W-5	266.50 ¹	69.09	65.00	-	50-60	208.64
W-6	Not Surveyed	69.23	65.00	-	50-60	-
MW-1	267.38**	71.17	66.00	-	59-61	211.08
MW-2	266.22**	71.50	66.00	-	59-69	211.32
MW-3	264.47	65.40	59.00	-	53-63	210.38
MW-4	266.54**	67.60	62.00	-	55-65	211.58
UW-1A	266.54	70.45	56.15	-	50-60	211.38
UW-1B	265.48	95.38	87.00	-	100-110	212.05
UW-1C	265.41	147.67	137.75	133.00	150-160	211.92
UW-2A	265.42	57.30	51.40	-	50-60	210.55
UW-2B	265.38	85.71	75.83	-	100-110	211.21
UW-2C	265.42	149.10	138.71	134.00	150-160	211.10
DW-1A	262.23	56.19	?	Not Measured	50-60	-
DW-1B	262.07	108.60	96.75	94.00	100-110	209.57
DW-1C	260.95	158.25	151.83	133.00	150-160	209.63
DW-2A	265.95	70.33	?	-	50-60	209.73 ²
DW-2B	264.99	110.22	99.33	95.00	100-110	209.54
DW-2C	266.34	169.37	155.65	144.00	150-160	210.87
OW-1	263.92	102.80	92.00	81.00	82.5-102.5	209.96
EW-1	264.52	?	?	?	50-100	210.52

* Water level measurements taken on: 5/11 - 5/18/89

**Portion of 2-inch PVC stick up cut to accommodate new pump

¹ From measurement by Mitchel/Anderson 7/29/88

² Water level measurement taken on 6/5/89

³ From top of 2" PVC casing

Table 11-3
Summary of Analyses for
Groundwater Well Samples

ANALYTICAL METHOD		VOC 8240	VOC 8010/8020	BNA 8270	Pest/PCB 8080	Herbicides 8150	Dioxin 8280	Total Metals 6010/7061 7471/7741	Bottles per Location
PRESERVATIVES		2 drops 1:1 HCl Chill to 4 C	2 drops 1:1 HCl Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	HNO3 to pH < 2	
ANALYTICAL HOLDING TIME		<14 days	<14 days	<7 days before extraction	<7 days before extraction	<7 days before extraction	<30 days before extraction	<6 months (28 days for Hg)	
SAMPLE NUMBER	SAMPLING SCHEDULE	3 x 40 ml glass vial	3 x 40 ml glass vial	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	1 x 1 liter polyethylene bottle	
UW1A-GW-001*	Day 1	-	3	2	2	2	-	1	10
UW1B-GW-001	Day 1	-	3	2	2	2	-	1	10
UW1C-GW-001	Day 1	-	3	2	2	2	-	1	10
W2-GW-001Q	Day 1	-	3	4	4	4	4	2	21
UW2A-GW-001*	Day 2	-	3	2	2	2	-	1	10
UW2B-GW-001	Day 2	-	3	2	2	2	-	1	10
UW2C-GW-001	Day 2	-	3	2	2	2	-	1	10
TOTALS		0	21	16	16	16	4	8	81

Q = laboratory QC sample

* = well dry during 9/90 sampling

Table 11-3
Summary of Analyses for
Groundwater Well Samples

ANALYTICAL METHOD		VOC 8240	VOC 8010/8020	BNA 8270	Pest/PCB 8080	Herbicides 8150	Dioxin 8280	Total Metals 6010/7061 7471/7741	Bottles per Location
PRESERVATIVES		2 drops 1:1 HCl Chill to 4 C	2 drops 1:1 HCl Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	HNO3 to pH < 2	
ANALYTICAL HOLDING TIME		<14 days	<14 days	<7 days before extraction	<7 days before extraction	<7 days before extraction	<30 days before extraction	<6 months (28 days for Hg)	
SAMPLE NUMBER	SAMPLING SCHEDULE	3 x 40 ml glass vial	3 x 40 ml glass vial	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	1 x 1 liter polyethylene bottle	
CDM1A-GW-001	Day 3	-	3	2	2	2	-	1	10
CDM1B-GW-001	Day 3	3	3	2	2	2	-	1	13
CDM1C-GW-001	Day 3	-	3	2	2	2	-	1	10
W3-GW-001	Day 3	-	3	2	2	2	2	1	12
CDM20-GW-001 (duplicate of W3-GW-001)	Day 3	-	3	2	2	2	-	2	11
W6-GW-001	Day 4	-	3	2	2	2	-	1	10
MW4-GW-001	Day 4	-	3	2	2	2	-	1	10
CDM2A-GW-001	Day 4	-	3	2	2	2	-	1	10
CDM2B-GW-001	Day 4	-	3	2	2	2	-	1	10
CDM2C-GW-001	Day 4	-	3	2	2	2	-	1	10
TOTALS		3	30	20	20	20	2	11	106

q = laboratory QC sample

* = well dry during 9/90 sampling

Table 1-3
Summary of Analyses for
Groundwater Well Samples

ANALYTICAL METHOD		VOC 8240	VOC 8010/8020	BNA 8270	Pest/PCB 8080	Herbicides 8150	Dioxin 8280	Total Metals 6010/7061 7471/7741	Bottles per Location
PRESERVATIVES		2 drops 1:1 HCl Chill to 4 C	2 drops 1:1 HCl Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	HNO3 to pH < 2	
ANALYTICAL HOLDING TIME		<14 days	<14 days	<7 days before extraction	<7 days before extraction	<7 days before extraction	<30 days before extraction	<6 months (28 days for Hg)	
SAMPLE NUMBER	SAMPLING SCHEDULE	3 x 40 ml glass vial	3 x 40 ml glass vial	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	1 x 1 liter polyethylene bottle	
CDM3A-GW-001	Day 5	-	3	2	2	2	-	1	10
CDM3B-GW-001	Day 5	-	3	2	2	2	-	1	10
OW1-GW-001Q	Day 5	3	3	4	4	4	-	2	20
EW1-GW-001**	Day 5	-	3	2	2	2	-	1	10
DW1A-GW-001*	Day 6	-	3	2	2	2	-	1	10
DW1B-GW-001	Day 6	3	3	2	2	2	2	1	15
CDM21--GW-001 (duplicate of DW1B-GW-001)	Day 6	3	3	2	2	2	2	1	15
DW1C-GW-001	Day 6	3	3	2	2	-	-	1	11
TOTALS		12	24	18	18	16	4	9	101

Q = laboratory QC sample
* = well dry during 9/90 sampling
** = pump broken 9/90

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Table 11-3
Summary of Analyses for
Groundwater Well Samples

ANALYTICAL METHOD		VOC 8240	VOC 8010/8020	BNA 8270	Pest/PCB 8080	Herbicides 8150	Dioxin 8280	Total Metals 6010/7061 7471/7741	Bottles per Location
PRESERVATIVES		2 drops 1:1 HCl Chill to 4 C	2 drops 1:1 HCl Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	HNO3 to pH < 2	
ANALYTICAL HOLDING TIME		<14 days	<14 days	<7 days before extraction	<7 days before extraction	<7 days before extraction	<30 days before extraction	<6 months (28 days for Hg)	
SAMPLE NUMBER	SAMPLING SCHEDULE	3 x 40 ml glass vial	3 x 40 ml glass vial	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	1 x 1 liter polyethylene bottle	
CDM4A-GW-001	Day 7	-	3	2	2	2	-	1	10
CDM4B-GW-001	Day 7	-	3	2	2	2	-	1	10
CDM4C-GW-001	Day 7	-	3	2	2	2	-	1	10
W4-GW-001*	Day 7	-	3	2	2	2	-	1	10
MW3-GW-001*	Day 8	-	3	2	2	2	-	1	10
W5-GW-001*	Day 8	-	3	2	2	2	-	1	10
19H1-GW-001	Day 8	-	3	2	2	2	-	1	10
MW2-GW-001	Day 8	-	3	2	2	2	-	1	10
TOTALS		0	24	16	16	16	0	8	80

* = well dry during 9/90 sampling

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Table 11-3
Summary of Analyses for
Groundwater Well Samples

ANALYTICAL METHOD		VOC 8240	VOC 8010/8020	BNA 8270	Pest/PCB 8080	Herbicides 8150	Dioxin 8280	Total Metals 6010/7061 7471/7741	Bottles per Location
PRESERVATIVES		2 drops 1:1 HCl Chill to 4 C	2 drops 1:1 HCl Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	HNO3 to pH < 2	
ANALYTICAL HOLDING TIME		<14 days	<14 days	<7 days before extraction	<7 days before extraction	<7 days before extraction	<30 days before extraction	<6 months (28 days for Hg)	
SAMPLE NUMBER	SAMPLING SCHEDULE	3 x 40 ml glass vial	3 x 40 ml glass vial	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	1 x 1 liter polyethylene bottle	
CDM5A-GW-001	Day 9	-	3	2	2	2	-	1	10
CDM5B-GW-001	Day 9	-	3	2	2	2	-	1	10
CDM5C-GW-001	Day 9	-	3	2	2	2	-	1	10
DW2A-GW-001Q	Day 9	3	3	4	4	4	-	2	20
DW2B-GW-001	Day 10	-	3	2	2	2	-	1	10
DW2C-GW-001	Day 10	-	3	2	2	2	-	1	10
W1R-GW-001	Day 10	-	3	2	2	2	2	1	12
MW1-GW-001	Day 10	-	3	2	2	2	2	1	12
CD22-GW-001 (duplicate of MW1-GW-001)	Day 10	-	3	2	2	2	-	2	11
TOTALS		3	27	20	20	20	4	11	105

Table 11-3
Summary of Analyses for
Groundwater Well Samples

ANALYTICAL METHOD		VOC 8240	VOC 8010/8020	BNA 8270	Pest/PCB 8080	Herbicides 8150	Dioxin 8280	Total Metals 6010/7061 7471/7741	Bottles per Location
PRESERVATIVES		2 drops 1:1 HCl Chill to 4 C	2 drops 1:1 HCl Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	HNO3 to pH < 2	
ANALYTICAL HOLDING TIME		<14 days	<14 days	<7 days before extraction	<7 days before extraction	<7 days before extraction	<30 days before extraction	<6 months (28 days for Hg)	
SAMPLE NUMBER	SAMPLING SCHEDULE	3 x 40 ml glass vial	3 x 40 ml glass vial	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	1 x 1 liter polyethylene bottle	
CDM6A-GW-001	Day 11	-	3	2	2	2	-	1	10
CDM7A-GW-001	Day 11	-	3	2	2	2	-	1	10
CDM7C-GW-001	Day 11	-	3	2	2	2	-	1	10
CDM8-GW-001 (blank)	Day 1	3	3	2	2	2	-	1	13
CDM9-GW-001 (blank)	Day 2	-	3	2	2	2	2 *	1	12
CDM10-GW-001 (blank)	Day 3	-	3	2	2	2	-	1	10
CDM11-GW-001 (blank)	Day 4	-	3	2	2	2	-	1	10
CDM12-GW-001 (blank)	Day 5	-	3	2	2	2	-	1	10
TOTALS		3	24	16	16	16	2	8	85

* = Dioxin blanks to be held by lab for possible future analysis

Table 11-3
Summary of Analyses for
Groundwater Well Samples

ANALYTICAL METHOD		VOC 8240	VOC 8010/8020	BNA 8270	Pest/PCB 8080	Herbicides 8150	Dioxin 8280	Total Metals 6010/7061 7471/7741	Bottles per Location
PRESERVATIVES		2 drops 1:1 HCl Chill to 4 C	2 drops 1:1 HCl Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	HNO3 to pH < 2	
ANALYTICAL HOLDING TIME		<14 days	<14 days	<7 days before extraction	<7 days before extraction	<7 days before extraction	<30 days before extraction	<6 months (28 days for Hg)	
SAMPLE NUMBER	SAMPLING SCHEDULE	3 x 40 ml glass vial	3 x 40 ml glass vial	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	1 x 1 liter polyethylene bottle	
CDM13-GW-001 (blank)	Day 6	-	3	2	2	2	-	1	10
CDM14-GW-001 (blank)	Day 7	-	3	2	2	2	-	1	10
CDM15-GW-001 (blank)	Day 8	-	3	2	2	2	-	1	10
CDM16-GW-001 (blank)	Day 9	-	3	2	2	2	-	1	10
CDM17-GW-001 (blank)	Day 10	-	3	2	2	2	-	1	10
CDM18-GW-001 (blank)	Day 11	-	3	2	2	2	-	1	10
TOTALS		0	18	12	12	12	0	6	60

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using the formula: $(3.14) \times (\text{well radius in feet})^2 \times (\text{length of water column}) \times (76.7.48 \text{ gallons/cubic foot})$, to determine one casing volume in gallons.

- . A minimum of 3 casing volumes of water will be purged, with exceptions made for wells with low recharge rates. Low recharge wells are defined as wells that cannot recharge 80% of the original volume within 8 hours. Low recharge wells will not be drawn down more than 50% of the original volume during purging.
- . Temperature, pH, and conductivity will be monitored during the purging to ensure that they have stabilized within 10% before sampling. These water quality measurements should be made at a frequency of 10 percent of purge volume (e.g., every 10 gallons for a 100 gallon purge volume). A model 33 YSI conductivity meter will be used to measure conductivity and temperature. The pH will be determined through the use of a portable Orion SA250 pH meter.
- . Information concerning well purging shall be recorded in the logbook. The disposal of purge water is discussed in Section 11.3.2.
- . Fill up the VOA vials first. Check for air bubbles in the VOA vial by turning it upside-down and tapping the side of the bottle. If bubbles are present, discard the sample and refill the bottle after first adding acid.
- . QA samples will be prepared at the frequency discussed in Section 11.11. All samples will be logged in the field logbook. The groundwater sampling form will be prepared and the form will be referenced in the field logbook. Included will be the well number, identifier, analyte(s), date, time, and collector's signatures.
- . Samples will be labeled and packed for shipment, following procedures in Section 11.10. Chain-of-custody records and any other necessary shipping documentation will be prepared.

11.3.2 Disposal of Contaminated Material

Purge water will be pumped from each well directly into a 100-gallon polyethylene tank for temporary on-site storage. The water will be transported to the Fresno Sanitary Treatment Plant for final disposal.

11.4 RESIDENTIAL WELL SAMPLING

Fourteen residential wells and one City well in the vicinity of the Fresno Sanitary Landfill will be sampled as part of the residential well sampling. The following is a summary of the field procedures for residential well sampling.

11.4.1 Summary of Field Procedures and Sample Collection for Residential Well Sampling

Since the 14 residential wells are operating domestic wells, samples will be obtained from faucet taps. At the on-site City well (19H1), the sample will be collected from a faucet at the wellhead. The rationale for residential well sampling locations has been discussed in Section 7.0; residential well owners are listed in Table 11-4. Table 11-5 lists elevation data for residential wells. Table 11-6 lists the analytical methods, sample containers, and sample collection points for residential well samples.

Summary of Field Procedures

1. The volume of holding tanks, if any, used by households to store well water will be estimated.
2. Based on flow estimates measured by timing flow into a calibrated bucket, the purge volume of the holding tanks will be calculated and evacuated prior to sampling. After the holding tank volume has been evacuated, water will be allowed to run for an additional fifteen minutes.
3. If no holding tanks are present, water from the tap will be run for 15 minutes prior to sampling, and field parameters will be monitored to ensure that they have stabilized.
4. Measure the conductivity, temperature, and pH of the groundwater periodically in a separate container. Record all field measurements in the field notebook. A Yellow Springs Instruments (YSI) conductivity (SCT) meter and an Orion pH probe will be used for these measurements. All manufacturers calibration and maintenance procedures will be followed. At least four measurements will be collected during the 15 minute purge. The conductivity and pH measurements should stabilize within 10% prior to sample collection.
5. Calculate the flow rate using a calibrated bucket and record the total volume purged.

TABLE 11-4

LIST OF WELL OWNERS IN THE IMMEDIATE VICINITY
OF THE FRESNO LANDFILL*

Mr. Richard Salinas
1770 West North Avenue
Fresno, CA 93706

Bobby and Mary Mink
2045 West North Avenue
Fresno, CA 93706

Mr. Dorsey Brown
2100 West North Avenue
Fresno, CA 93706

Mr. Walter Kraft
2142 West North Avenue
Fresno, CA 93706

Mr. John Trujillo
P. O. Box 725
Mendota, CA 93640
(for 2168 West North Avenue)

Concha Trujillo
2188 West North Avenue
Fresno, CA 93706

Mr. Cecil Nuckels
2429 West North Avenue
Fresno, CA 93706

Mr. Augustine Gaona
1304 West Jensen Avenue
Fresno, CA 93706

Mr. Mitchel Batrich
1346 West Jensen Avenue
Fresno, CA 93706

**Barbara Paolini and
Jan Victoria Angel
300 Fairview Avenue
Seattle, WA 98109
(for 1635 West Jensen Avenue)

**1638 and 1646 West Jensen:
unknown owners; houses vacant

Mr. Marvin Wines
1650 West Jensen Avenue
Fresno, CA 93706

Mike and Jeanine Chiarito
1912 Jensen Avenue
Fresno, CA 93706

*Earth Science Associates 9/25/89
**Owners not residing at these addresses

TABLE 11-5

ELEVATION DATA FOR RESIDENTIAL WELLS IN THE
IMMEDIATE VICINITY OF THE FRESNO SANITARY LANDFILL*

Well	Elevation at Well Datum (ft)	Distance From Well Datum To Grade (ft)	Approximate Elevation At Grade (ft above MSL)	Static Water Depth** (ft)	Elevation of Water Surface (ft above MSL)	Total Well Depth (ft)
1770 North	(1)	?	265.70	(2)	(2)	90+
2045 North	(1)	-0.75	(1)	53.28	(2)	(2)
2100 North	264.60	-0.50	264.10	52.95	211.15	197
2142 North	263.32	-0.42	262.90	52.48	210.42	-144
2168 North	263.57	-0.47	263.10	52.53	210.57	-133
2188 North	262.51	-0.21	262.30	52.09	210.21	-102?
2429 North	(1)	?	(1)	(2)	(2)	(2)
1304 Jensen	(1)	?	(1)	(2)	(2)	150?
1346 Jensen	(1)	?	(1)	(2)	(2)	-100
1642/38 Jensen	(1)	-0.60	(1)	53.71	(2)	100±
1635 Jensen	268.12	-2.02	266.10	(2)	(2)	200±
Domestic						
1650 Jensen	(1)	?	(1)	(2)	(2)	(2)
1912 Jensen	(1)	-0.75	(1)	57.86	(2)	-98
2121 Jensen	?	?	?	(2)	(2)	?
19H1	290.67	-1.67	289.00	(2)	(2)	255

(1) Not surveyed

(2) Unable to measure or determine.

*Earth Science Associates 9/25/89.

**Water level measurements taken on 5/89.

Table 11-6
Summary of Analyses for
Residential Well Samples

ANALYTICAL METHOD		VOC 8240	VOC 8010/8020	BNA 8270	Pest/PCB 8080	Herbicides 8150	Dioxin 8280	Total Metals 6010/7061 7471/7741	Bottles per Location
PRESERVATIVES		2 drops 1:1 HCl Chill to 4 C	2 drops 1:1 HCl Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	HNO3 to pH < 2	
ANALYTICAL HOLDING TIME		<14 days	<14 days	<7 days before extraction	<7 days before extraction	<7 days before extraction	<30 days before extraction	<6 months (28 days for Hg)	
SAMPLE NUMBER	SAMPLING SCHEDULE	3 x 40 ml glass vial	3 x 40 ml glass vial	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	1 x 1 liter polyethylene bottle	
1770N-GW-001	Day 1	-	3	2	2	2	-	1	10
2045N-GW-001	Day 1	-	3	2	2	2	-	1	10
2100N-GW-001	Day 1	-	3	2	2	2	-	1	10
2142N-GW-001	Day 1	-	3	2	2	2	-	1	10
2168N-GW-001Q	Day 1	3	3	4	4	4	4	2	24
2600N-GW-001 (duplicate of 2168N-GW-001)	Day 1	3	3	2	2	2	2	1	15
2188N-GW-001	Day 1	-	3	2	2	2	-	1	10
2429N-GW-001	Day 1	3	3	2	2	2	2	1	15
2500N-GW-001 (blank)	Day 1	3	3	2	2	2	2	1	15
TOTALS		12	27	20	20	20	10	10	119

Q = laboratory QC sample

* = Dioxin blanks to be held by lab for possible future analysis

Table 11-6
Summary of Analyses for
Residential Well Samples

ANALYTICAL METHOD		VOC 8240	VOC 8010/8020	BNA 8270	Pest/PCB 8080	Herbicides 8150	Dioxin 8280	Total Metals 6010/7061 7471/7741	Bottles per Location
PRESERVATIVES		2 drops 1:1 HCl Chill to 4°C	2 drops 1:1 HCl Chill to 4°C	Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	HNO ₃ to pH < 2	
ANALYTICAL HOLDING TIME		<14 days	<14 days	<7 days before extraction	<7 days before extraction	<7 days before extraction	<30 days before extraction	<6 months (28 days for Hg)	
SAMPLE NUMBER	SAMPLING SCHEDULE	3 x 40 ml glass vial	3 x 40 ml glass vial	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	1 x 1 liter polyethylene bottle	
1304J-GW-001	Day 2	-	3	2	2	2	-	1	10
1346J-GW-001	Day 2	-	3	2	2	2	-	1	10
1635J-GW-001	Day 2	-	3	2	2	2	-	1	10
2620J-GW-001 (duplicate of 1635J-GW-001)	Day 2	-	3	2	2	2	-	1	10
1642J-GW-001	Day 2	-	3	2	2	2	-	1	10
1650J-GW-001	Day 2	-	3	2	2	2	-	1	10
1912J-GW-001	Day 2	-	3	2	2	2	-	1	10
2121J-GW-001	Day 2	-	3	2	2	2	-	1	10
2520J-GW-001 (blank)	Day 2	-	3	2	2	2	-	1	10
TOTALS		0	27	18	18	18	0	9	90

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6. Collect a water sample from the tap, filling the sample containers directly.
7. Fill VOA containers completely, checking inverted bottle to ensure that bubbles are absent. VOA vials will be preserved with two drops 1:1 HCl placed in the vial prior to sample collection. Leave 10% ullage in extractable containers and mark volume level on extractable container. Fill the polyethylene metals container and preserve to pH < 2 with HNO₃. Bottle types, preservation and holding times are shown in Table 11-6 and discussed in Section 11.8 and 11.9.
8. Place all samples on ice immediately after collection. Record preservative on sample label.
9. Prepare the necessary quality assurance samples (Section 11.11).
10. Log all samples in the field notebook. Include well number, sample number, date, time, samplers, bottle type, and lot number(s), and preservatives used, if any.
11. Label all samples containers with date, time, sample number, requested analysis, and preservatives used.
12. Pack the samples as required (Section 11.10) and complete necessary chain-of-custody forms.
13. Ship samples as specified in Section 11.10.

11.4.2 Disposal of Contaminated Material

Tap water purged from the residential well lines and holding tanks will be allowed to discharge directly into the drains. Purge water from the City well (19H1) will be pumped directly into the landfill water truck. Since contamination has never been detected in 19H1, the water will be sprayed directly onto the landfill as part of their daily dust control operations.

11.5 SURFACE AND SUBSURFACE SOIL INVESTIGATION

Surface and subsurface soils will be sampled during the hydrogeologic and soil gas investigation. This section describes the field procedures and sample collection methods. The analytical methods, sample containers, and number of samples for surface and subsurface soil collection are outlined in Tables 11-7, 11-8, and 11-9.

Table 11-7
 Summary of Analyses for
 Surface Soil Samples
 (Soil Gas Investigation)

ANALYTICAL METHOD		VOC 8010/8020	BNA 8270	Pest/PCB 8080	Herbicides 8150	Dioxin 8280	Metals 6010/7000/ 7471/7741	Bottles per Location
PRESERVATIVES		Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	
ANALYTICAL HOLDING TIME		<14 days	<14 days	<14 days	<14 days	<14 days	<6 months (28 days for Hg)	
SAMPLE NUMBER	SAMPLING SCHEDULE	2 x 120 ml glass vial	1 x 8 oz jar	1 x 8 oz jar	1 x 8 oz jar	1 x 4 oz jar	1 x 8 oz jar	
2416-SS-A1-001	Day 1	2	1	1	1	1	1	7
2416-SS-A2-001	Day 1	2	1	1	1	1	1	7
2416-SS-A3-001	Day 1	2	1	1	1	1	1	7
2416-SS-A4-001	Day 1	2	1	1	1	1	1	7
2416-SS-A5-001	Day 1	2	1	1	1	1	1	7
2416-SS-A6-001	Day 1	2	1	1	1	1	1	7
2416-SS-A7-001	Day 1	2	1	1	1	1	1	7
2416-SS-A8-001	Day 1	2	1	1	1	1	1	7
2416-SS-A9-001	Day 1	2	1	1	1	1	1	7
2416-SS-A10-001 (duplicate of 2416-SS-A9-001)	Day 1	2	1	1	1	1	1	7
2416-SS-A11-001	Day 1	2	1	1	1	1	1	7
2416-SS-A11-001-Q	Day 1	2	1	1	1	1	1	7
TOTALS		24	12	12	12	12	12	84

Q = Laboratory QC Sample
 SS = Surface Soil Sample

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Table 11-8
 Summary of Analyses for
 Subsurface Soil Samples
 (Hydrogeologic Investigation)

ANALYTICAL METHOD		VOC 8010/8020	Grain-size ASTM C136	TOC ASTM D4129/D5136	Bottles per Location
PRESERVATIVES		Chill to 4 C	None	Chill to 4 C	
ANALYTICAL HOLDING TIME		<14 days	<30 days	<28 days	
SAMPLE NUMBER	SAMPLING SCHEDULE	brass sleeve	1 x 1000 gm ziploc baggie	brass sleeve	
2416-SB-B1-001	Day 1	1	1	1	3
2416-SB-B1-002	Day 1	1	1	1	3
2416-SB-B2-001	Day 1	1	1	1	3
2416-SB-B2-002	Day 1	1	1	1	3
2416-SB-B3-001	Day 1	1	1	1	3
2416-SB-B3-002	Day 1	1	1	1	3
2416-SB-B4-001	Day 1	1	1	1	3
2416-SB-B4-002	Day 1	1	1	1	3
2416-SB-B5-001	Day 2	1	1	1	3
2416-SB-B5-002	Day 2	1	1	1	3
2416-SB-B6-001	Day 2	1	1	1	3
2416-SB-B6-002	Day 2	1	1	1	3
2416-SB-B7-001 (duplicate of 2416-SB-B6-002)	Day 2	1	1	1	3
2416-SB-B8-001	Day 2	1	1	1	3
2416-SB-B8-002Q	Day 2	1	1	1	3
TOTALS		15	15	15	45

SB = Subsurface Soil Sample
 Q = Laboratory QC Sample

Table 11-9
 Summary of Analyses for
 Subsurface Soil Samples
 (Soil Gas Investigation)

ANALYTICAL METHOD		VOC 8010/8020	BNA 8270	Pest/PCB 8080	Herbicides 8150	Dioxin 8280	Metals 6010/7061 7471/7741	Bottles per Location
PRESERVATIVES		Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	
ANALYTICAL HOLDING TIME		<14 days	<14 days	<14 days	<14 days	<14 days	<6 months (28 days for Hg)	
SAMPLE NUMBER	SAMPLING SCHEDULE	brass sleeve	brass sleeve	brass sleeve	brass sleeve	brass sleeve	brass sleeve	
2416-SB-B9-001	Day 1	1	1	1	1	1	1	6
2416-SB-B10-001	Day 1	1	1	1	1	1	1	6
2416-SB-B11-001	Day 1	1	1	1	1	1	1	6
2416-SB-B12-001	Day 1	1	1	1	1	1	1	6
2416-SB-B13-001	Day 1	1	1	1	1	1	1	6
2416-SB-B14-001	Day 1	1	1	1	1	1	1	6
2416-SB-B14-001-Q	Day 1	1	1	1	1	1	1	6
TOTALS		7	7	7	7	7	7	42

Q = Laboratory QC Sample
 SB = Subsurface Soil Sample

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11.5.1 Field Procedures and Sample Collection Method

Surface Soils

- . Prepare sampling location by removing any dead vegetation, such as leaves from ground surface.
- . Using a clean trowel remove 0-6 inches in depth of the surface soil and place in a clean sampling jar.
- . Prepare sample jar as described in Section 11.8, 11.9, 11.10, and 11.11.

Subsurface Soils

Approximately 13 soil borings will be drilled for both the soil gas well installation and the hydrogeologic investigation, with subsurface soil samples collected to verify and define off-site contamination. All soil samples are to be collected in accordance with procedures in a "Compendium of Superfund Field Operation Methods" EPA/540/P-87/001, Section 8.1.6.2, Sampling Techniques. Subsurface soil sampling has been described previously in Section 11.1.3 and 11.2.1.

11.5.2 Disposal of Contaminated Material

Any material generated during the sampling of subsurface soil will be handled as described in Section 11.1.3.

11.6 AMBIENT AIR SAMPLING

Ambient air samples will be collected in the FSL field program. Samples will be collected with a Summa canister. The field procedures and sample collection methods are described in the following sections. Table 11-10 outlines the analytical method, sample container, and number of samples for ambient air sampling.

11.6.1 Summary of Field Procedures and Sample Collection Methods

Prior to sample collection, the temporary on-site meteorological station will be activated. Operating procedures for the weather station are

Table 11-10

described in Appendix C. The weather station is required to record wind speed and direction and any precipitation during the 24-hour sampling period.

24-hour, time-integrated ambient air samples will be collected using 6-liter Summa canisters. The locations for the ambient samples are shown on Figure 8-1. The procedure for collecting air samples are described below:

- . Laboratory will provide canisters with critical orifice valves, which allow slow sampling rates over a 24-hour period.
- . Connect vacuum gauge to sample canister, open valve, check and record initial vacuum, close valve, remove vacuum gauge.
- . Attach a length of tubing, of appropriate length, to the sample canister.
- . Connect or position the opposite end of the tubing in such a way so as to access the sampling point.
- . Open the valve following laboratory instructions, to initiate integrated sampling.
- . After 24 hours, close the valve, disconnect the tubing, and attach a label to the sample canister with pertinent sample information.

11.6.2 Disposal of Contaminated Material

No contaminated material is expected to be produced during the ambient air field sampling program.

11.7 RI DERIVED WASTE AND DECONTAMINATION

The field procedures dealing with RI derived waste are discussed in Section 11.1.5, 11.2.2, 11.3.2, 11.4.2, 11.5.2, and 10.6.2. All RI derived waste will be handled in accordance with the Standard Operating Procedures for Investigation - Derived Waste, which is presented in Appendix C.

11.7.1 Equipment Decontamination

All reusable field equipment used to collect, handle, or measure samples will be decontaminated before coming into contact with any sample. The decontamination procedure will match the degree of contamination on the sampling tool. For example, steam cleaning will be necessary to remove dirt from auger flights, to prepare well screen and casing for installation into the borehole, and to clean brass sleeves for soil sample collection. Brushes and soap will be required to remove dirt from split spoon samplers. Sampling equipment that has come into contact with oil and grease will have to be cleaned with hexane to remove the oily material.

A centrally located decontamination station will be established for steam cleaning of drilling equipment. This decontamination system will include a pad on which the drill rigs and other large drilling equipment, such as auger flights, can be steam cleaned. The drilling rigs and other drilling equipment will be steam cleaned between each hole. The pad will be constructed so that it drains into a sump. Steam cleaning water collected in the sump will be collected by a vacuum truck contractor and disposed of at the Fresno Sanitary Treatment Plant.

All equipment decontamination episodes will be recorded in the field logbook. The general decontamination procedures are as follows:

- . A sufficient supply of tap water of known quality will be obtained. Water from fire plugs and untested sources that may contain contaminants will not be used.
- . Augers, well casing, and well screen will be steam cleaned to remove all visible dirt.
- . Copious amounts of water with a phosphate-free detergent will be used to wash and brush all dirt from the sampling item, including the steam cleaned items.
- . Sampling items will be rinsed thoroughly with tap water, checked for any residual dirt, and rewashed if necessary.
- . The item will be rinsed with solvent to remove residual organics. Solvents will be pesticide grade or better.
- . The item will be rinsed twice with tap water.

- . The item will then be rinsed with deionized water (ASTM Type II).
- . The item will be completely air dried prior to use. Items will be covered if not immediately used. Large items will be placed on a clean sheet of plastic.
- . Items not used immediately will be either wrapped in aluminum foil (small items) or in sheet plastic (larger items) to prevent cross-contamination.

11.8 SAMPLE CONTAINERS

All samples will be placed into containers provided by the laboratory. Groundwater samples will be collected in the following containers:

- . For VOCs, three 40-ml glass vials with Teflon-lined silicon septa and black phenolic caps.
- . For each BNA, pesticide, PCB, herbicide, and dioxin sample, 2-1 liter amber glass bottles.
- . For metals, 1-1 liter polyethylene bottle.

Surface soil samples will be collected in the following containers:

- . For VOCs, 2-120 ml glass vials with Teflon-lined silicon septa and black phenolic caps.
- . For each BNA, pesticide, PCB, herbicide, and metal sample, 1-8 ounce jar.
- . For dioxin, 1-4 ounce jar.
- . For grain-size analysis, 1-1,000 gram ziploc baggie.

Subsurface soil samples will be collected in brass sleeves, with the exception of grain-size analysis samples which will be collected in ziploc baggies.

11.9 SAMPLE PRESERVATION AND HOLDING TIMES

All samples for both on-site and fixed-base laboratory analyses (except grain-size) will be chilled to 4 degrees Centigrade in the field, during

shipment, and in the laboratory. The sample containers will be placed in chilled coolers immediately following collection and kept cool with ice prior to and during shipment. Groundwater samples for volatiles analysis will be preserved with two drops 1:1 HCL in each 40 ml vial. Groundwater samples for metals analysis will be preserved by bringing the sample to a pH less than 2 using nitric acid. No preservatives are added to the soil samples. Preservatives will be recorded on the container label and in the field logbook.

Analytical holding times for the groundwater samples are 14 days for VOCs; 7 days before extraction for BNAs, pesticides, PCBs, and herbicides; 30 days before extraction for dioxin; 6 months for metals (28 days for mercury). Analytical holding times for soil samples are 14 days for VOCs, BNAs, pesticides, PCBs, herbicides, and dioxin; 6 months for metals (28 days for mercury). There is no method specified holding time for particle size.

11.10 SAMPLE SHIPMENT

All samples collected at Fresno Sanitary Landfill are considered environmental samples; they are not known to contain hazardous levels of contaminants and may be shipped to the laboratory accordingly.

Each of the sample bottles will be sealed and labeled as follows: bottle labels will contain all required information including sample number, time, and date of collection, analysis requested, sampler's name and preservatives used, if any. Sealed bottles will be placed inside polyethylene ziploc bags. The bagged bottles will be packed in large coolers, padded with an absorbent material, such as vermiculite, and chilled with ice contained in ziploc bags. All sample documents will be affixed to the underside of each cooler lid. See Appendix B for environmental sample packaging procedures.

The coolers will be labeled for shipment according to EPA and Department of Transportation procedures. No precautionary notices are required on the package exterior. Shipments to the laboratory will be handled by an

overnight carrier such as Federal Express. Other "cargo only" aircraft may be used but samples will not be transported by any carrier that also carries passengers. Samples may be transported by CDM personnel in private vehicles.

Samples with restrictive holding times will be shipped within 24 hours following collection, usually on the same day for volatiles analysis. Samples collected late in the day will be shipped the following day. Advance coordination will be required for any shipments on Friday (which will arrive at the lab on Saturday). Samples without holding times will be held until the next critical shipment is ready in order to reduce shipping and handling costs.

The following information shall be included on sample labels:

- . Site name.
- . Field identification of sample station number.
- . Date and time collected.
- . Whether the sample is preserved or unpreserved and preservative use, if any, and the type of preservative used.
- . Types of analysis to be conducted.

11.10.1 Sample Identification

Samples will be identified through the use of a coding system to identify sample locations and sample replicates. This coding system will ensure that samples are uniquely identified, and provide a tracking procedure to facilitate data validation and retrieval. The following information will be included on each sample label:

- . Sample number.
- . Date and time of the sample collection.
- . Designation of the sample as a grab or composite.
- . Whether the sample is preserved or not, and the preservative used.

- . Type(s) of analysis.
- . Samplers name.

Sample labels will be waterproof, written with indelible ink, and secured to the sample container with clear acetate tape.

It should be noted that only the double volume quality control samples will be labeled with their QC classification. All other QC samples will only be logged in the field notebooks and FPC's copy of the chain-of-custody form, not on the sample labels or the laboratory's chain-of-custody forms. This will ensure that the laboratory does not know which of the samples are blanks or duplicates.

The groundwater well samples will be numbered according to the following system:

UWIA-GW-001

- UWIA - Identification of the well.
- GW - Identification of the media: groundwater.
- 001 - Identification of the sample event at the well
Q-QA/QC sample

The residential well samples will be numbered according to the following system:

1770N-GW-001

- 1770N - Identification of the residential well, QA/QC duplicate, and rinsate blank.
- GW - Identification of the media: groundwater.
- 001 - Identification of the sampling event at the residential well

The surface soil samples will be numbered according to the following system:

2416-SS-S1-001

- 2416 - CDM job number
- SS - Identification of the media: surface soil

- S1 - Identification of the sampling location
- 001 - Identification of the sampling event at the sampling location
- Q - QA/QC sample

The subsurface soil samples will be numbered according to the following system:

2416-SB-T1-001

- 2416 - CDM job number
- SB - Identification of the media: subsurface soil
- T1 - Identification of the sampling location
- 001 - Identification of the sampling event at the sampling location
- Q - QA/QC sample

11.10.2 Sample Report Forms and Chain-of-Custody Records

Chain-of-custody procedures will be used to document the handling and processing of all samples from the time of collection until they are destroyed. Each shipment of samples will be accompanied by a CDM chain-of-custody record which documents all aspects concerning the time of collection, method of shipment, analysis requested, etc., for each sample. This written record may become important if the results of any analysis are used in litigation. A sample chain-of-custody record is included in Appendix A. The following is a summary of chain-of-custody procedures:

- . The following information will be supplied on the chain-of-custody form:
 - Project name.
 - Signature of sampler.
 - Sampling station number or sample number date and time of collection, grab, or composite sample designation and a brief description of the type of sample.
- . Individuals receiving the samples shall sign, date, and note the time that they received the samples on the form matrix.
- . Chain-of-custody records initiated in the field shall be placed in a plastic cover and taped to the inside of the shipping container used for sample transport from the field to the laboratory.
- . Custody seals shall be used when samples are shipped to the laboratory.

- . When samples are relinquished to a shipping company for transport, the tracking number for the shipping bill/receipt shall be recorded on the chain-of-custody form.
- . Collection of soil gas vapors and the analysis of these vapors with the on-site QC are addressed in the Supplemental SCP QAPP for the Central Base Area.

11.11 QUALITY CONTROL SAMPLES

Duplicate, blank, and lab QC samples will be prepared in accordance with the procedures in the QAPP and will be used as a check of laboratory and field sampling procedures.

11.11.1 Duplicates

Duplicates of field samples will be collected at a frequency of 10 percent at sampling points which are known or suspected to be contaminated. Duplicates will be collected, numbered, packaged, and sealed in the same manner as the other samples. The samples will not be identified as duplicates on the sample labels so that the identify of the sample as a duplicate will be unknown to the laboratory personnel performing the analyses. The samples will be recorded as a duplicate in the field logbook for documentation and verification purposes. Duplicate samples are identified in the Summary of Analyses Tables in Section 11.

Duplicate water samples will be collected by filling all bottles for the first analysis before filling bottles for the second analysis. Duplicate surface soil samples will be composited, except for those samples to be analyzed for VOCs. Duplicate subsurface samples will be consecutive brass sleeves. Duplicate ambient air samples will be collected by collocating two Summa canisters and collecting simultaneous samples. Duplicate soil gas samples will be collected simultaneously for Level IV analysis, and in series for Level II on-site analysis.

11.11.2 Laboratory QC Samples

Laboratory QA/QC samples are collected to provide the laboratory extra sample volume to perform laboratory QC checks. Lab QC samples will be

collected at a frequency of 1 in 20, and will be collected at locations of suspected contamination. For groundwater samples, these QA/QC samples consist of a "double volume"; double volume samples are not required for VOCs. For soil and air samples, it is not necessary to include a double volume. Lab QC samples are identified on the sample labels, and the chain-of-custody forms. Lab QC samples are identified in the Summary of Analyses Table in Section 11.

11.11.3 Groundwater Field Blanks

Since all groundwater sampling equipment is dedicated, field blanks will be collected rather than equipment blanks. Field blanks will consist of analyte free water that is transported from the analytical laboratory to the sampling site. The analyte free water is decanted into the organic sample containers in the field at a sample collection point. For inorganic parameters, deionized water will be used to prepare the blank. The samples will not be identified as blanks on the sample labels. One blank will be placed in each cooler to accompany field samples during shipment to the laboratory. Field blanks are identified in the Summary of Analyses Table in Sections 6 and 7.

The laboratory will be instructed to hold blank samples collected for the analysis of dioxin. These samples will be analyzed only if dioxin is detected in any of the samples.

11.11.4 Air Blanks

Blanks are used to determine if field measurements are affected by contamination due to improper cleaning techniques or carry-over contamination from previous samples. Field blanks for Summa canisters will be prepared on-site by filling a cannister with ultra high purity nitrogen. Blanks will be prepared at a frequency of one per day and will be sent blind to the laboratory. Blank samples collected for analysis by the on-site laboratory are discussed in Appendix E.

11.11.5 Background Samples

Two background surface soil samples will be collected at locations 800 ft. east and 400 ft. west of the landfill (Figure 8-1).

Section Twelve

12.1 FIELD DATA ANALYSIS AND REPORTING

Data and readings taken at the site will be recorded in data logbooks or on pre-printed data sheets using indelible ink. Supplemental records will be recorded in field notebooks. These records will be retained on file at CDM-Walnut Creek for the duration of the contract and for 6 years thereafter.

- . Data to be recorded will include date, time, sampling personnel, sample location, sample number, weather conditions, field measurement data, and the signature of the person entering the data.
- . When possible, field measurements will be taken with direct-reading instruments so that calculations are not necessary. Regardless of the equipment used to obtain field data, the data will be reviewed in the field for consistency and for reasonable agreement with expected or typical results. Extreme, anomalous, or seemingly unreasonable results will be reported only after the measuring instrument has been checked and verified to be in proper working order, and the anomalous readings have been verified by one or more additional measurements.
- . Data and inspection sheets will be checked for completeness, accuracy, and reasonableness by a different project staff member than the person who collected the data. The Field Supervisor and QA Coordinator will be responsible for spot-checking data and inspection sheets. The QA Coordinator will conduct periodic reviews of files, notebooks, logs, and other records to ensure that proper documentation procedures are followed.

The following actions are routinely followed:

- . Review completed field data forms, and analysis results for transcription, typographic, and other errors.
- . Review data to determine if procedures were followed in the field sample holding times and preservation requirements were met, and Chain-of-Custody procedures were followed.
- . Review field equipment calibration data.

- . Review monitoring and sampling/analysis data for consistency with expected or historical results.
- . Review blank, duplicate, and background/control sample data.
- . Review laboratory QA/QC including calibration, method detection limits and quality control checks.

12.2 DATA MANAGEMENT SYSTEM

The data generated through sampling and analysis will be tracked and filed in the CDM Walnut Creek Project File "Fresno Sanitary Landfill RI/FS". Such documentation will include, but is not limited to, the following:

- . Field data sheets.
- . Chain-of-custody forms.
- . Field log books.
- . Analytical reports and data.
- . Data validation reports.

All of the analytical data, along with their associated qualifiers, will be entered into CDM's computer database. The Project Manager will be responsible for verifying that all data are accurately and completely entered into the database. The QA Coordinator will routinely check at least 10% of the database against raw data sheets to verify that data are not altered during data processing operations.

12.3 DATA VALIDATION

Data validation is the process of screening data and accepting, rejecting, or qualifying it on the basis of sound criteria. Data validation must occur soon after data collection and be objective in its approach. The EPA Contract Laboratory Program (CLP) Data Validation Functional Guidelines will be used for validation of all Level IV data. Data will be validated using methods and criteria appropriate to the type of data and the purpose

of measurement. Items to be considered during data validation include the following:

- . Comparing data to QA objectives for precision, accuracy, and completeness.
- . Evaluating field and laboratory replicates, spikes, blanks, and other QA samples.
- . Checking for data "outliers".
- . Checking for transcription and calculation errors.
- . Qualifying data that does not meet acceptance criteria.
- . Verifying sample custody.

In order to provide the deliverables required for data validation, "Laboratory Documentation Requirements for Data Validation" (EPA Region 9, 01/90) will be followed by laboratories compiling Level IV data packages. Deliverable requirements for all analyses will be outlined in the analytical requests sent to each lab.

The procedures used by the laboratories to assess precision, accuracy, and completeness are discussed in Appendix A.

Section Thirteen

13.1 PERFORMANCE AND SYSTEM AUDITS

At least one performance audit of field activities will be conducted during the course of the project. At a minimum, the audit will include an inspection of field notebooks, equipment calibration and maintenance records, sample collection and equipment decontamination procedures, and overall adherence to procedures outlined in this Plan. The audit will be conducted by a qualified CDM employee not directly involved in the progress.

System audits of the field measurement laboratory may be conducted if determined to be necessary by the Quality Assurance Coordinator after consultation with the Field or Site Managers. At a minimum, the audits will include an inspection of the laboratory facilities, lab or field notebooks, control sheets, log sheets, computer files, and equipment calibration and maintenance records.

A written report of the results of all audits will be submitted to the following individuals:

- . City of Fresno Program Manager.
- . City of Fresno Project Manager.
- . EPA Remedial Project Manager.
- . CDM Project Manager.

Performance and system audits conducted by the off-site laboratories are discussed in the Laboratory Quality Assurance Manuals provided in Appendix E.

13.2 CORRECTIVE ACTION

If performance or system audits of field activities result in detection of unacceptable conditions or data, as defined by the DQOs in this Plan, the QA Coordinator will be responsible for developing and initiating corrective action. A discussion of the corrective action, any follow-up action and final recommendations will be included in a report to the CDM Project Manager, and in the monthly status report.

13.3 QUALITY ASSURANCE REPORTS TO MANAGEMENT

Monthly reports for the Fresno Sanitary Landfill will be prepared by the CDM Site Manager. These monthly reports will discuss the project status, results of performance and system audits, and any necessary corrective action. Copies of the monthly status report will be sent to the following individuals:

- . City of Fresno Program Manager.
- . City of Fresno Project Manager.
- . EPA Remedial Project Manager.

LIST OF REFERENCES

- BSK & Associates, Solid Waste Assessment Test, Proposal and Report, AB3525 Calderon, Fresno City Sanitary Landfill, December 22, 1986.
- BSK & Associates, Final Report, Extent of Groundwater Degradation, Jensen and West, February 9, 1987.
- CH2M Hill, Final EIR - Jensen Avenue Landfill Closure Plan, October 1989.
- Earth Sciences Associates, Phase I Geologic and Hydrogeologic Investigation of the Fresno Landfill, December 23, 1988.
- EMCON Associates, Air Quality Solid Waste Assessment Test Report, City of Fresno Sanitary Landfill, October 1988.
- EMCON Associates, Close and Post Closure Maintenance Plan, Fresno City Landfill, December 1989.
- James M. Montgomery, Preliminary Feasibility Study for the Remediation of Groundwater at the City of Fresno Landfill, September 1989.
- Kenneth D. Schmidt and Associates, Results of the Pilot Extraction Well Test and the City of Fresno Landfill, October 1987.
- Hackel, Otto. Summary of the Geology of the Great Valley in Geology of Northern California. Bulletin 190. California Division of Mines and Geology, p. 217-238. 1966.
- U.S. EPA, Data Quality Objectives for Remedial Response Activities (EPA 540/G-87/003A) 1987.
- U.S. Environmental Protection Agency, Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final, October 1988.
- U.S. EPA, Natural Oil and Hazardous Substances Pollution Contingency Plan, February 6, 1990.
- U.S. EPA, Streamlining the RI/FS for CERCLA Municipal Landfill Sites, Fact Sheet, September 1990.
- U.S. EPA Region 9, SAS Methods Compendium, December 1989.
- U.S. EPA Region 9, Preparation of a U.S. EPA Region 9 Field Sampling Plan for Private and State Lead Superfund Projects, April 1990.
- U.S. EPA Region 9, Guidance for Preparing Quality Assurance Project Plans for Superfund Remedial Projects, September 1989.

APPENDIX A
QUALITY ASSURANCE GOALS

APPENDIX A
QUALITY ASSURANCE GOALS

PRECISION

Precision measures the reproducibility of measurements under a given set of conditions. Specifically, it is a quantitative measure of the variability of a group of measurements compared to their average value. The overall precision of measurement data is a mixture of sampling and analytical factors. Analytical precision is much easier to control and quantify than sampling precision. There are more historical data related to individual method performance and the "universe" is limited to the samples received in the laboratory. In contrast, sampling precision varies with sampling methods and matrix heterogeneity.

For all analytical measurements, an estimate of analytical precision will be made by calculating the relative percent difference (RPD) between values obtained for the MS and MSD using the following formula:

$$\% \text{ RPD} = \frac{| \text{MS} - \text{MSD} |}{0.5 (\text{MS} + \text{MSD})} \times 100$$

The way in which precision is used to evaluate the acceptability of analytical data is compound and laboratory specific. These procedures will be described in the data report, and are outlined below.

For Level IV soil and groundwater organic analyses, a control limit that is three times the standard deviation of ten replicate samples is established. For Level IV inorganic analyses, a twenty percent control limit is established. For Level IV air analyses, a thirty percent control limit is established. The precision goals for Level II soil gas analyses are discussed in Appendix E.

Analytical results falling outside these numerical goals will be identified by data qualifiers during the data validation process.

ACCURACY

Accuracy may be estimated from the analytical results obtained from the analyses of laboratory control samples (LCSs) (i.e., internal standards and surrogate samples). Where appropriate, accuracy will be assessed by comparing the analytical result to the actual concentration. Percent accuracy (%A) and percent recovery (%R) may also be determined from the analytical results obtained for surrogate or analyte compounds spiked into samples. For all organic and metal measurements, accuracy will be represented by percent recovery of laboratory matrix spikes using the following equations for accuracy and recovery:

$$\%A = \frac{\text{measured value of analyte}}{\text{true value of analyte}} \times 100$$
$$\%R = \frac{\text{measured value in spiked sample} - \text{amount in unspiked sample}}{\text{actual concentration of spike added}} \times 100$$

The way in which accuracy is used to evaluate the acceptability of analytical data is compound and laboratory specific. These procedures will be described in the data report, and are outlined below.

For Level IV air analyses, an acceptability range of 70 to 130 percent is established. For Level IV soil and groundwater analyses, compound specific control limits will be established by the laboratory and provided on the analytical reports. The accuracy goals for Level II soil gas analyses are discussed in Appendix E.

Analytical results falling outside these control limits will be identified by data qualifiers during the data validation process.

REPRESENTATIVENESS

Representativeness is defined as the degree to which sample data accurately and precisely represent a characteristic of a sample population, parameter variations at a sample point, or an environmental condition.

Representativeness is a qualitative parameter which most expresses the proper design of a sampling program. The representativeness criterion is best satisfied by making certain that sampling locations are selected properly, sampling technique is described, and a sufficient number of samples are collected. For each aspect of this sampling effort, the rationale for sample location and number of samples are described. Sampling technique is described for each aspect of the sampling program.

COMPLETENESS

Completeness is defined as the percentage of measurements made which are judged to be valid measurements. The completeness goal is essentially the same for all data uses: that a sufficient amount of valid data be generated. It is important that critical samples are identified and plans made to achieve valid data for them.

For Level IV data, the completeness objective for this project is 85 percent. For the Level II analysis of methane gas, the completeness objective is 70 percent. If the completeness is less than the stated goal, CDM will provide documentation explaining why this objective was not met, and how much it will affect the project.

COMPARABILITY

The comparability of analytical data will be maximized by using standard analytical methods and reporting the data in standard units. All results for organic or inorganic constituents will be reported in either mg/l or $\mu\text{g}/\text{l}$. Measurements for pH, conductivity, alkalinity, turbidity, and temperature will be reported in their standard units.

APPENDIX B

FIELD FORMS

APPENDIX B - CONTENTS

- . Field Equipment Log
- . Unified Soil Classification System
- . Sample Boring Log
- . Boring Log
- . Sample Monitoring Well Construction Log - Standard Flush Mount
- . Monitoring Well Construction Log - Standard Flush Mount
- . Well Development Log
- . Sample Label Example
- . Chain of Custody Record
- . Custody Seal
- . Field Change Request Form

1. FIELD EQUIPMENT LOG

Equipment Number _____ Page ____ of ____

Equipment Description _____

1. CALIBRATION 2. CLEANING 3. MAINTENANCE

Personnel Qualified to Operate and Maintain

Reviewed By _____ Date/Time _____

Entries Complete? [Y or N] _____

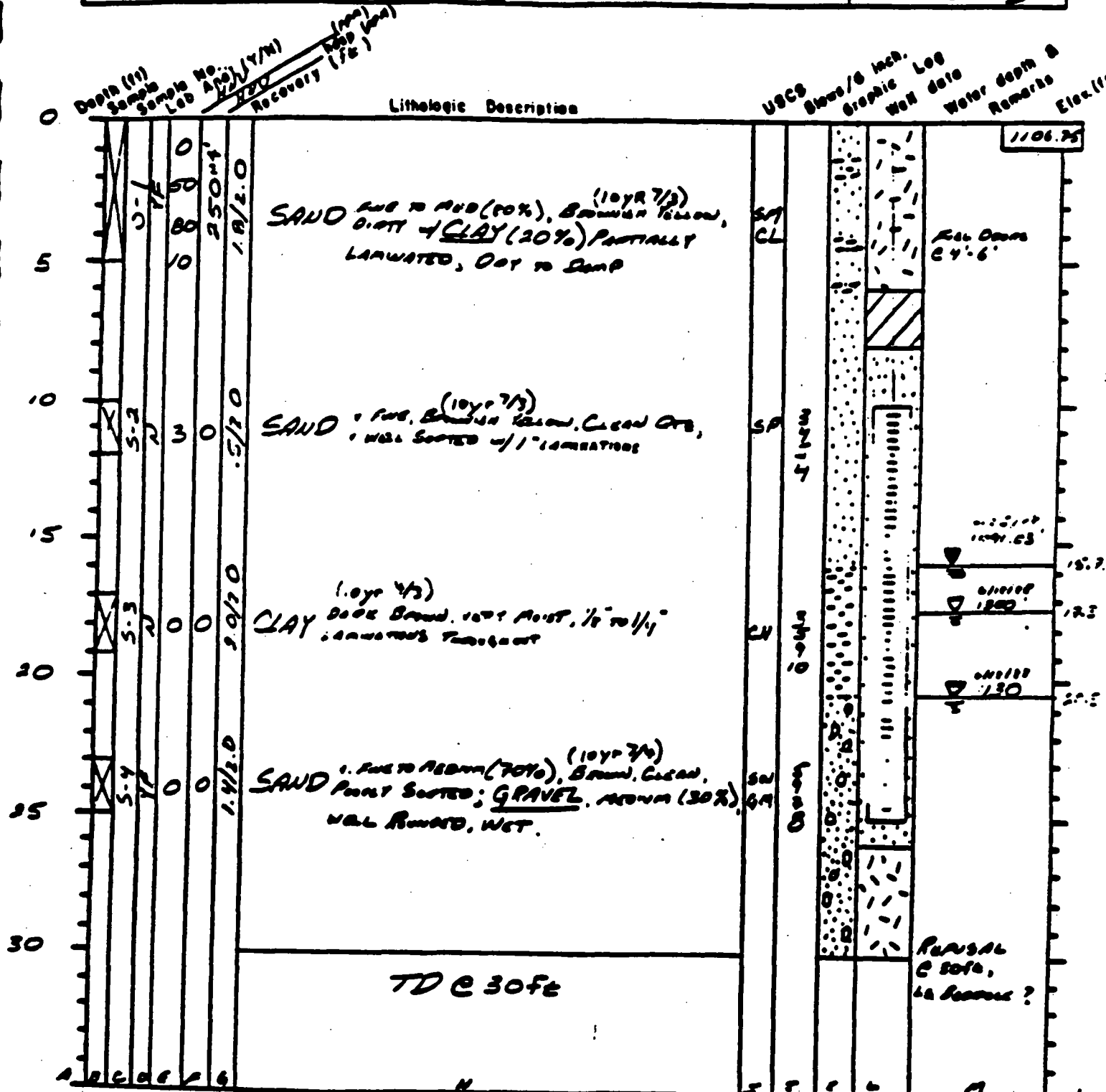
UNIFIED SOIL CLASSIFICATION SYSTEM

GRADATION AND PLASTICITY CHARACTERISTICS (Excluding particles larger than 3 in.)			GROUP SYMBOL	SOIL NAMES
PREDOMINANTLY COARSE-GRAINED More than 50% of soil retained by No. 200 Sieve	GRAVEL More than 50% of coarse-grained fraction retained by No. 4 sieve	CLEAN Less than 5% fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4 $C_c = \frac{D_{30}^2 - D_{10}D_{60}}{D_{10}^2}$ between 1 and 3 Not meeting all gradation requirements for GW	GW Well-graded GRAVEL or SANDY GRAVEL
		WITH FINES More than 5% fines	Atterberg limits below A-line or PI less than 4	GP Poorly graded, uniform, or gap-graded GRAVEL or SANDY GRAVEL
		CLEAN Less than 5% fines	Atterberg limits above A-line with PI greater than 7†	GM SILTY GRAVEL
		WITH FINES More than 5% fines	Atterberg limits above A-line with PI greater than 7†	GC CLAYEY GRAVEL
		CLEAN Less than 5% fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 6 $C_c = \frac{D_{30}^2 - D_{10}D_{60}}{D_{10}^2}$ between 1 and 3 Not meeting all gradation requirements for SW	SW Well-graded SAND or GRAVELLY SAND
	SAND More than 50% of coarse-grained fraction passes No. 4 sieve	WITH FINES More than 5% fines	Atterberg limits below A-line or PI less than 4	SP Poorly graded, uniform, or gap-graded SAND or GRAVELLY SAND
		WITH FINES More than 5% fines	Atterberg limits below A-line or PI less than 4	SM SILTY SAND
		WITH FINES More than 5% fines	Atterberg limits above A-line with PI greater than 7†	SC CLAYEY SAND
		WITH FINES More than 5% fines	Atterberg limits above A-line with PI greater than 7†	SC CLAYEY SAND
		WITH FINES More than 5% fines	Atterberg limits above A-line with PI greater than 7†	SC CLAYEY SAND
PREDOMINANTLY FINE-GRAINED More than 50% of soil passes No. 200 sieve	SILT Atterberg limits below A-line or PI less than 4	INORGANIC	Liquid limit less than 50	ML Nonplastic, slightly plastic, or moderately plastic SILT, CLAYEY SILT, SANDY SILT, or GRAVELLY SILT
		INORGANIC	Liquid limit greater than 50	MH Highly plastic or very highly plastic SILT, CLAYEY SILT, SANDY SILT, or GRAVELLY SILT
	CLAY Atterberg limits above A-line with PI greater than 7†	ORGANIC	Liquid limit less than 50	OL Slightly plastic or moderately plastic ORGANIC SILT (ORGANIC CLAY if Atterberg limits above A-line)
		ORGANIC	Liquid limit greater than 50	OH Highly plastic or very highly plastic ORGANIC SILT (ORGANIC CLAY if Atterberg limits above A-line)
	CLAY Atterberg limits above A-line with PI greater than 7†	INORGANIC	Liquid limit less than 50	CL Slightly plastic or moderately plastic CLAY, SILTY CLAY, SANDY CLAY, or GRAVELLY CLAY
		INORGANIC	Liquid limit greater than 50	CH Highly plastic or very high plastic CLAY, SILTY CLAY, SANDY CLAY, or GRAVELLY CLAY
HIGHLY ORGANIC (Identified by spongy feel)			Pt	PEAT

*Predominantly coarse-grained soil with 5% to 12% fines is borderline case requiring use of dual symbol, such as GW-GC or SM-SP.

†Atterberg limits above A-line with PI between 4 and 7 is borderline case requiring use of dual symbol, GC-GM or SC-SM for predominantly coarse-grained soil or CL-ML for predominantly fine-grained soil.

BORING LOG		BORING/WELL NO.. MN-237		Page 2 of 2
Installation: HIGHTOP A.F.B.			Site: FTA-3A	
Project No.: 28-247		Client/Project: HAZWAB/TAC/ERP		
HAZWAB Contractor: E.C. JORDAN		Drig Contractor: J.N. RICHARDSON ASSN	Driller: J. POYCE	
Drig Started: 4/1/87 (8:45 AM)		Drig Ended: 6/1/87 (6:25 PM)	Borehole dia(s): 8 1/2"	
Drig Method/Rig Type: HSA-CHE-55				
Logged by: BOB BANSTON		E-Log (Y/N) From _____ to _____		Protection Level: D



U = Thin well tube R = Rock coring Field G/C (Date/Mod) **PORTAL 10235**
 S = Split spoon (tube) O = Other **1 1/2"** G/C Oper.: **E. BANSTON**
 C = Cuttings Notes: _____

EXPLANATION OF MONITORING WELL CONSTRUCTION LOG

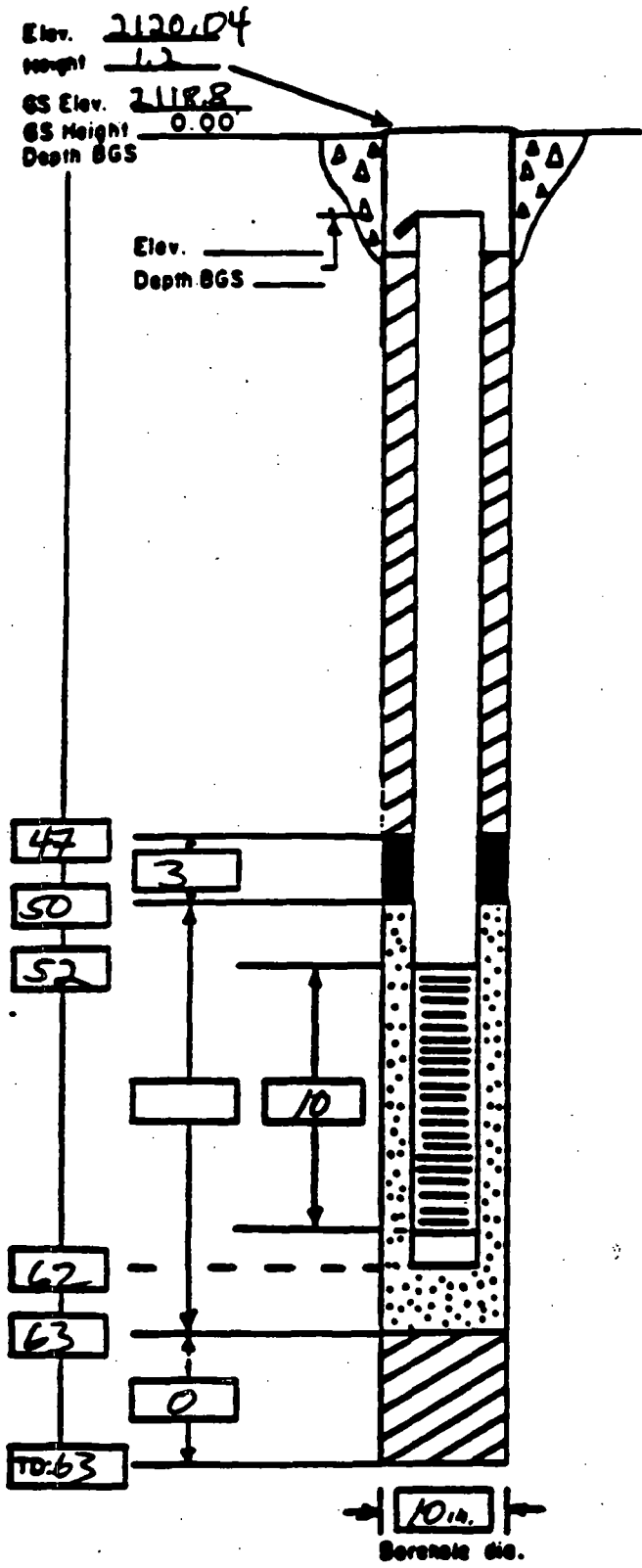
The majority of items on this form are self-explanatory. However, some items deserve further clarification.

- . Height refers to length above or below ground surface to the nearest tenth of a foot. Elevation is that above mean sea level to the nearest 0.01 ft.
- . BGS = below ground surface. TD = total depth. TOC = top of casing. TOS = top of screen.
- . Depths and lengths to the nearest 0.1 ft should be supplied within the blocks in the lower left portion of these figures. Borehole diameters should be in inches.
- . Under the heading "Built By": include both drilling contractor personnel and prime contractor personnel involved in the well completion.

As with the boring log form, this form can be neatly and legibly filled out in the field. Some items such as surveyed well coordinates, however, will require completion in the office.

For unique well completions that do not correspond to any of the six forms provided, modifications to these forms should be made appropriately while maintaining the general format of the forms. These modified forms must have concurrence from the HAZWRAP project staff.

MONITORING WELL CONSTRUCTION LOG - Standard Flush Mount			
WELL NO.: <u>MW165</u>	Installation: <u>Norfolk AFB</u>	Site:	
Project No.: <u>7400</u>	Client/Project:		
MAZWRAP Contractor: <u>CDM/FPC</u>	Drig Contractor: <u>Layne Western</u>		
Comp. Start: <u>2/20/90</u>	<u>11:20 AM</u>	Comp. End: <u>2/20/90</u>	<u>5:00 PM</u>
Built By: <u>Layne Western</u>		Well Coord.:	



PROTECTIVE CSG
 Material/Type STEEL
 Diameter 8 inches Water Tight Seal (Y/N)
 Depth BGS 6 inch Weep Hole (Y/N)

SURFACE PAD
 Composition & Size Cement - 2 ft x 2 ft

RISER PIPE
 Type Schedule 80 PVC
 Diameter 4 inch ID
 Total Length (TOC to TOS) 52

GROUT
 Composition & Proportions Bestwick (QuickSet) + TYPE II Alkali Cement
 Tremied (Y/N)
 Interval 0-47

CENTRALIZERS (Y/N)
 Depth(s) _____

SEAL
 Type Bestwick Pellets
 Source _____
 Setup/Hydration time 1 hr Vol. Fluid Added NA
 Tremied (Y/N)

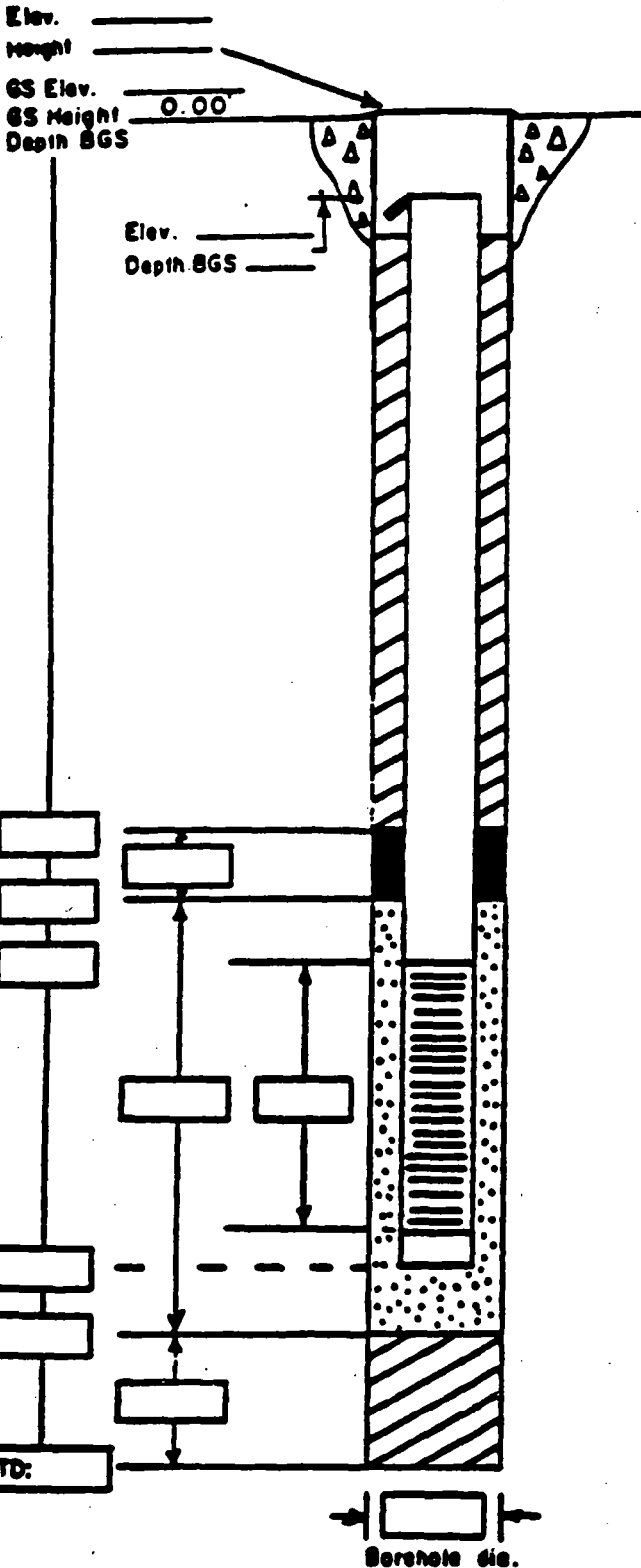
FILTER PACK
 Type Monterey #3
 Amt Used 10 bags
 Tremied (Y/N)
 Source Lanesford
 Gr. Size Dist. see # 3 specs

SCREEN
 Type PVC
 Diameter 4 inch
 Slot Size & Type 0.010
 Interval BGS 52-62

SLIMP (Y/N)
 Interval BGS _____ Length _____
 Bottom Cap (Y/N)

BACKFILL PLUG NA
 Material NA
 Setup/Hydration time _____
 Tremied (Y/N)

MONITORING WELL CONSTRUCTION LOG - Standard Flush Mount		
WELL NO.:	Installation:	Site:
Project No.:	Client/Project:	
HAZWRAP Contractor:	Drig Contractor:	
Comp. Start: (: __ m)	Comp. End: (: __ m)	
Built By:	Well Coord.:	



PROTECTIVE CSG

Material/Type _____
 Diameter _____ Water Tight Seal (Y/N)
 Depth BGS _____ Weep Hole (Y/N)

SURFACE PAD

Composition & Size _____

RISER PIPE

Type _____
 Diameter _____
 Total Length (TOC to TOS) _____

GROUT

Composition & Proportions _____
 Tremied (Y/N) _____
 Interval _____

CENTRALIZERS (Y/N)

Depth(s) _____

SEAL

Type _____
 Source _____
 Setup/Hydration time _____ Vol. Fluid Added _____
 Tremied (Y/N) _____

FILTER PACK

Type _____
 Amt Used _____
 Tremied (Y/N) _____
 Source _____
 Gr. Size Dist. _____

SCREEN

Type _____
 Diameter _____
 Slot Size & Type _____
 Interval BGS _____

SUMP (Y/N)

Interval BGS _____ Length _____
 Bottom Cap (Y/N) _____

BACKFILL PLUG

Material _____
 Setup/Hydration time _____
 Tremied (Y/N) _____

EXPLANATION OF WELL DEVELOPMENT LOG

Page one of this form is assumed to be self-explanatory and must be filled out for every well during development. Under the heading "Developed By:," include the names of both development (drilling) contractor personnel and prime contractor personnel involved in the well development.

Page two, the plot of postdevelopment water level recovery, should be used as appropriate whenever this task is specified for a project. The water level recovery graph should be plotted for each well immediately following the well development/pumping process but in general should not extend over a period of more than approximately 30 min. If water level recovery to 90% of the original static water level occurs over a period of a few minutes, the recovery plot can be shortened. Conversely, if the need exists, the 30-minute time period can be extended as appropriate.



00

57

1751 -00-57

EPA REGION-9 SUPERFUND RECORDS CENTER



1751-00057

FRESNO SANITARY LDFL

ATTENTION!! ATTENTION!!

You are responsible for this file. Do not pass on to anyone else. When finished, return to:

EPA-9 Superfund Records Center
75 Hawthorne Street
9th floor, H-6-1
San Francisco, CA 94105

**PROPERTY OF EPA REGION 9
HAZARDOUS WASTE MANAGEMENT DIVISION**



**PLEASE RETURN TO RECORDS CENTER
215 FREMONT STREET
SAN FRANCISCO, CALIFORNIA 94105**

05

POST DEVELOPMENT WATER LEVEL RECOVERY GRAPH

REV. DATE: JAN 1969

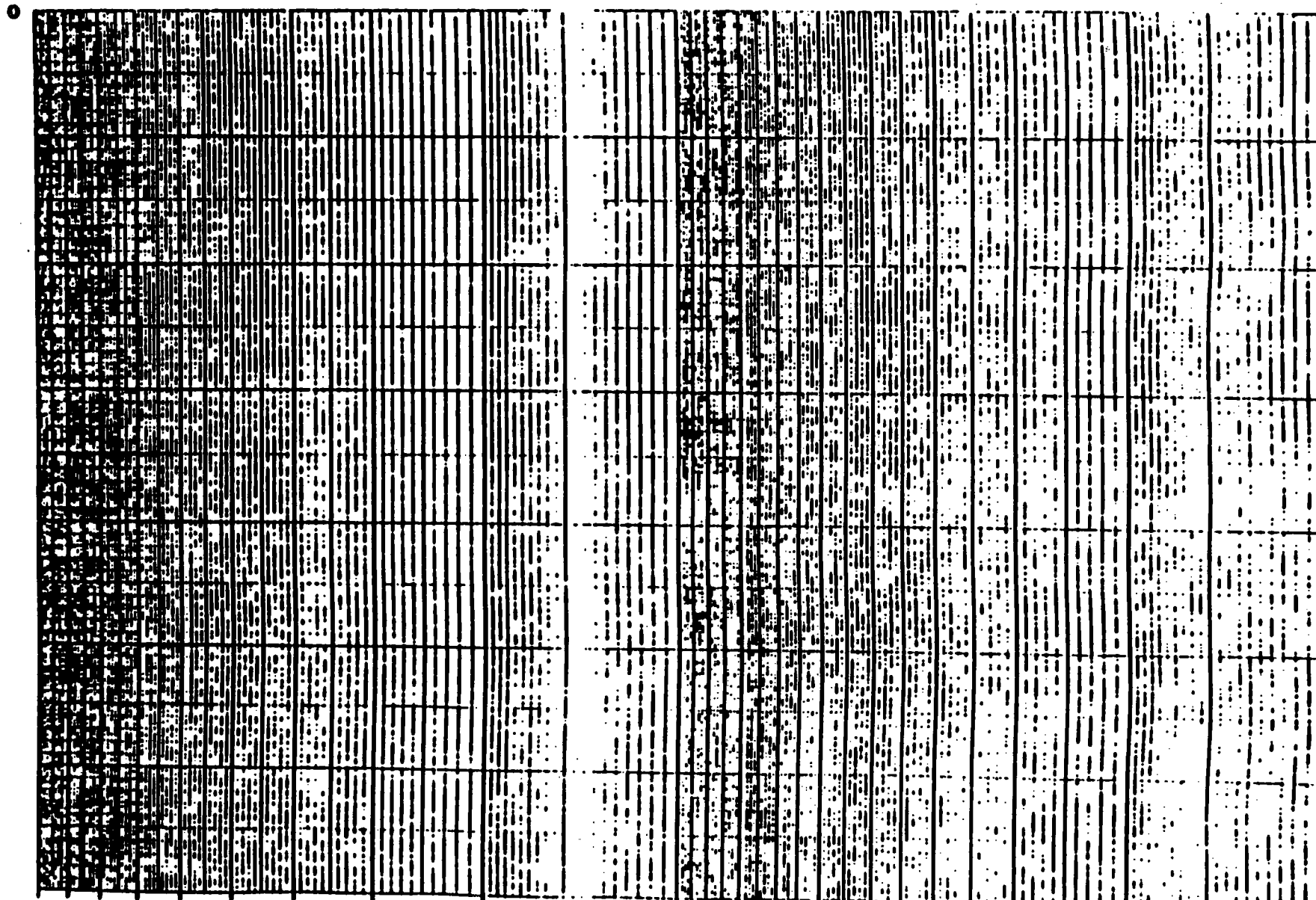
Well Recording Instrument _____

Start Recovery: _____ (: ___ m) End Recovery: _____ (: ___ m)

Total Recovery Time _____

Beginning WL _____ Final SWL _____

DRAWDOWN ()



TIME ()

Camp Dresser & McKee Inc. Sample Label F6261

Sample ID	Project	Type	Station	Number	Replicate
Code	_____	_____	_____	_____	_____
Hazardous	_____	Environmental	_____	_____	_____
Collected by	_____	Date	_____	Time	_____
Witnessed by	_____	_____	_____	_____	_____
Container Prepared by	_____	Preservative	Yes	No	Type _____
References/Notes	_____				

Laboratory	_____			Lab No.	_____

Sample Label Example

CUSTODY SEAL

SIGNATURE _____

DATE _____

7. FIELD CHANGE REQUEST FORM

Field Change No. _____
Page _____ of _____

Project _____

Project No. _____

Applicable Document: _____

Description:

Reason for change:

Recommended disposition:

Impact on present and completed work:

Final Disposition:

Requested by:
Field/Project Manager: _____

Approvals:
HAZWRAP Project Manager: _____

FIGURE 8-1

APPENDIX C
STANDARD OPERATING PROCEDURES

APPENDIX C - CONTENTS

- . Investigation-derived Waste
- . Environmental Sample Shipping
- . Weather Station
- . Summa Cannister
- . Gas Monitoring Well Monitoring

Standard Operating Procedure 5-1-1

INVESTIGATION-DERIVED WASTES

1.0 INTRODUCTION

The purpose of this standard operating procedure for investigation-derived wastes is to:

- o Provide general guidelines for the identification of potentially hazardous chemicals and materials.
- o Provide general guidelines for the control and handling of investigation-derived wastes.
- o Establish a necessary inter-office notification network for resolving problems that may arise

Wastes may result during site investigations and remedial activities at Superfund (CERCLA/SARA) sites as well as during investigations or inspections at operating RCRA facilities. The investigation-derived wastes from these activities must be handled, treated or disposed in the proper manner. The following procedures should generally be followed during field-related activities and tailored to the site-specific conditions and objectives of the field activities. The program manager for the specific contract under which the field activities are being conducted should be consulted for general guidance and resolution of specific issues that arise at a particular site.

2.0 WASTE CATEGORIES

Field activities that include monitoring well installation, sampling of surface and ground waters, and sampling of other media often result in environmental and/or hazardous samples being collected for analysis. In addition, there are materials that result from such field activities that will be not be packaged and sent to a laboratory for testing. A representative list of wastes that may be routinely produced, is as follows:

- o Expendable personal protection equipment: tyvek, gloves, booties, respirator cartridges, and empty calibration gas bottles.
- o Ground water and surface water samples that are not being shipped for laboratory analysis.

Prepared: _____	Reviewed: _____	Approved for Release: _____
Date: _____	Date: _____	Date: _____

- o Drilling fluids, cuttings and core samples from well installation.
- o Decontamination fluids such as water, solvents, or other mixtures.
- o Purged water from wells prior to ground water sampling.
- o Drum Sampling equipment.

3.0 GENERAL GUIDELINES

Generally, the following guidelines should be considered during the planning phase for the field activities:

- o In the appropriate project operation plan, such as the sampling and analysis plan, health and safety plan, and/or QA/QC plans, the site specific procedures for the identification of investigation-derived waste and the handling of such waste must be specified.
- o The program manager should be consulted on a site specific basis regarding the handling (storage, transport, or disposal) of investigation-derived hazardous substances.
- o No generated waste during field activities should be transported off site by CDW employees. The only permissible exception to this policy is the off-site shipment of samples being sent to a laboratory for analysis.

4.0 CERCLA ACTIVITIES

Pursuant to CERCLA 121, CERCLA remedial activities must be carried out in accordance with federal and state requirements. EPA's policy is that field investigation teams should use best professional judgment in determining when investigation-derived wastes contain appreciable amounts of hazardous waste and then should be handled properly so that federal and state standards are met. When the field team does not know the specific hazard of the waste, EPA expects that reasonable attempts to comply with federal and state requirements will be made. Currently, the general practice is that investigation-derived materials can remain onsite until the remedial activities are complete.

Prior to the any site activities, the field team should determine if the investigation-derived wastes may contain hazardous wastes and identify the logistics required for the proper handling of such wastes.

EPA shall be consulted to ensure that public health and the environment are protected. The field investigation team should address the following considerations and consult with the EPA regional office, if necessary:

- o Determine the likelihood and probability that hazardous waste will be generated from the field activities. This may be accomplished by review of site records, pertinent data and other available information.
- o Identify the sampling procedures in the sampling and plan and address the issue of investigation-derived waste.
- o If sampling of ground water and soil in areas of known or suspected areas of significant contamination is to occur, then purged water or waste samples should be segregated and contained. Certain exceptions to this practice may be allowed with prior EPA consultation and approval (for example, discharging purged water onto the ground). However, it must be emphasized that off-site transport/storage of such materials by CDM employees is prohibited.
- o If materials need to be collected in drums or other containers, solids should be segregated from liquids. The drums or containers must be clearly labeled.
- o Disposable protective clothing is segregated and shall be placed in large industrial grade plastic bags and/or 55 gallon drums.
- o Non-disposable items such as boots, sampling equipment, and other field equipment shall be decontaminated using the appropriate decontamination solutions and procedures prior to taking off site.
- o Any wash waters used for decontamination shall be collected in properly labeled drums for disposal on site.

5.0 RCRA ACTIVITIES

Generally, for an investigation or inspection at a RCRA facility, any investigation-derived waste can be handled in the appropriate manner by the RCRA facility. Coordination with the facility manager, prior to the site visit is necessary. The field investigation team should explain the purpose of the visit and list the anticipated investigation-derived wastes

that may result. Written documentation is necessary to indicate that the handling of such wastes has been discussed with the facility and that the facility concurs with the waste being left onsite. Documentation may be a letter to the facility, or a telephone log. A CDM field team shall not commence any field sampling activities until arrangements have been made with the facility regarding the handling of the investigation-derived wastes.

6.0 GUIDELINES FOR TRANSPORTING WASTES OFF SITE

When a hazardous waste as defined in 40 CFR Part 261, Subparts C and D, is known or expected to result from field activities, then the field investigation team should be aware that the handling and managing of these wastes off-site must meet the treatment, storage and disposal requirements of RCRA. Guidance for this determination is provided in Exhibits 1, 2, 3, and 4.

In certain instances, contractors may be tasked by EPA to provide assistance with offsite transport of wastes to a treatment/storage/disposal (TSD) facility. In these cases, strict adherence to 40 CFR Part 262 is required.

CERCLA 121(c)(3)(B) requires off-site storage, destruction, treatment, or secure disposition of hazardous substances from Superfund sites to be done at hazardous waste disposal facilities that are in compliance with Subtitle C of RCRA. In this situation, EPA is the generator of the hazardous waste and must comply with the requirements of 40 CFR Part 262, Standards Applicable to Generators of Hazardous Waste and which include:

- o Subpart A: General
- o Subpart B: The Manifest
- o Subpart C: Pre-Transport Requirements
- o Subpart D: Recordkeeping and Reporting

Pursuant to 40 CFR Part 262, EPA must:

- o Initiate notification.
- o Obtain the appropriate EPA ID number.
- o Complete EPA form 8700-22 and 8700-22A, Uniform Hazardous Waste Manifest (refer to Exhibit 1).

Standard Operating Procedure 4-1-0

ENVIRONMENTAL SAMPLE SHIPPING

1.0 Application

Shipment of environmental samples (samples of ambient air, water, or soil with little contamination) from a field location to a laboratory. This procedure is summarized in Exhibit 1.

2.0 Packing the Sample

- Leave enough outage (10% by volume) in the sample jar to accommodate thermal expansion.
- Place the sample container, sealed with a lid, in a polyethylene bag.
- Attach a sample identification tag to the jar. Seal the bag.
- Place the bagged sample(s) in a fiberboard container or picnic cooler lined with a large polyethylene bag.
- Pack enough non-combustible, absorbent, cushioning material around the samples to minimize the possibility of container breakage.
- Place the chain-of-custody sheets and the CLP traffic reports in a plastic bag. Tape the bag to the cooler's lid on the inside.
- Seal the large bag.
- Close the cooler with strapping tape and seal it on two sides with custody seals.

3.0 Marking and Labeling

- Mark the outside container; "Environmental Sample" and "This End Up" with arrows placed accordingly. No Department of Transportation (DOT) marking or labeling is required.

4.0 Shipping Papers

- Attach the carrier's waybill form to the cooler. No DOT papers are required.

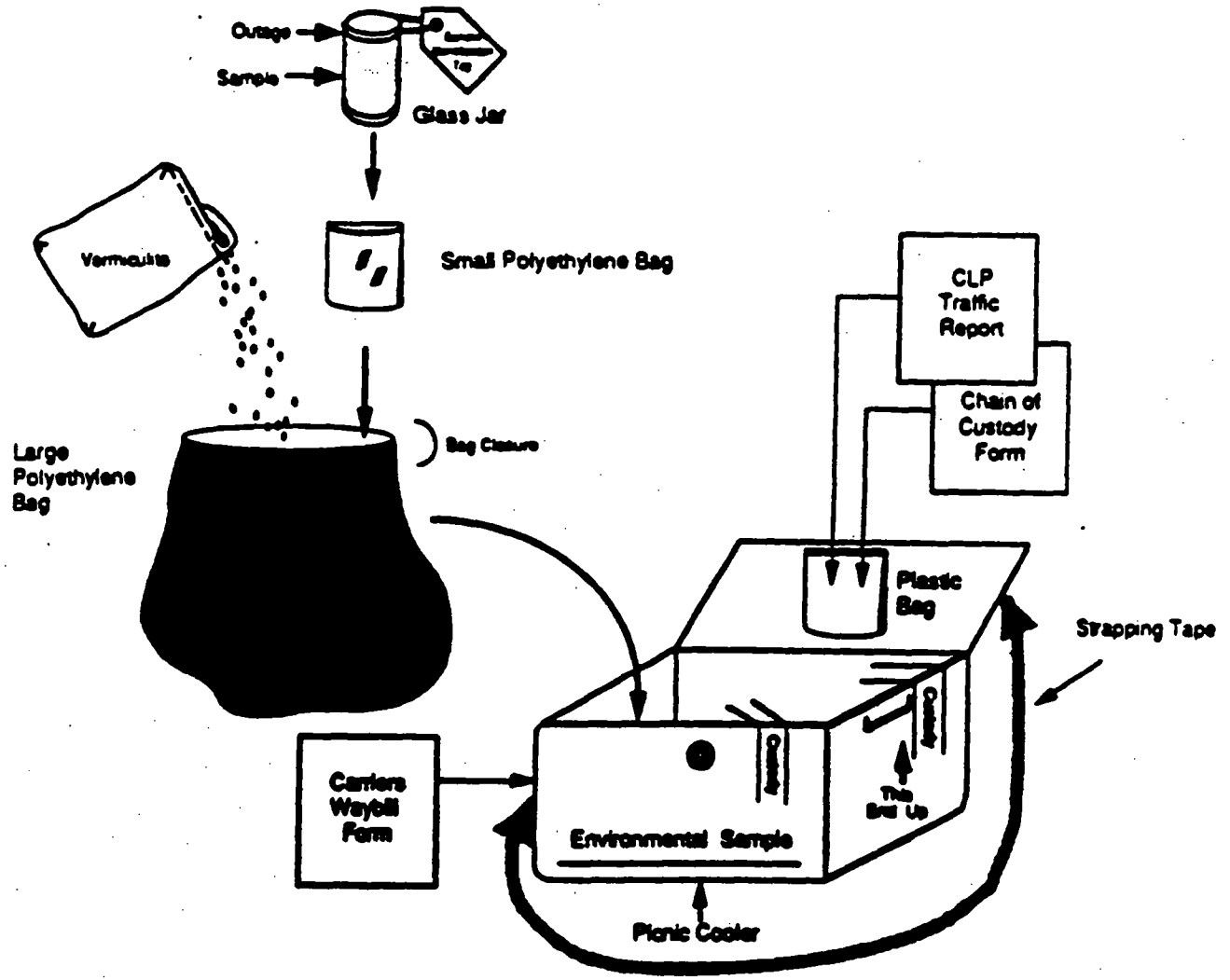
5.0 Modes of Transportation

- The shipment may travel on any mode of transportation.

Prepared: <u>CSEY</u>	Reviewed: <u>MSM</u>	QA: <u>RNS</u>	Approved: <u>CAO</u>	Issued: <u>JAC</u>
Date: <u>2/1/89</u>	Date: <u>3/30/89</u>	Date: <u>4/5/89</u>	Date: <u>6/13/89</u>	Date: <u>6/13/89</u>

EXHIBIT 1

ENVIRONMENTAL SAMPLE PACKAGING PROCEDURES



Procedure: 5607013
Revision: 0
Date: 4/85
Page: 1 of 5

GENERAL CONSIDERATIONS FOR METEOROLOGICAL MONITORING

1.0 INTRODUCTION

The following discussion defines a general program developed for monitoring wind speed and direction at an uncontrolled hazardous waste site. The program is generic in the sense that equipment specific protocols are dependent on the type of equipment used. Wind monitoring will provide real time continuous on-site data essential for operational safety procedures during clean-up operations.

2.0 SITING AND INSTALLATION

Proper equipment siting along with good instrumentation is a critical factor in obtaining good meteorological data. The obvious objective in siting wind recording instruments is to place the equipment in a location that characterizes air flow in the general site area as well as the impact areas of concern. The wind instruments should be located at the standard exposure height of 10 meters in open terrain. Locating the equipment in open terrain will ensure that the equipment will not be exposed to disturbed air flow resulting from air interactions in and around obstructions. Obstructions can be buildings, fences, signs, trees, vegetation, elevated terrain, or any other object that would unduly influence the general air flow in the area. Open terrain is defined as an area where the distance between the instrument and any obstruction is at least 10 times the height of the obstruction. This convention is adopted by the World Meteorological Organization (WMO) and is generally observed in order to compare recorded data to other observed wind data. Secondary considerations should also be taken into account but should not be allowed to compromise the quality of the recorded data. Secondary considerations include accessibility as well as equipment security.

Procedure: 5607013
Revisions: 0
Date: 4/85
Page: 2 of 5

The instrument should be firmly positioned on a mast or tower which will not twist, rotate, or sway. Wind instruments mounted on the roof of a building should be placed high enough to be out of the area in which air flow is disturbed. This height can be determined using standard NMO and EPA guidelines.

Orientation of the wind vane to the true north is another necessity in instrument siting. Equipment manufacturers will provide some means to identify which way to align the translator to the north. This is usually accomplished by an engraving mark on the equipment housing or by supplying, as an option, a mounting jig for keeping the vane in proper alignment for orientation. This jig is also handy for periodic calibration of equipment which is described in section 3.2 on calibration.

The most accepted procedure for determining true north involves shooting the North Star with a first-order theodolite. A land surveying handbook will describe this technique and contain all the necessary tables. The preferred method of establishing true north is to utilize a registered land surveyor who may be involved in the project to carry out the above mentioned procedure. USGS maps of the site area also give the compass declination. Another acceptable method to establish true north is by the location of the sun at solar noon. This can be accomplished by using an empirical formula based on the site's longitude and "Equation of Time" found in standard Meteorological tables (List, 1979).

3.0 OPERATION

3.1 Equipment Maintenance

Operational checks are important to assure the best quality data. The use of time marks on chart rolls is a very effective means to

Procedure: 5607013
Revision: 0
Date: 4/85
Page: 3 of 5

check the recorder clock mechanism. This can be done manually and should be performed every 24 hours.

The establishment of a preventive maintenance program and the performance of operational checks will ensure the highest possible quality data. Operational checks include time syncs, data retrieval, data inspection and visual equipment inspection. The anemometer should never come to an abrupt stop or start but should come to a slow start and stop. Abrupt stopping and starting of the anemometer would indicate worn bearings. Bearings can be checked with a torque watch. Oilless bearings should never be oiled. Bearings should be replaced every 12 months. Other operational/maintenance items include system cleaning, tightening, lubricating and a zero and span adjustment every time the strip chart is replaced (frequency determined by type of equipment, refer to equipment specification for frequency). Physical checks of the equipment should be made as often as possible, at least monthly. These checks include an examination of the sensors and the readout equipment. At some locations with heavy pollution, it may be necessary to routinely change the bearings in both the anemometer and vane housing.

Light freezing rain with little wind is the most detrimental condition for cups and especially for propellers. It has been found that a LIGHT spray coating of SILICONE, or an equivalent non-sticking spray, helps to retard the formation of ice. Spare parts for anemometers and vanes should include replacement bearings. A log should be kept on all maintenance and operational checks.

Procedure: 5607013
Revision: 0
Date: 4/85
Page: 4 of 5

3.2 Equipment Calibration

There are two basic types of calibrations: bench and field. The bench calibration is conducted under controlled laboratory conditions (i.e., wind tunnel) where known inputs are compared to observed outputs. Adjustments are then made to equalize output to input. Bench calibrations may be performed by the manufacturer or by the user, providing the proper equipment is available. During a bench calibration, it is desirable to simulate as closely as possible the field configuration of the sensor system. How often field calibrations are needed depends upon the length of the measurement program and the stability of the specific instrument. (Stability is the time period an instrument is expected to retain its calibration.) If portable mobile instrumentation is available, bench calibrations may actually be possible on site, minimizing down time.

Bench calibrations check specific dynamic response characteristics such as threshold speeds, damping ratios, delay distances and distant constants which can only be checked in a wind tunnel, and must be performed by qualified personnel or returned to the manufacturer for major calibration.

Field calibrations would check the output of the transducer by coupling the anemometer shaft through a flexible, universal connector to a synchronous motor and gear assembly that will run at a fixed, known RPM. Calibration units are commercially available with 1800 RPM or 300 RPM output when powered by standard 60 Hz line voltage (115 V).

Procedure: 5607013
Revision: 0
Date: 4/85
Page: 5 of 5

Calibrating the electronic system exclusive of the sensor/transducer involves the substitution of a stable, known voltage for a voltage generator, or a known frequency for a frequency generator.

Some equipment contains an internal calibration mechanism to check the system electronics. This is usually accomplished by a built-in reference frequency (or voltage) to supply a known value to check the anemometer system electronics excluding the sensor/translator but including the readout device. The wind vane system electronics can be checked using precision resistors and comparing the known values to the output. The output of the wind vane itself can be compared using a test fixture which allows the wind vane potentiometer to be set at certain directions. With these set directions known, the readout can be verified. It is also useful to rotate the vane both clockwise and counter clockwise observing the readout. The size of the gap where there is no electrical signal is significant in single potentiometer, 360-degree direction vanes. The fidelity with which the transition at north is made is significantly improved in 540-degree direction vanes.

Field calibration or calibration checks should be performed at least once every 3 months.



141 Suburban Road	•	San Luis Obispo, CA 93401	•	(805) 543-2553	•	Fax (805) 543-2685
751 S. Kellogg, Suite A	•	Goleta, CA 93117	•	(805) 964-7838	•	Fax (805) 967-4386
1885 North Kelly Road	•	Napa, CA 94558	•	(707) 257-7211	•	Fax (707) 226-1001
9333 Tech Center Dr., Ste. 800	•	Sacramento, CA 95826	•	(916) 368-1333	•	Fax (916) 362-2484
2400 Cumberland Dr.	•	Valparaiso, Indiana 46383	•	(219) 464-2389	•	Fax (219) 462-2953

COAST-TO-COAST ANALYTICAL SERVICES
AIR SAMPLING PROCEDURE
SUBATMOSPHERIC "GRAB" TECHNIQUE

Equipment:

- 1) Stainless steel SUMMA canister, evacuated to -29.5"Hg
- 2) Teflon, stainless steel or copper tubing, 1/4" OD with 1/4" swagelok fittings attached.
- 3) Vacuum gauge 0 to -30"Hg in 1" increments.

Procedure:

- 1) Connect vacuum gauge to sample canister, open valve, check and record initial vacuum, close valve, remove vacuum gauge.
- 2) Attach a length of tubing, of appropriate length, to the sample canister.
- 3) Connect or position the opposite end of the tubing in such a way so as to access the sampling point.
- 4) Open the valve for a period of 30 to 60 seconds.
- 5) Close the valve, disconnect the tubing and attach a label to the sample canister with pertinent sample information.

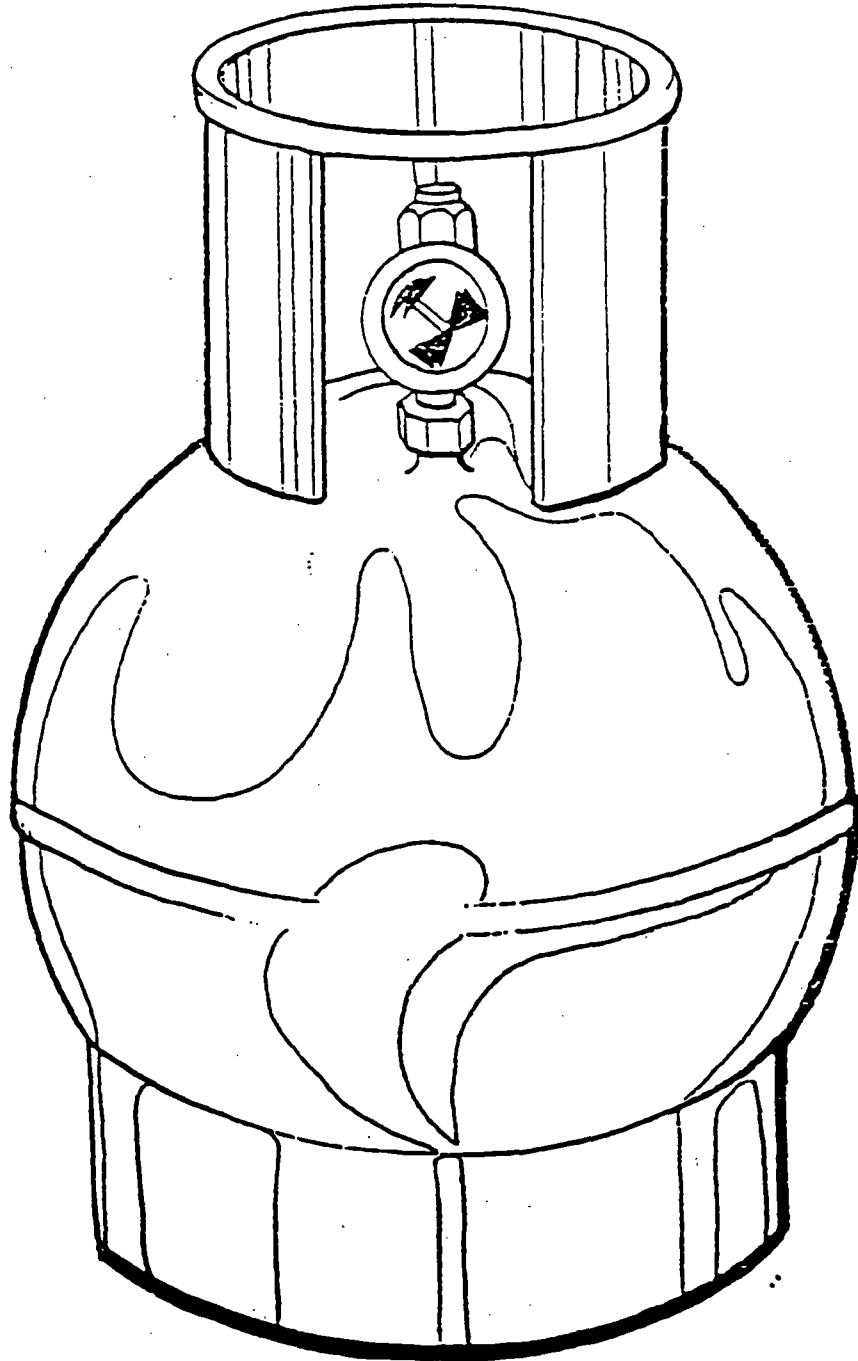
Discussion:

When opened to the atmosphere containing the VOC's to be sampled, the differential pressure causes the sample to flow into the canister. The tubing is used to access an otherwise awkward sampling point, eg. tank headspace, manhole, monitoring well, exhaust stack etc., and may be omitted if unnecessary.

**COAST - TO -
COAST
ANALYTICAL
SERVICES**

Air, Water & Hazardous Waste Sampling, Analysis & Consultation
Certified Hazardous Waste, Chemistry, Bacteriology & Bioassay Laboratories

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9333 Tech Center Dr., Ste. 800	• Sacramento, CA 95826	• (916) 368-1333	• Fax (916) 362-2484
2400 Cumberland Dr.	• Valparaiso, Indiana 46383	• (219) 464-2389	• Fax (219) 462-2953



SUMMA POLISHED SAMPLING CANNISTER

COAST TO COAST ANALYTICAL SERVICES

CRYOGENIC GRAB SAMPLING METHOD
FOR
VOLATILE ORGANIC COMPOUNDS IN AIR

Equipment needed:

- 1) Six liter SUMMA-Stainless Steel sampling canister (Can). Sample Cans are supplied under vacuum.
- 2) Teflon (TFE) tubing 1/4 inch diameter by 2 feet in length. The TFE tubing must have a ferrule attached, and a 1/4 inch brass swagelok nut in place.
- 3) Ice chest, 34 quart minimum.
- 4) Liquid Nitrogen (LN₂), 25-30 liters. More LN₂ may be required if many samples are to be collected.
- 5) Gloves suitable for use with cryogenic liquids, safety glasses, protective clothing.

Procedure:

- 1) Exercise care when handling cryogenic liquids. Wear proper protective clothing. Check site safety plan regarding possible need for extra protective clothing and equipment.
- 2) Check sample Can to be sure that valve is closed (knob fully clockwise).
- 3) Remove protective nut from top of Can and attach TFE tubing.
- 4) Fill Ice chest 1/2 to 3/4 full with LN₂.
- 5) Hold Can by valve assembly. Immerse sample Can in LN₂ for 3 minutes.
- 6) Hold TFE tube upright and open canister valve fully. After 2 minutes close valve.
- 7) Allow Can to warm to ambient temperature. Open valve to flush sample from Can.
- 8) Repeat steps 5, 6, and 7 three times to flush Can thoroughly.
- 9) Finally, repeat steps 5, and 6 to collect grab sample.



141 Suburban Road	• San Luis Obispo, CA 93401	• (805) 543-2553	• Fax (805) 543-2685
751 S. Kellogg, Suite A	• Goleta, CA 93117	• (805) 964-7838	• Fax (805) 967-4386
1885 North Kelly Road	• Napa, CA 94558	• (707) 257-7211	• Fax (707) 226-1001
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2400 Cumberland Dr.	• Valparaiso, Indiana 46383	• (219) 464-2389	• Fax (219) 462-2953

CANISTER SAMPLING FIELD DATA SHEET

A. GENERAL INFORMATION

SITE LOCATION: _____	SHIPPING DATE: _____
SITE ADDRESS: _____	CANISTER SERIAL NO.: _____
_____	SAMPLER ID: _____
_____	OPERATOR: _____
SAMPLING DATE: _____	CANISTER LEAK CHECK DATE: _____

B. SAMPLING INFORMATION

	TEMPERATURE				PRESSURE	
	INTERIOR	AMBIENT	MAXIMUM	MINIMUM	CANISTER PRESSURE	
START			 	 		
STOP					 	

	SAMPLING TIMES		FLOW RATES		
	LOCAL TIME	ELAPSED TIME METER READING	MANIFOLD FLOW RATE	CANISTER FLOW RATE	FLOW CONTROLLER READOUT
START					
STOP					

SAMPLING SYSTEM CERTIFICATION DATE: _____
 QUARTERLY RECERTIFICATION DATE: _____

C. LABORATORY INFORMATION

DATE RECEIVED: _____
 RECEIVED BY: _____
 INITIAL PRESSURE: _____
 FINAL PRESSURE: _____
 DILUTION FACTOR: _____
 ANALYSIS
 GC-FID-ECD DATE: _____
 GC-MSD-SCAN DATE: _____
 GC-MSD-SIM DATE: _____

RESULTS*: _____

 GC-FID-ECD: _____
 GC-MSD-SCAN: _____
 GC-MSD-SIM: _____

 SIGNATURE/TITLE

GAS MONITORING WELL MONITORING

The standard operating procedures (SOPs) for data collection at soil gas monitoring wells with the used the Bacharach HPK combustible gas and oxygen indicator is described below.

DESCRIPTION OF AND ACCESS TO THE MONITORING WELLS

The monitoring wells consist of one or more probes constructed of 1/4" polyethylene tubing connecting the ground surface to gravel packs at specific depths. The probes may be under positive pressure requiring the field personnel to perform the necessary monitoring as described in the Health and Safety Plan.

Many gas wells contain more than one probe. The probes are coded with colored tubing to identify the depth at which they are completed. The data collection forms shall indicate which color corresponds to the specific probe. Collect the gas quality data from the probes in the order in which they appear on the data sheet.

EQUIPMENT AND SUPPLIES NEEDED

- . HPK combustibles/oxygen meter configured per Appendix D, Calibration and Operating Procedures.
- . Protective equipment required for the task by the Health and Safety Officer.
- . 1/4" Tygon^R tubing (approximately 25').

COMBUSTIBLES MEASUREMENT

Turn the HPK combustible gas indicator to ON. Perform the HPK startup procedure (Appendix D). Attach the probe to the stopcock with a length of 1/4" Tygon^R tubing. The pump should almost stop. If it does not, there is a leak in the sample line. Locate and repair the leak before proceeding.

Open the stopcock. Watch closely for water in the sampling line. Turn the HPK off quickly if water enters its liquid trap. Read the combustible and oxygen meters when the needle on the oxygen meter reaches its low point. Close the stopcock. Disconnect the Tygon^R tubing at the stopcock let the HPK vent. With the pump running until the oxygen meter reads 21 percent again.

APPENDIX D

CALIBRATION AND OPERATING PROCEDURES

APPENDIX D - CONTENTS

- . Calibration for the Hnu PI 101
- . YSI Model 33 Conductivity Meter
- . Orion SA 250 pH Meter
- . Bacharach HPK Combustible Gas & Oxygen Indicator
- . Foxboro Century 128 OVA Flame Ionization Detector

CALIBRATION PROCEDURE FOR THE HNu PI 101

1.0 INTRODUCTION

1.1 Content

This procedure presents the steps required to calibrate the HNu Model PI 101 photoionization analyzer. This instrument should be calibrated once daily for each day of field use. The principle of detection and operating procedures are described in Procedure 5607001. This procedure presents calibration steps only.

1.2 Equipment

- o Calibration Gas (2 ranges)

Low range 0-20 ppm and mid range 20-200 ppm Isobutylene gas for standard field operation when contaminants are unknown or a mixture of gases is present. Isobutylene is the gas used for general calibration because of the instrument's relatively high sensitivity to it and the non-toxic nature of the gas.

Note: A specialty gas may be required if a single atmospheric contaminant is present and the contaminant has a sensitivity different from that of the calibration gas. See procedure for 5607001 for a discussion on specialty calibration.

- o Tubing and fittings (See Figure 1).

- o Rotometer or bubble flow meter.

- o Calibration Form F6264.

- o Table 1 for ionization potentials for compounds of interest.

Section 1.1 modified Reviewed Date 11/19 Issued 11/19/90
on 11/19/90 by Approved Date 11/19

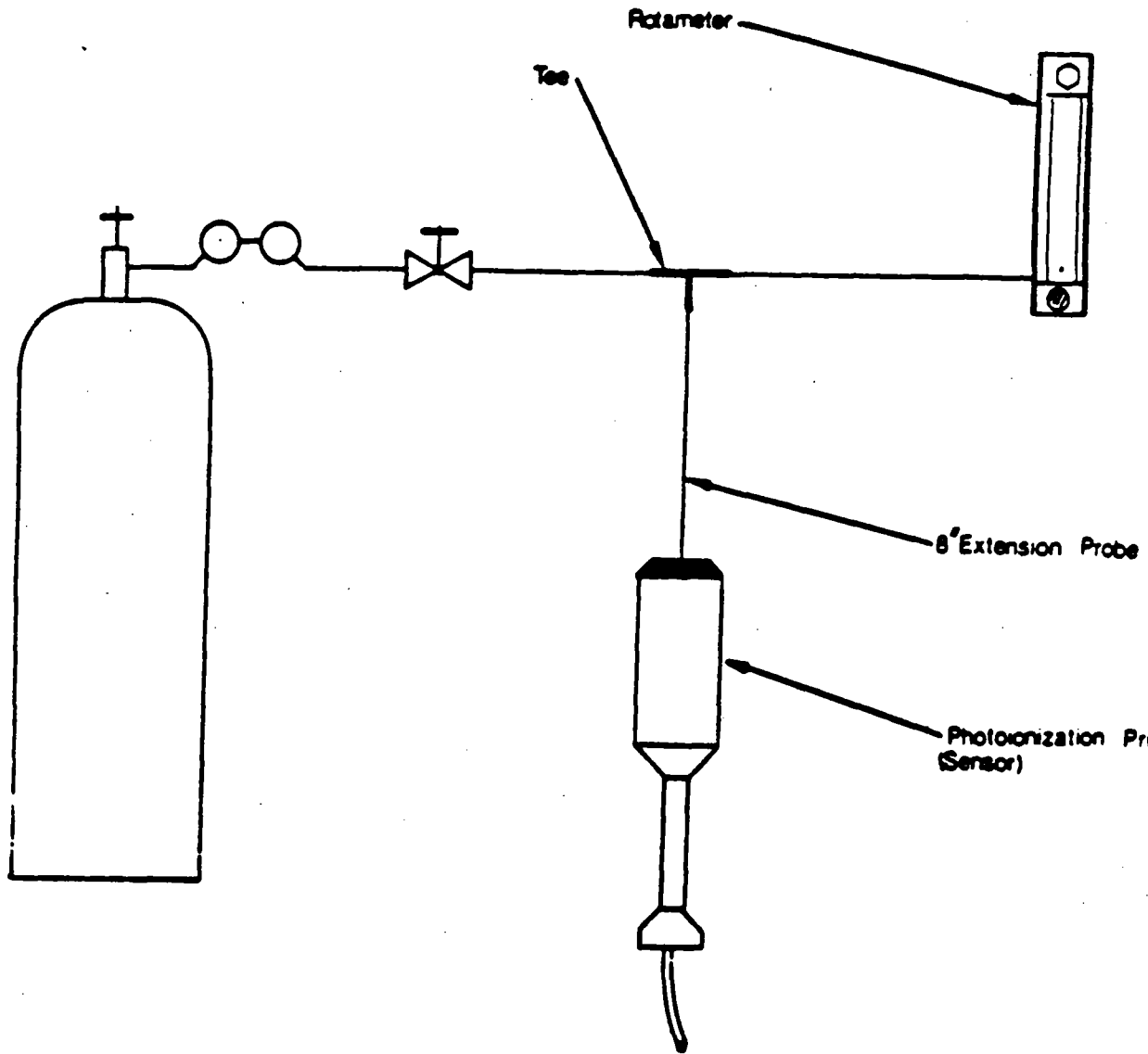


FIGURE 1 RECOMMENDED CALIBRATION PROCEDURE FOR PHOTOIONIZATION ANALYZER

TABLE 1 RELATIVE SENSITIVITIES FOR VARIOUS GASES
(10.2 eV Lamp)

Species	Photoionization Sensitivity*
p-xylene	11.4
m-xylene	11.2
benzene	10.0 (reference standard)
toluene	10.0
diethyl sulfide	10.0
diethyl amine	9.9
styrene	9.7
trichloroethylene	8.9
carbon disulfide	7.1
isobutylene	7.0
acetone	6.3
tetrahydrofuran	6.0
methyl ethyl ketone	5.7
methyl isobutyl ketone	5.7
cyclohexanone	5.1
naptha (85% aromatics)	5.0
vinyl chloride	5.0
methyl isocyanate	4.5
iodine	4.5
methyl mercaptan	4.3
dimethyl sulfide	4.3
allyl alcohol	4.2
propylene	4.0
mineral spirits	4.0
2,3-dichloropropene	4.0
cyclohexene	3.4
crotonaldehyde	3.1
acrolein	3.1
pyridine	3.0
hydrogen sulfide	2.8
ethylene dibromide	2.7
n-octane	2.5
acetaldehyde oxime	2.3
hexane	2.2
phosphine	2.0
heptane	1.7
allyl chloride (3-chloropropene)	1.5
ethylene	1.0
ethylene oxide	1.0
acetic anhydride	1.0
α -pinene	0.7
dibromochloropropane	0.7
epichlorohydrin	0.7
nitric oxide	0.6

TABLE 1 RELATIVE SENSITIVITIES FOR VARIOUS GASES
(10.2 eV Lamp) (Continued)

Species	Photoionization Sensitivity*
b-pinene	0.5
citral	0.5
ammonia	0.3
acetic acid	0.1
nitrogen dioxide	0.02
methane	0.0
acetylene	0.0

*Expressed in ppm (v/v).

2.0 CALIBRATION PROCEDURE

2.1 CDM employs a two-point standardization procedure to facilitate proper instrument calibration over the 0-20 ppm and 20-200 ppm operating ranges. Two distinct mixtures of the calibration gas (isobutylene) in air are used. Each mixture should give a 3/4 scale deflection in its respective operating range.

2.2 Instrument Setup.

2.2.1 Remove Instrument cover by pulling up on the side straps.

2.2.2 Prior to calibration, check the function switch (Figure 2) on the control panel to make sure it is in the OFF-positon. The probe nozzle, is stored inside the instrument cover. Remove cover plate by pulling up on the pins that fasten the cover plate.

2.2.3 Remove the nozzle from the cover. Assemble probe by screwing nozzle into casing.

2.2.4 Attach probe cable to instrument box by inserting 12 pin interface connector of the probe cable into the connector on the instrument panel. Match the alignment keys and insert connector. Turn connector in clockwise direction until a distinct snap and lock is felt.

2.2.5 Turn the function switch to the Battery Check position. When the battery is charged, the needle should read within or above the green battery arc on the scale plate. If the needle is below the green arc or the red LED light

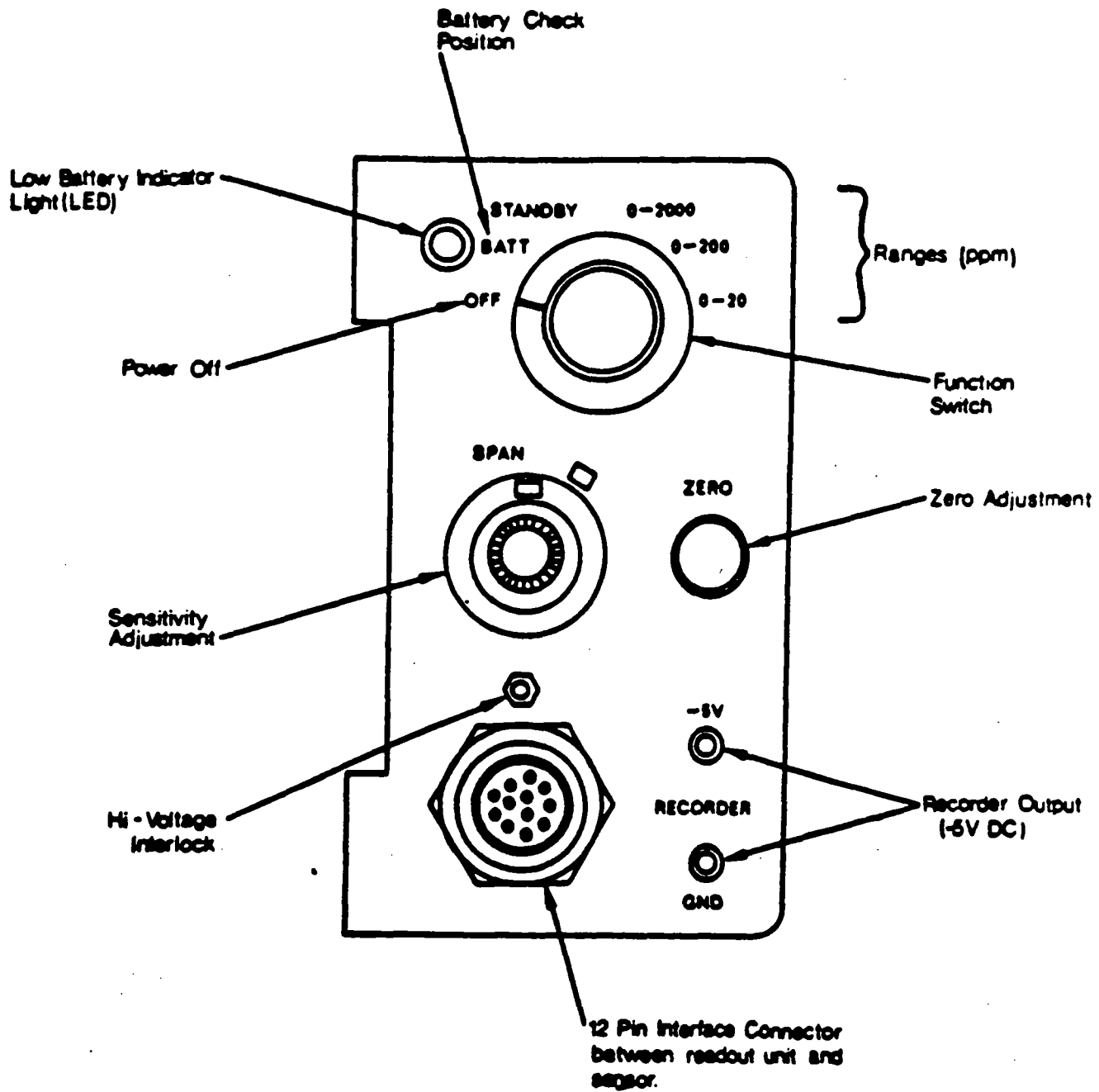


FIGURE 2 CONTROL PANEL FEATURES

comes on, the instrument should be recharged prior to making any measurements. Implement step 3.0 to recharge battery.

2.2.6 Turn the function switch to the ON position. In this position, the UV light source should be on. To verify, gaze at the end of the probe for a purple glow. Do not look directly at the lamp itself. If the lamp does not come on refer to maintenance step 4.1.2.

2.2.7 To zero the instrument, turn the function switch to the standby position and rotate the zero potentiometer until the meter reads zero. Clockwise rotation of the zero potentiometer produces an upscale deflection while counter clockwise rotation yields a downscale deflection. (Note: no zero gas is needed since this is an electronic zero adjustment.) If the span adjustment is changed during instrument calibration, the zero should be rechecked and adjusted. If necessary wait 15 to 20 seconds to ensure that the zero reading is stable. Readjust as necessary.

2.3 Calibration Steps

2.3.1 Insert one end of T tube (Figure 1) into probe. Insert second end of probe into calibration gas in the 20-200 ppm range. The third end of probe should have the rotometer (bubbler) attached.

2.3.2 Set the function switch in the 0-200 ppm range.

- 2.3.3 Crack the valve on the pressured calibration gas container until a slight flow is indicated on the rotometer. The instrument will draw in the volume required for detection with the rotometer indicating excess flow.
- 2.3.4 Adjust the span potentiometer so that the instrument is reading the exact value of the calibration gas. (Calibration gas value is labeled on the cylinder).
- 2.3.5 Turn instrument switch to the standby position and check the electronic zero. Reset zero potentiometer as necessary following step 2.3.7.
- 2.3.6 Record on form F6264 all original and readjusted settings as specified in the form.
- 2.3.7 Next, set the function switch to the 0-20 ppm. Remove the mid range (20-200 ppm) calibration gas cylinder and attach the low range (0-20 ppm) calibration gas cylinder as described above.
- 2.3.8 Do not adjust the span potentiometer. The observed reading should be ± 3 ppm of the concentration specified for the low range calibration gas. If this is not the case, recalibrate the mid range scale repeating procedures 3.3.1 to 3.2.7 above. If the low range reading consistently falls outside the recommended tolerance range, the probe light source window likely needs cleaning. Clean window following step 4.1.3. When the observed reading is within the required tolerances, the instrument is fully calibrated.

2.3.9 Complete forms F6264 and F6265 for the respective instrument being calibrated.

3.0 BATTERY RECHARGING

- 3.1 Place plug on end of charger cable into jack on left side of instrument case
- 3.2 Plug charger into 120V AC supply.
- 3.3 To ensure that charger is functioning, turn the function switch to the battery check position. The meter should go upscale if the charger is working correctly and correctly inserted.
- 3.4 The battery is completely charged overnight (ca, 14 hours).
- 3.5 When disconnecting charger, remove from 120 V AC before removing mini phone plug.

4.0 TROUBLE SHOOTING AND MAINTENANCE

4.1 General Fault Determination and Correction

- 4.1.1 Battery level is low. Recharge if necessary implementing step 3.0. If the battery will not recharge it will have to be replaced.
- 4.1.2 UV lamp function. Gaze at sample inlet when mode switch is on an instrument function position and observe for purple glow of lamp. If the lamp does not glow in any of the three instrument function positions, it may be burned out and will have to be replaced. To replace the lamp:

1. Turn the function switch to the off position and disconnect the probe connector from the readout unit.
2. Remove the exhaust screw found near the base of the probe (Figure 3).
3. Grasp the end cap in one hand and the probe shell in the other and gently pull to separate the end cap and lamp housing from the shell.
4. Loosen the screws on the top of the end cap and separate the end cap and ion chamber from the lamp and lamp housing. Care must be taken so that the ion chamber does not fall out of the end cap and the lamp does not slide out of the lamp housing.
5. Turn the end cap over in your hand and tap on the top of it; the ion chamber should fall out of it.
6. Place one hand over the top of the lamp housing and tilt slightly. The light source will slide out of the housing.
7. Replace lamp with one of same energy source as the one removed by sliding it into the housing. Note: the amplifier board and instrument circuitry are calibrated for one light energy source. Insertion of a lamp of a different energy level will produce false instrument readings.
8. Place the ion chamber on top of the lamp housing, checking to ensure that the contacts are aligned.
9. Place the end cap on top of the ion chamber and replace the two screws. The screws should be tightened only enough to seal the "O" ring. Do not overtighten.
10. Line up the pins on the base of the lamp housing with the pins inside the probe shell. Gently slide the housing assembly into the probe shell. Do not force the assembly as it only fits one way.
11. Replace and tighten the exhaust screw.
12. Reconnect the 12 pin connector and turn instrument mode switch to a function position. Check for glow of lamp. If lamp still does not function the instrument has an electrical short or other problem that will have to be corrected at the factory.

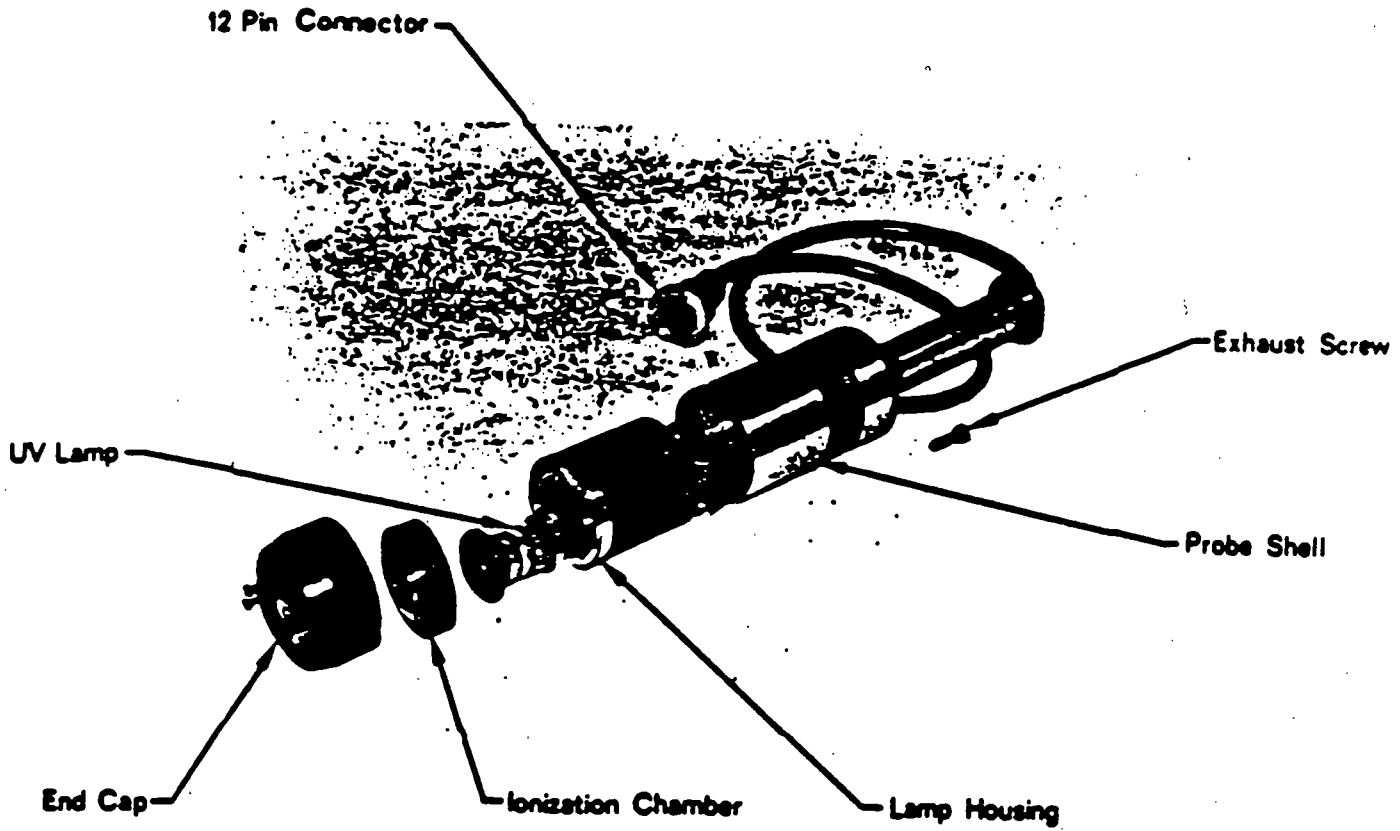


FIGURE 3 COMPONENT PARTS OF PROBE

4.1.3 Instrument appears to be functional, but responses are lower than expected or erratic. The window of the light source may be dirty and need to be cleaned. To clean the light source window:

1. Disassemble the probe assembly by repeating steps 1 through 6 under 4.1.2 above.
2. Clean the window of the light source using compound provided with instrument and soft clean cloth.
Important: use cleaning compound on the window of the 10.2 eV lamp only. The cleaning compound may damage the windows of the 9.5 and 11.7 eV lamps.
3. Reassemble the probe assembly repeating step 7 through 12 above.

4.2 Specific Faults

4.2.1 No meter response in any switch position (including BATT CHK)

1. Broken meter movement: Tip instrument rapidly from side to side. Meter needle should move freely, and return to zero.
2. Electrical connection to meter is broken: Check all wires leading to meter and clean the contacts of quick-disconnects.
3. Battery is completely dead: Disconnect battery and check voltage with a volt-ohm meter.
4. Check 2 amp fuse.
5. If none of the above solves the problem, consult the factory.

4.2.2 Meter responds in BATT CHK position, but reads zero or near zero for all others.

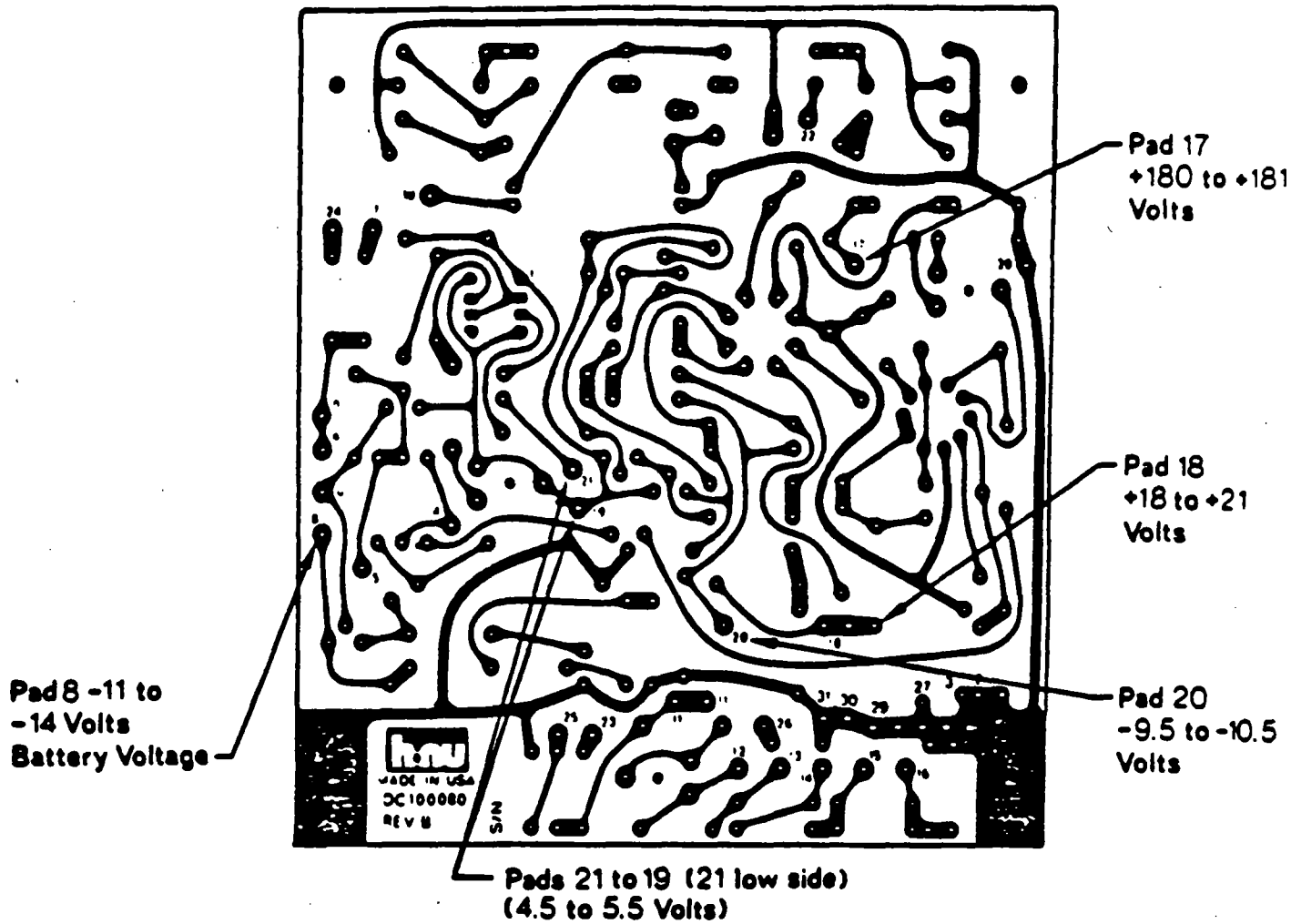
1. Power supply defective: Check power supply voltages per Figure 4. If any voltage is out of specification, consult the factory.
2. Input transistor or amplifier has failed: Rotate zero control; meter should deflect up/down as control is turned. Open probe; both transistors should be fully seated in sockets.
3. Input signal connection broken in probe or readout: Check input connector on printed circuit board. Should be firmly pressed down. Check components on back side of printed circuit board. All connections should be solid, and no wires should touch any other object. Check all wires in readout for solid connections.

4.2.3 Instrument responds correctly in BATT CHK, and STBY, but not in measuring mode.

1. Check to see the light source is on (See Section 4.1.2).
2. Check high voltage power supply (see Figure 4).
3. Open end of probe, remove lamp and check high voltage on lamp contact ring.
4. If high voltage is present at all above points, light source has most likely failed. Consult the factory.

4.2.4 Instrument responds correctly in all positions, but signal is lower than expected.

1. Check span setting for correct value.
2. Clean window of light source (See 4.1.3).
3. Double check preparation of standards.
4. Check power supply 180 V output. See Figure 4.
5. Check for proper fan operation. Check fan voltage. See Figure 4.
6. Rotate span setting. Response should change if span pot is working properly.



All Voltages Respect to Ground

pads	voltage	pads	voltage	pads	voltage	pads	voltage
1	- 5.7V	9	- 12.2V	17	180V	25	0
2	GRD	10	- 12.1V	18	+ 19.4V	26	0
3	GRD	11	0	19	- 10.6V	27	GRD
4	-10.7V	12	0	20	- 9.7V	28	0
5	- 11.3V	13	0	21	-14.5V	29	GRD
6	- 12.1V	14	0	22	- 400V	30	GRD
7	0	15	0	23	0	31	GRD
8	- 12.2V	16	0	24	0		

Figure 4 Power Supply PC Board

AR8-4

4.2.5 Instrument responds in all switch positions, but is noisy (erratic meter movement).

1. Open circuit in feedback circuit. Consult the factory.
2. Open circuit in cable shield or probe shield. Consult the factory.

4.2.6 Instrument response is slow and/or irreproducible.

1. Fan operating improperly. Check fan voltage. See Figure 4.
2. Check calibration and operation.

4.2.7 Low battery indicator.

1. Indicator comes on if battery charge is low.
2. Indicator also comes on if ionization voltage is too high.

Standard Measurement Procedure 9-1-3

YSI MODEL 33 CONDUCTIVITY METER

1.0 INTRODUCTION

This document describes procedures that employees must perform when using the YSI Model 33 S-C-T meter. Field personnel must perform the procedures that appear in Sections 1.2 to 1.7. The procedures in Section 1.8 may only be performed by authorized service technicians.

1.1 INSTRUMENT PROFILE

- Function:** Salinity, conductivity, and temperature measurements.
- Application:** Conductivity measurements in $\mu\text{mhos/cm}$ indicate the concentration of salt and ionic contaminants in a water sample. Water with high conductivity can not be consumed by people or used in industrial processes. Organic contaminants are poorly soluble in highly conductive water.
- Components:** Meter with analog readout; Temperature Adjustment knob; Mode Select knob; Redline control knob; Cell Test button; 2 "D" size alkaline batteries; and probe assembly.
- Operation:** The model 33 S-C-T meter face yields a reading of the conductivity of a water sample by measuring the current flow between two electrodes in the probe. Salinity is calculated from the conductivity measurement, which includes a user-adjusted temperature compensator. The meter measures temperature by measuring changes in the resistance of a precision thermistor in the probe.
- Readout:** Conductivity is scaled 0-500, 0-5000, and 0-50000 $\mu\text{mhos/cm}$ with YSI 3300 series probes. Salinity is scaled 0-40 parts per thousands in temperature range -2 to +45 degrees C. Temperature is scaled -2 to +50 degrees C.
- Calibration:** The S-C-T meter and probe is factory calibrated. The meter's calibration is checked against a test solution of known conductivity prior to use to generate a correction factor which is used to obtain accurate readings.
- Inherent Safety:** The S-C-T meter is not approved for use in areas where flammable or explosive gases or vapors are present.

Prepared: <u>CSEM</u>	Reviewed: <u>DOJ</u>	QA: <u>PMZ</u>	Approved: <u>CAO</u>	Issued: <u>JML</u>
Date: <u>3/27/89</u>	Date: <u>3/31/89</u>	Date: <u>4/7/89</u>	Date: <u>6/13/89</u>	Date: <u>10/13/89</u>

1.2 EQUIPMENT AND SUPPLIES**1.2.1 Equipment needed:**

- YSI Model 33 S-C-T Meter
- YSI Model 3310 Combination S-C-T Probe
- NITS-traceable laboratory thermometer (e.g. SAMA types CP10 or CP15)
- Hard-shell plastic carrying case

1.2.2 Supplies needed:

- Thirty disposable 150 ml beakers, such as Sherwood Lancer Tri-Pour polypropylene beakers
- One liter of distilled water
- One laboratory wash bottle for distilled water
- Two standard "D" size alkaline batteries
- Conductivity calibration solutions (potassium chloride in water) 1,000 (YSI 3167), 1,413 (VWR 51430), or 10,000 (YSI 3168) $\mu\text{hos/cm}$
- Conductivity probe platinizing solution (YSI 3140).

1.3 START UP

- a. Place the meter in the position in which it will be used, either vertical or flat on its back. Record the instrument model and serial numbers and last warehouse preventive maintenance date of the conductivity meter in the field log book. If the preventive maintenance occurred over a month ago, send the meter back to CDM for service (Section 1.7.5).
- b. With the Mode Select knob in the OFF position, adjust the meter with the screw on the dial face until the red needle and its reflection in the dial mirror line up with the zero on the conductivity scale.
- c. Plug the probe into the plug receptacle in the side of the meter. Place the probe body in distilled water.
- d. Turn the Mode Select knob to the RED LINE position.
- e. Adjust the Red Line control knob so that the meter needle and its reflection in the dial mirror line up with the red line on the meter face. If this cannot be accomplished, replace the batteries.
- f. Perform a calibration check (Section 1.4.3). If the instrument has not been used today, perform a full calibration (Section 1.4.2)

1.4 INSTRUMENT CALIBRATION

1.4.1 Frequency of Calibration

- a. The user should calibrate the S-C-T meter (Section 1.4.2) before each day of use.
- b. The user should check the calibration of the S-C-T meter (Section 1.4.3) whenever it is covered up and after every tenth reading.
- c. CDM service technicians must perform the monthly preventive maintenance check described in Section 1.8.1.

1.4.2 Field Calibration

The S-C-T meter and probe is factory-calibrated. Check its calibration against the conductivity standard closest to the values expected in the samples. A calculated factor is used to obtain accurate readings.

- a. Attach the probe to the meter and rinse it with distilled water. Soaking the probe in distilled water for up to 24 hours improves accuracy of calibration.
- b. Select a conductivity standard (1,000, 1,413, or 10,000 μmhos) closest to the values expected in the samples.
- c. Perform the start up procedure (Section 1.3).
- d. Allow the meter to warm up for one or two minutes.
- e. Place the standard in a laboratory-clean beaker or glass jar. Gently shake the probe in air to remove distilled water. Immerse the probe. Move the probe up and down in the standard to soak the electrodes.
- f. Empty the beaker and refill it with solution. Repeat step "e" with this aliquot of standard before reading the meter.
- g. Rotate the Mode Select knob to X10 or X100 to yield an on-scale reading.
- h. Read the point on the conductivity scale at which the red needle and its reflection on the dial mirror rest. Record the meter reading and the conductivity standard's value in the field log book.
- i. Depress the Cell Test button. Enter the changed reading in the field log book. If the reading changes by more than 2%, the electrode is fouled and needs to be cleaned. Measurements collected on that meter will be unreliable. See Section 1.7.3.

- j. Calculate a cell constant by dividing the standard's conductivity value by the meter reading and the scale factor (10, or 100). Write this constant on the calibration sticker.

$$\text{Cell Constant} = \text{Standard Value} / (\text{Meter Reading} \times \text{Scale Factor})$$

- k. Enter the time and place of calibration, the standard used, the meter readings, and the resulting cell constant in the field log book.

1. Rinse the probe with distilled water.

1.4.3 Field Calibration Check

- a. Place standard solution in a laboratory-clean beaker or glass jar. Gently shake the probe in air to remove distilled water. Immerse the probe. Move the probe up and down in the standard to soak the electrodes.
- b. Read the point on the conductivity scale which aligns with the red needle and its reflection on the dial mirror.
- c. If the meter reading diverges from that found in the calibration step [Section 1.4.2 (j)] by 5% or more, repeat steps "a" and "b" with another aliquot of standard.
- d. If this repeated meter reading diverges from that found in the calibration step (Section 1.4.2) by 5% or more, recalculate the cell constant by the method in 1.4.2 (j).
- e. If the meter reading agrees within 5%, note that you performed a calibration check. If a new cell constant is necessary, enter the time and place of calibration, the standard used, the meter readings, and the resulting cell constant in the field log book.

1.5 FIELD MEASUREMENTS

1.5.1 Measuring Temperature and Conductivity

- a. Place the sample, or an aliquot of medium identical to the sample, in a laboratory-clean beaker or glass jar. The beaker can be re-used if rinsed with the next sample medium.
- b. Gently shake the probe in air to remove distilled water and place it into the sample solution. Move the probe up and down in the beaker to soak the electrodes with the sample.
- c. Repeating steps "a" and "b" with two aliquots of sample medium before reading will improve accuracy.
- d. Set the Mode Select knob to TEMPERATURE. Read the temperature on the bottom scale of the meter in degrees Celsius. Allow time for the probe to achieve temperature equilibrium before reading it. Record the temperature in the field log book.

- e. Adjust the Red Line control knob so the meter needle and its reflection in the dial mirror lines up with the red line on the meter face. (Note: Temperature compensation has no effect on conductivity readings.)
- f. With the probe in the solution to be tested, set the Mode Select knob to the lowest conductivity range that yields a meter reading below full scale.
- g. Multiply the meter reading, in $\mu\text{hos/cm}$, by the scale factor (1, 10, or 100) selected and the cell constant from instrument calibration procedure (1.4.2). Record the direct measurement, and the calculated value directly in the field log book.

Sample Conductivity = Meter Reading X Scale Factor X Cell Constant

- h. Rinse the probe with distilled water between samples.
- i. Conductivity measurements may be taken by immersing the probe into rivers, tanks, lakes, etc. Keep the probe at least 6" from metallic objects.

1.5.2 Measuring Salinity

- a. If the conductivity is above 500 μhos , don't try to determine the salinity.
- b. Adjust the temperature compensator dial to the water's temperature.
- c. Set the Mode Select knob to SALINITY. Read the salinity in parts per thousand from the "XS" scale.

1.6 SHUT DOWN AND STORAGE

- a. Store the probe in distilled water whenever feasible.
- b. Store the unit in the case.
- c. Don't store conductivity meters on site unless staff are on site.
- d. If the meter will be inactive for more than a week, return it to the Regional Equipment Warehouse for service and/or reassignment.

1.7 TROUBLE-SHOOTING (By Instrument Users)

1.7.1 Preventive Maintenance

Warehouse service technicians must perform a monthly preventive maintenance (PM) check which is described in Section 1.8.1. Don't use the conductivity meter unless a calibration sticker showing a PM date within the last month appears on the meter.

1.7.2 Indicators of Instrument Malfunction

- a. If the Red Line adjustment [Section 1.3 (e)] won't align the needle, its reflection, and the red line, replace the batteries.
- b. If the meter reads over 10 μ hos when the probe is in distilled water, replace the water. If it still reads over 10 μ hos, the meter zero may need adjustment [Section 1.3 (b)].
- c. If a reading on the X10 and X100 scales decreases more than 2% when you depress the Cell Test button, the electrode is fouled and needs to be cleaned. Measurements collected on that instrument will be unreliable. Field personnel may clean probe following the procedure in Section 1.7.4.
- d. If calibrations (Section 1.4.2) performed with two different strengths of standard yield cell constants that differ by 10% or more, return the meter and probe to the CDM warehouse for service.

1.7.3 Battery Replacement

- a. Replace the batteries with alkaline "D" cells only. Carbon/zinc batteries can cause errors.
- b. Replace the batteries every six months to avoid damage to the meter from leaking battery fluids.

1.7.4 Probe Cleaning

- a. Immerse the probe in a commercially available bathroom tile cleaner such as Lysol[®] Basin, Tub, & Tile Cleaner. Use the cleaner at full strength.
- b. Soak the probe in the cleaner for five minutes.
- c. Rinse the probe thoroughly with tap water.
- d. Rinse the probe thoroughly in distilled water.
- e. Re-calibrate the meter and probe (Section 1.4.2).

1.7.5 Other Types of Repair

- a. All other types of repair may be performed only by the YSI or CDM service technicians.
- b. Meters must return to the warehouse for a preventive maintenance check (Section 1.7.1) at least once a month.
- c. Complete and send an Equipment Condition Report Form for the instrument each time you send it to the warehouse.

1.8 PREVENTIVE MAINTENANCE AND SERVICE (By CDM Warehouse)**1.8.1 Preventive Maintenance Check**

Service technicians must perform a preventive maintenance (PM) check once a month. The PM check shall consist of:

- a. Calibrating the thermistor against an NITS-traceable glass thermometer (see Section 1.8.2).
- b. Calibrating the meter against both the 10,000 and the 1,000 or the 1,413 μ mhos solutions before shipping the meter to the field (Section 1.4.2). If the meter is working properly, the cell constants will be equal at both strengths. If not, the electrode may need platinizing (Section 1.8.4)
- c. Performing a Cell Test on the probe. If the meter reading changes by 2X or more, the probe needs cleaning (Section 1.8.3)

1.8.2 Calibrating the Thermistor

- a. Perform this temperature calibration with both cold and warm water prepared as follows:
 - Withdraw tepid water from a tap, or allow cold tap water to rise to room temperature in a closed container.
 - Mix approximately 400 ml of cold tap water with 400 ml of ice for 5 to 10 minutes. Decant the ice from the water before using it.
- b. Fill a beaker that is at least 400 ml in volume with the cold water to a height of three inches.
- c. Perform the start up procedure (Section 1.3) on the conductivity meter.
- d. Place the probe in the water.
- e. Place the NITS-traceable glass thermometer in the water alongside the probe.
- f. Move the probe up and down in the water until the temperature readings stabilize.
- g. If the two temperature readings agree within two degrees Celsius, note the two temperature readings on the maintenance and calibration worksheet.
- h. If the temperature readings diverge by more than two degrees Celsius, contact YSI for a replacement.
- i. Repeat the procedure with the warm water.

1.8.3 Probe Cleaning

- a. Immerse the probe in a solution of ten parts distilled water, ten parts isopropanol, and one part hydrochloric acid.
- b. Soak the probe in the solution for five minutes.
- c. Rinse the probe thoroughly with tap water.
- d. Rinse the probe thoroughly in distilled water.
- e. Re-calibrate the meter and probe (Section 1.4.2).
- f. Fill in the calibration/maintenance log.

1.8.4 Re-Platinizing

- a. Clean the probe according to the procedure in 1.8.3.
- b. Perform the start up procedure (Section 1.3).
- c. Place the probe in a clean 150 ml glass beaker and add enough platinizing solution (YSI 3140) to cover the electrode.
- d. Plug the probe into the meter and set the meter on the X100 scale.
- e. Read the conductivity of the platinizing solution on the meter.
- f. The time required to re-platinize is determined as follows:

<u>Meter Reading (µmhos/cm)</u>	<u>Time (minutes)</u>
30,000	5
25,000	6
20,000	8
15,000	11
10,000	16

- g. After the elapsed time, rinse the probe thoroughly in tap water.
- h. Rinse it thoroughly in distilled water.
- i. Return the platinizing solution to its container.
- j. Store the probe in distilled water.
- k. Complete the calibration/maintenance log.

1.8.5 Other Types of Repair

Service technicians may perform other types of repair with the advice of YSI technical service.

ORION SA 250 pH METER

This section outlines procedures for field operations with the ORION SA 250 pH meter.

Instrument Profile

- Application:** To measure the pH of waters, wastewaters, and some types of solids.
- Components:** The pH meter consists of a plastic body, electrode and an automatic temperature compensation probe.
- Read Out:** The meter can display 0.1 or 0.01 pH resolution.
- Calibration:** The meter is calibrated prior to use and after every 10 samples with standard buffer solutions. The calibration procedure is described in the Orion manual. If fresh buffers are prepared prior to instrument calibration, the buffer lot number, date prepared, and the technician's initials are entered in the field logbook. If standard bottled pH buffer solutions are used, the lot number(s) and expiration date(s) are entered in the field logbook.
- Inherent Safety:** None.

Field Procedures

The Orion manual details the procedures to be followed in the field. EPA Method 9045 describes the soil pH procedure.

ORION

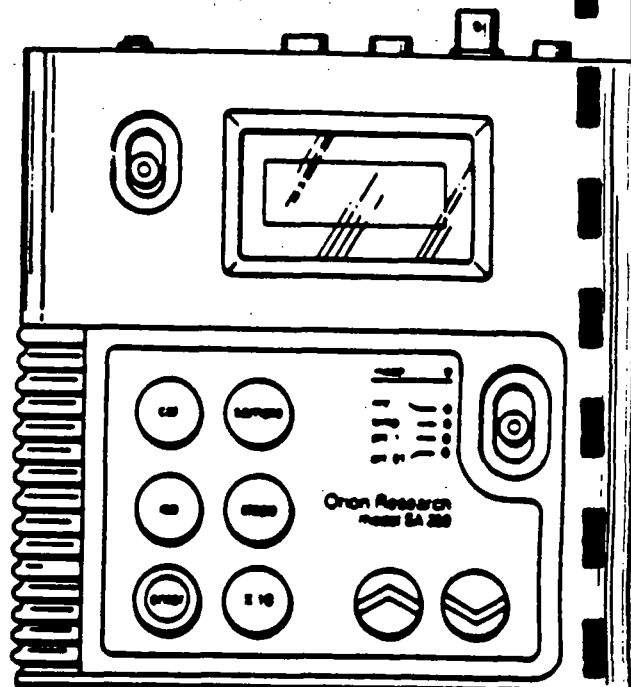
Orion Research Incorporated
Laboratory Products Group

SA 250 pH METER TRAINING GUIDE

The ORION SA 250 Meter is an advanced portable pH meter with many features previously found only in bench-top meters.

- Autocalibration recognizes and enters 4.01, 7.00, or 10.01 pH buffers. Other buffer values can be manually entered.
- Choice of .1 or .01 pH resolution. You choose speed or better accuracy.
- Prompting you through 1 or 2 point calibration to sample measurement.
- Assistance codes diagnose errors.
- Superior design for outdoor, process, or active lab environments.
- Durable splash, dust, and corrosion-resistant housing.
- Lightweight, no slip grip for hand-held operation.
- Convenient carrying case with ROSS pH Electrode, ATC probe, and all the accessories you need for immediate start-up.

Turn this card over for instructions on a calibration with two buffers using the ATC probe. Consult the meter instruction manual for initial check out, specifications, and further operational information.



ORION SA 250 pH METER

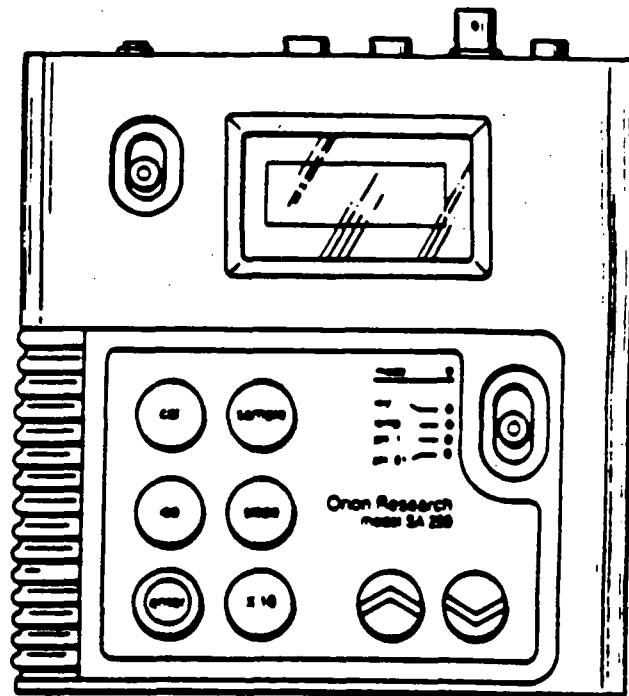
Autocalibration With Two Buffers and an ATC Probe

Select either 4.01 and 7.00, or 7.00 and 10.01 buffers, whichever will bracket the expected sample range.

An ATC probe is used for convenience and accuracy. Once the ATC probe is plugged into the input jacks, and placed into solution, entering temperature values manually is not possible. The ATC probe automatically senses buffer or sample temperature for use in calculating accurate pH values.

1. Connect electrodes and ATC probe to meter.
2. Select pH mode and resolution by sliding the mode switch to pH .1 or pH .01.
3. Press iso and verify that the isopotential point is 7.00.
4. Place electrodes and ATC probe into 7.00 buffer.
5. Press cal. The display will alternate between .1. and the pH value of the buffer, indicating that the electrodes are in the first buffer and a value has not yet been entered.
6. Wait for the pH value to stabilize. Press enter. The correct display will freeze for 3 seconds, then advance to .2., indicating the meter is ready for the second buffer.
7. Rinse electrodes and ATC probe and place into the second buffer, either 4.01 or 10.01. The display will alternate between .2. and the pH value of the buffer.
8. Wait for the pH value to stabilize. Press enter. The letters pH will be displayed. The SA 250 Meter is now calibrated and automatically advances into the sample mode.
9. Rinse electrodes and ATC probe and place into sample. Read the pH directly from the display.

NOTE: A different isopotential point can be entered. However, if you do not know the isopotential point of your pH electrode, the 7.00 default setting is recommended for Ag/AgCl and ROSS pH Electrodes.



ORION

Orion Research Incorporated
Laboratory Products Group
THE SCHRAFFT CENTER
529 MAIN STREET, BOSTON, MA 02129
TEL 800-225-1480 617-242-3900 / TLX 4430019
IN EUROPE ORION RESEARCH AG
FAHNLEBRUNNENSTRASSE 3
CH-8700 KUSNACHT, SWITZERLAND
TEL 01 910 7858 / TLX 825767

INTRODUCTION

ORION Automatic Temperature Compensation (ATC) Probes transmit a signal to the pH meter, which automatically corrects pH measurements for variation in electrode slope due to temperature change. The 917001 and 917002 ATC Probes are designed for use with the following ORION Meters:

SA 230	501	811
231	SA 520	EA 920
SA 250	SA 720	EA 940

These probes may also be used with other meters requiring a PT-100 type thermistor automatic temperature compensator with dual banana plugs.

The 917001 ATC Probe has a break resistant epoxy body. The epoxy is not recommended for use in organic solvents, but may be used on an intermittent basis in methanol or ethanol.

The 917002 ATC Probe is an all glass probe. This probe is preferred for use in solutions containing organic solvents or at temperatures over 80°C.

For automatic temperature compensation and temperature measurement procedures, consult the appropriate meter instruction manual.

SPECIFICATIONS

Temperature Range

917001: 0-80°C

917002: -5 to 100°C (ATC), 120° (TEMP on

pH Range

0 to 14 pH

Accuracy

±0.1°C or 1%, whichever is greater

Storage

Store in air

Connector

Dual banana plugs

Size

Probe length: 15 cm

Cable length: 100 cm

Probe diameter: 8 mm

Specifications subject to change without notice

GENERAL INFORMATION

Introduction

The ORION SA 250 pH Meter is an advanced, portable pH meter with many features previously found only on bench-top meters.

Automated functions such as autocalibration, prompting, automatic temperature compensation, and diagnostic operator assistance codes make the SA 250 Meter very easy to use.

With your choice of 1 or 0.1 pH resolution, you decide if you need speed or better accuracy.

The meter comes with a ROSS Combination pH Electrode and ATC probe for fast, accurate results, no matter what the temperature difference between samples and standards.

Created for the outdoor, process, or active lab environment, the meter is lightweight, with a no-slip grip, large LCD display and has a rugged splash and dust-resistant housing. The SA 250 Meter meets or exceeds tests to Department of Transportation and Mil specs for shock, vibration, and moisture.

See Figure 1.

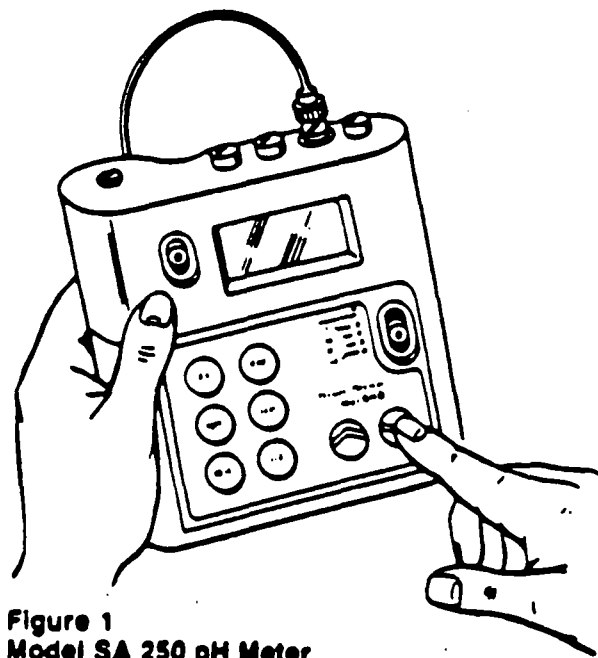


Figure 1
Model SA 250 pH Meter

INSTRUMENT DESCRIPTION

Refer to Figure 2.

- 1 **ON/OFF Switch** Controls power to the meter. Memory is maintained even when the instrument is turned off.
- 2 **LCD Display** SA 250 pH Meter automatically displays data on an easy-to-read 3 1/2 digit LCD.
- 3 **Mode Switch** Used to select mV, temp, pH .1, or pH .01 modes.
- 4 **Keys** Eight touch keys are used to control the meter. Each key is labelled as to the function performed. The following table summarizes the function of each key:

Key	Function
sample	Press to display pH of the sample.
cal	Press to start the calibration sequence.
iso	Press to display current isopotential point.
slope	Press to display slope in percent of theoretical
enter	Press to enter a value into the meter memory.

The following keys, X10, \wedge , \vee , are used to change the numeric display. This process is called scrolling.

- X10 Increases the displayed value to the next decade - for example, pH 6.14 would increase to 7.00. At the upper end of the scale pressing X10 will cause the display to wrap around - for example: pH 19.00 would go to -2.00.
- \wedge up Increases the value displayed by increments equal to the least significant digit.
- \vee down Decreases the value displayed by increments equal to the least significant digit.

If the \wedge or \vee key is pressed and held, the next significant digit will change.

The sample, cal, iso, and slope keys function only while the mode control is in either pH .1 or pH .01.

The \wedge or \vee keys function in temp, pH .1, or pH .01 modes.

- 5 **Electrode Input:** Accepts BNC connector from combination or sensing electrodes. A separate pin tip input accepts reference electrodes.
- 6 **ATC Probe Jack:** Accepts ATC probe for automatic temperature compensation.
- 7 **Line Converter Jack:** Accepts an AC line converter for use without batteries.

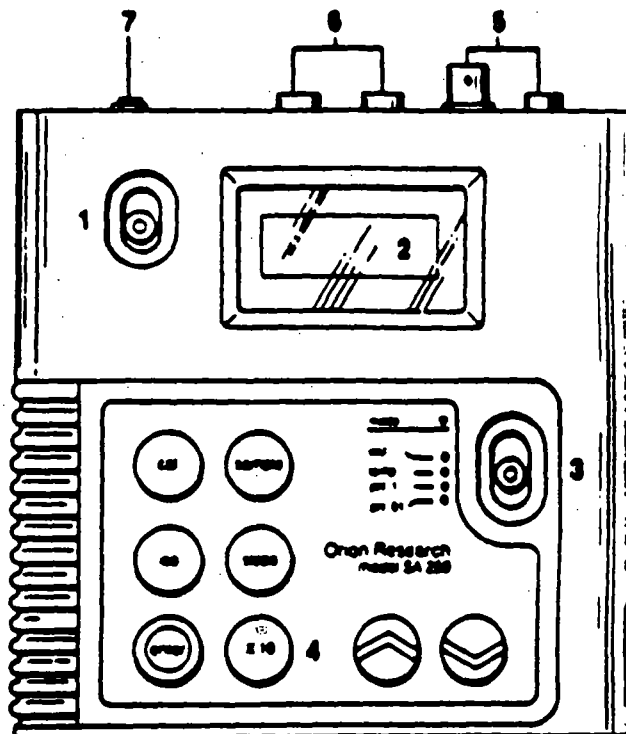


Figure 2
SA 250 Meter Controls

INSTRUMENT SET-UP

Support Rod

See Figure 3.

1. Attach support rod base to side of meter carrying case and tighten clamp screw
2. Insert support rod into base. Tighten rod by turning clockwise.
3. Attach electrode holder to top of support rod.

Power Source

The ORION SA 250 pH Meter operates on one 9 volt nonrechargeable alkaline battery. If the SA 250 pH Meter is left on while using battery power, there will be approximately 30 hours of continuous life. Optional AC line converters are available for both 110 and 220 volt mains. Refer to **ORDERING INFORMATION**.

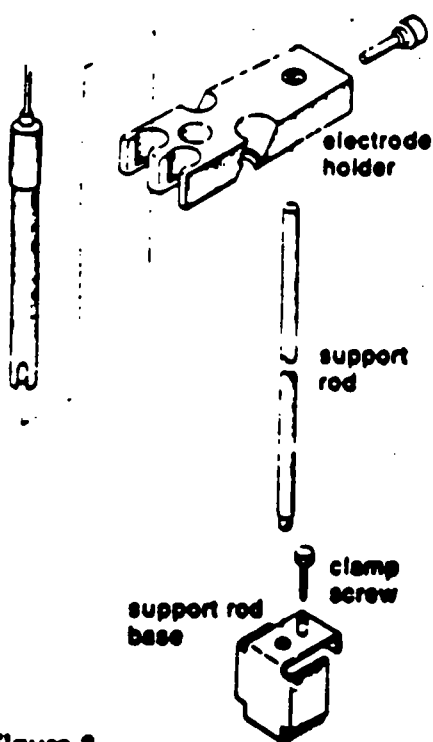


Figure 3
Support Rod and Clamp

Battery Installation

See Figure 4.

1. Remove access panel on back of meter, by sliding cover towards bottom of meter.
2. Attach battery connector clip to battery terminals, install battery and replace access panel.

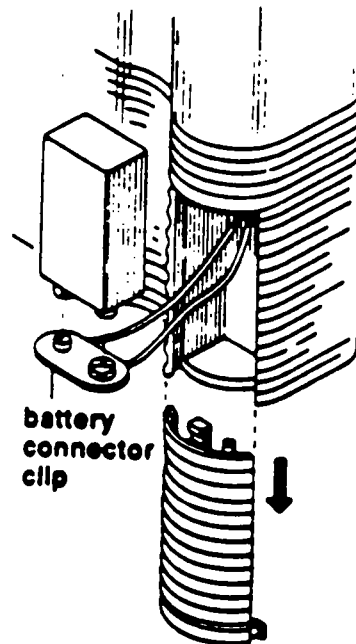


Figure 4
Battery Installation

Meter Check Out Procedure

1. Slide power switch to ON position. Attach BNC Shorting Plug (Onon Cat. No. 090045) to BNC connector on top of meter. Refer to Figure 5.
2. If using optional AC line converter, connect it to meter and appropriate power source. Proceed to step 4.
3. If LO BAT indicator on LCD remains on, the battery must be replaced.
4. Slide mode switch to mV. Display should read 0 ± 0.3 .
5. Slide mode switch to temp. Display should read 25.0. If 25.0 is not displayed, scroll, using \wedge , \vee , and X10 keys, until 25.0 is displayed and press enter.
6. Slide mode switch to pH .01. Press iso. Display should read the letters ISO then a value of 7.00. If 7.00 is not displayed, scroll until 7.00 is displayed and press enter.
7. Press slope. Display should read the letters SLP then a value of 100.0. If 100.0 is not displayed, scroll until 100.0 is displayed and press enter.
8. Press sample. Observe the letters pH then a steady reading of 7.00 ± 0.02 should be obtained. If not, press cal and scroll until 7.00 is displayed and press enter. Press sample and observe a reading of 7.00.
9. Remove the shorting plug. After a successful completion of steps 1-8 the meter is ready to use with an electrode.

Electrode Connections

Refer to Figure 5.

1. Attach electrodes with BNC connectors to sensor input by sliding connector onto input, pushing down and turning clockwise to lock into position. Connect reference electrodes with pin tip connectors by pushing connector straight into reference input.

NOTE: If using a combination electrode with a BNC connector, the reference pin-tip jack is not used (4 in Figure 5).

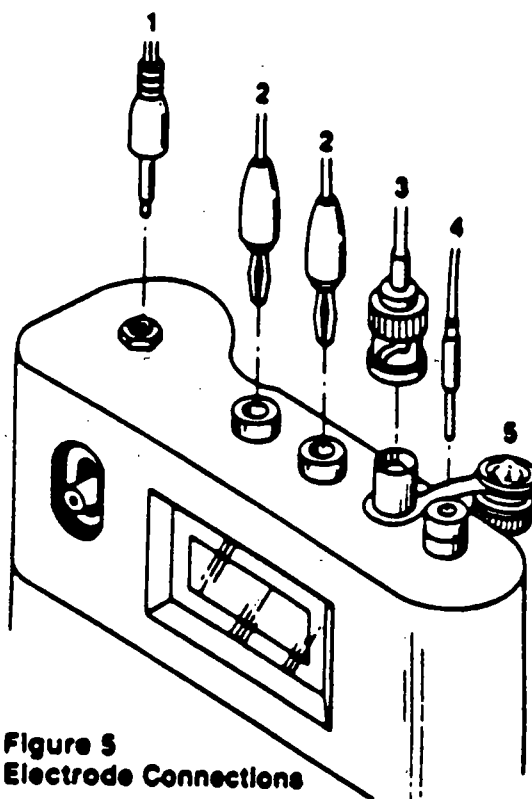


Figure 5
Electrode Connections

Legend

- 1 AC line converter to line converter jack
- 2 ATC plugs to ATC jacks
- 3 BNC connector to sensor input (shown with shorting plug disconnected)
- 4 Reference pin-tip plug to reference input
- 5 BNC shorting plug (Onon Cat. No. 090045)

MEASUREMENT PROCEDURES

pH Measurements

See Figure 6

A calibration with one or two buffers should be performed before pH is measured. It is recommended that a calibration with two buffers be performed at the beginning of each day to determine the correct slope of the electrode. This serves the dual purpose of determining if the electrode is working properly and storing the slope value in the meter's memory. Perform a one buffer calibration every two hours to compensate for electrode drift.

Check the stored value for *ISO* before calibration. Unless the isopotential point of the electrode is known verify that the display reads 7.00. If not, scroll until 7.00 is displayed and press enter. See *Isopotential Point*.

There are two ways of calibrating the SA 250 Meter, autocalibration or manual calibration.

NOTE: It is recommended to select either autocalibration or manual calibration and not use a combination of the two methods. Following is a description and instructions for each method.

Autocalibration

Autocalibration is a feature of the SA 250 Meter that automatically recognizes the 7.00, 4.01 and 10.01 buffers with a range of ± 0.5 pH units. The user waits until the pH display is stable and presses enter. The SA 250 Meter automatically calibrates to the correct buffer value using temperature compensation. Do not scroll when using autocalibration.

When calibrating, the SA 250 Meter compares actual values to theoretical values to determine if the buffer is within range. Buffers greater than ± 0.5 pH units from the correct value will trigger an operator assistance code.

It is recommended that an ATC probe be used for autocalibration. If an ATC probe is not used, all samples and buffers should be at the same temperature or use manual temperature compensation. See *Temperature Mode*.

Autocalibration With Two Buffers

1. Connect electrode(s) to meter. Slide the mode switch to either pH .1 or pH .01. Choose either 4.01 and 7.00, or 7.00 and 10.01 buffers, whichever will bracket your expected sample range.
2. Place electrode(s) into either 4.01, 7.00 or 10.01 buffer.
3. Press cal. The display will alternate between .1, and the pH value of the buffer, indicating this is the first buffer and a value has not been entered. Wait for a stable pH display and press enter. The correct display will freeze for 3 seconds then advance to .2, indicating the meter is ready for the second buffer.

4. Rinse electrode(s) and place into a second buffer. Wait for a stable pH display and press enter.

After the second buffer value has been entered the letters *PH* will be displayed. The meter is now calibrated and automatically advances to sample mode.

5. Rinse electrode(s), place into sample. Record pH directly from the meter's display.

Autocalibration With One Buffer

1. Check slope term by pressing slope. If necessary, scroll and enter the correct value. If slope value is unknown, either enter 100.0 or perform a two buffer calibration. A single buffer calibration does not change the slope term.
2. Connect electrode(s) to meter. Slide mode switch to either pH .1 or pH .01.
3. Place electrodes into either 4.01, 7.00 or 10.01 buffer.
4. Press cal. The display will alternate between .1, and the pH value of the buffer, indicating this is the first buffer and a value has not been entered.
5. Wait for a stable pH reading and press enter.

After enter is pressed the correct display will freeze for 3 seconds then advance to .2, indicating the meter is ready for the second buffer. By pressing sample the letters *PH* will be displayed, indicating the meter has advanced into the sample mode.

6. Rinse electrode(s) and place into sample. Read the pH directly from the display.

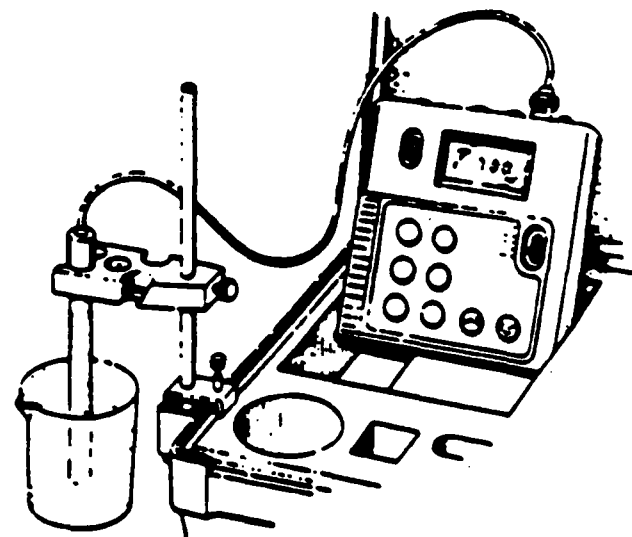


Figure 6
Optional Way to Set Up SA 250 Meter
for Sample Measurements

Manual Calibration

To calibrate with buffers other than 4.01, 7.00 or 10.01, use the manual calibration technique. The calibration sequence is the same as autocalibration, except buffer values are scrolled in.

It is recommended that an ATC probe be used. If an ATC probe is not used, all samples and buffers should be the same temperature or use manual temperature compensation. See Temperature Mode.

NOTE: Even if scrolling is not necessary, scroll one digit and return to correct value before pressing enter. Otherwise meter will assume autocalibration is to be used.

Manual Calibration With Two Buffers

1. Connect electrode(s) to meter. Slide mode switch to either pH .1 or pH .01. Choose two buffers that will bracket your expected sample range.
2. Place electrode(s) into the first buffer.
3. Press cal. The display will alternate between .1 and the pH value of the buffer, indicating this is the first buffer and a value has not been entered.
4. Wait for a stable pH display. Using \wedge , \vee or X10 keys, scroll in the correct value and press enter.

The display will freeze for 3 seconds then advance to .2, indicating the meter is ready for the second buffer.

5. Rinse electrode(s) and place into the second buffer. Wait for a stable pH display. Scroll in the correct value and press enter.

After the second buffer value has been entered the letters *PH* will be displayed. The meter is now calibrated and automatically advances to the sample mode.

6. Rinse electrode(s) and place into sample. Record pH directly from the meter's display.

Manual Calibration With One Buffer

1. Verify slope by pressing slope. If necessary scroll in correct value, using \wedge , \vee and X10 keys, and press enter. If correct slope is unknown, either enter 100.0 or perform a two buffer calibration.

2. Connect electrode(s) to meter. Slide mode switch to either pH .1 or pH .01.

3. Place electrodes into the buffer.

4. Press cal. The display will alternate between .1 and the pH value of the standard, indicating this is the first buffer and a value has not been entered.

Wait for a stable pH display, scroll until the correct value is displayed and press enter.

The display will freeze for 3 seconds then advance to .2, indicating the meter is ready for the second buffer. By pressing sample the letters *PH* will be displayed. The meter is now calibrated and automatically advances to sample mode.

5. Rinse electrode(s) and place into sample. Read the pH directly from the display.

NOTE FOR MANUAL CALIBRATION: In the event that scrolling was started but the value was not entered and the mode switch was changed, either a P1 or a P2 will be displayed upon returning to the pH mode. P1 indicates that a value has not been entered for the first buffer while P2 indicates a value has not been entered for the second buffer.

Slope

By pressing the slope key the slope is displayed as percent of theoretical. A properly functioning electrode will have a 92% to 102% slope. See Troubleshooting, if the slope is out of range. The slope value is retained in the meter's memory until another two buffer calibration is performed or another value is entered. A one buffer calibration does not change the slope value.

At the beginning of each day and every time a different electrode is used a two buffer calibration should be performed for accurate measurements.

To enter a slope value:

1. Slide the mode switch to either pH .1 or pH .01.
2. Press the slope key.
3. Scroll, using \wedge , \vee or X10 keys, until the correct value is displayed.
4. Press enter.

Isopotential Point

The isopotential point is the pH at which the potential (mV) of the electrode will not vary with temperature.

For the majority of pH electrodes the isopotential point is pH 7.00. There are some exceptions where the operating range used for a particular electrode is primarily at one end of the pH scale.

If your pH electrode has an isopotential point other than 7.00, the correct value may be entered as follows:

1. Slide mode switch to pH .1 or pH .01.
2. Press iso.
3. Scroll, using \wedge , \vee , or X10 keys, until correct value is displayed.
4. Press enter.

A two buffer calibration should be performed after an isopotential point value has been changed. It is good practice to verify the isopotential point whenever the meter has been turned on.

Temperature Mode

Sliding the mode switch to temp will display the temperature in °C. When the temperature is outside of the operating range -5.0 to 105.0°C, an operator assistance code will be displayed, E-1 for below -5°C, or E 1 for above 105°C.

During a calibration or sample measurement the mode switch can be changed to temp. When an ATC probe is connected the temperature can be monitored and automatic temperature compensation will take place.

To use manual temperature compensation:

1. Using a thermometer accurate to $\pm 1^\circ\text{C}$ determine the temperature of the solutions to be measured.
2. Slide mode switch to temp.
3. Scroll, using \wedge , \vee or X10 keys, until the correct temperature value is displayed.
4. Press enter.
5. Return mode switch to either pH .1 or pH .01.

When an ATC probe is not connected, the last entered value of temperature is displayed. If a temperature value has not been entered since the removal of an ATC probe, a default value of 25°C is displayed.

Potentiometric Measurements

Potentiometric titrations are performed in mV mode using either pH, ion-selective or redox electrodes. Detailed instructions for any ORION Electrode are given in the electrode instruction manual. Titration instructions are included in ORION Redox Electrode (Model 96-78 or 97-78) Instruction Manual, or in standard analytical texts. Electrodes that have a U.S. Standard Connector need a U.S. Standard to BNC Adaptor which are available from Orion (Cat. No. 090033).

Dissolved Oxygen Measurements

Dissolved oxygen measurements are displayed in ppm O_2 when ORION Model 97-08 Dissolved Oxygen Electrode is used with ORION SA 250 Meter. Follow these instructions for calibrating the electrode.

1. Connect the Model 970899 to meter and leave electrode mode switch "off".
2. Unplug and do not use an ATC probe.
3. Set the mode switch of the SA 250 Meter to temp and scroll in 25.0°C, press enter.
4. Set the mode switch to pH .1 or pH .01.
5. Press the slope key. Scroll until the value 100.0 appears and press enter.
6. Press the iso key and verify that it is 7.00. If not, scroll in the value 7.00 and press enter.
7. Press the cal key. Scroll in the value 7.00 and press enter.
8. Press sample.
9. Turn the mode switch on the electrode to BT CK. Good battery operation is indicated by a reading of 13.00 or greater on the meter.
10. Turn the mode switch on the electrode to ZERO. Use the zero calibration control on the electrode to set the meter to read 0.00.
11. Insert the reservoir (funnel) into a BOD sample bottle containing enough water to just cover the bottom. Insert the electrode, making sure that the electrode tip is not immersed in the water and does not have water droplets clinging to the outside of the membrane. Let stand approximately 30 minutes to ensure water saturation of air in BOD bottle. This bottle should be used for electrode storage between measurements.
12. Turn the electrode mode switch to the AIR position. If measurements are being made at sea level, use the AIR calibration control on the electrode to set the pH meter reading to the prevailing barometric pressure in mm Hg (divided by 100). If the barometric pressure is unknown, if the elevation is above sea level or if the sample has a salinity greater than 2 parts per thousand, consult Table 1 found in the Model 97-08 Instruction Manual to obtain the correct AIR setting.
13. Turn electrode mode switch to H_2O for sample analysis.

OPERATOR ASSISTANCE CODES

Operator assistance codes are used to inform the user of an out of range value. The following table outlines the operator assistance codes that are available in the SA 250 pH Meter and suggests a remedy. The table is divided according to the modes of the meter.

Code	Problem	Remedy
MV MODE		
E 1 E-1	mV out of range	<ol style="list-style-type: none"> 1. If occurs when electrodes are out of solution, code will disappear when electrodes are returned to solution. 2. Verify electrodes are properly connected and filled. 3. Dilute standards or samples. 4. Review calibration and operating procedures.
TEMP MODE		
E 1 E-1	Temp out of range	<ol style="list-style-type: none"> 1. Verify ATC probe is properly connected.
pH .1 or pH .01 MODES while in sample function		
E 1 E-1	mV, temp or pH out of range	<ol style="list-style-type: none"> 1. Go to mV mode and check. If mV is out of range, perform remedy steps described above for mV mode. 2. Go to temp mode and check. If temp is out of range, perform remedy steps described above for temp mode. 3. Check the sample. 4. Check slope and iso values. 5. Recalibrate.
While in cal function:		
E 1 E-1	mV, temp or pH out of range	<ol style="list-style-type: none"> 1. Go to mV mode and check. If mV is out of range, perform remedy steps described above for mV mode. 2. Go to temp mode and check. If temp is out of range, perform remedy steps described above for temp mode. 3. Check the buffer. 4. Check iso value.
E21	Slope not in the range 80.0 to 100.0%	<ol style="list-style-type: none"> 1. Press enter to acknowledge code and repeat calibration using fresh buffers. 2. Clean electrode and refill reference. 3. Refer to electrode instruction manual for check out.
E31	First cal point out	<ol style="list-style-type: none"> 1. Press enter and repeat calibration using fresh buffers. 2. Check iso, slope, and temp values. 3. Verify electrodes are properly connected.
E35 E36	pH Autocalibration error. Electrode voltage being measured is greater than ± 0.5 pH units from nominal value for the pH buffer	<ol style="list-style-type: none"> 1. Press enter and repeat calibration using fresh buffers. 2. Clean electrodes and refill reference. Recalibrate. 3. Perform a manual calibration. Certain electrodes may operate out of acceptable range for pH autocalibration

TROUBLESHOOTING GUIDE

Malfunction	Possible Cause	Remedy
No Display	No power to meter	<ol style="list-style-type: none">1. Check that switch is in ON position.2. Replace battery.3. Check that adaptor is receiving power and is plugged in securely.
Erratic readings or reading out of range	Meter or electrode failure	<ol style="list-style-type: none">1. Follow meter checkout procedure.2. Follow instructions in electrode instruction manual.
Unable to calibrate	Isopotential error	<ol style="list-style-type: none">1. Verify iso.
Unable to calibrate in autocalibration	Certain electrodes may operate outside the limits of ± 0.5 pH units.	<ol style="list-style-type: none">1. Try scrolling value to within range and press enter to cal if E 1 or E-1 appearing.2. Check temp. slope. and iso and repeat.

Orion Technical Service Chemists can be consulted for troubleshooting advice by calling 800-225-1480 or 617-242-3900. Outside North America contact your local authorized Orion Representative

Required Equipment

Meter - Any ORION pH or ion selective meter or other pH/ISE meter with appropriate connectors

Combination pH Electrode or pH and Reference Electrode Half Cells - Use the ORION Model 81-01 ROSS pH Half Cell only with a ROSS Reference Half Cell Electrode, Model 80-05

Thermometer - Readable to $\pm 0.5^{\circ}\text{C}$.

Beakers - Plastic or glass

Magnetic Stirrer - Suggested for precision measurements.

Required Solutions

pH Buffers - Two are recommended for precise measurement. The first near the electrode isopotential point (pH 7) and the second near the expected sample pH (e.g., pH 4 or 10)

ROSS Internal Filling Solution - 3M KCl Orion Cat. No. 810007. Do not use any filling solution which contains silver. (Electrode damage may result.)

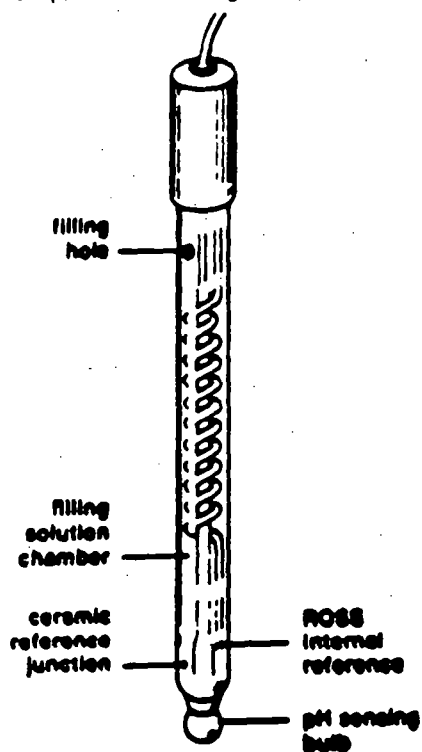


Figure 1
ROSS Combination Electrode - Cat. No. 81-02

2

USING THE ELECTRODE

Set up

Electrode Preparation

1. Remove the protective shipping cap from the sensing element and save for storage. Remove plastic covering from sleeve junction of Model 81-02.
2. Clean any salt deposits from exterior by rinsing with distilled water.
3. Uncover filling hole and add ROSS Filling Solution, Orion Cat. No. 810007, to electrode. See Figure 2. To maintain an adequate flow rate, the level of filling solution must always be above the reference junction and at least one inch above the sample level of immersion. The filling hole should be open whenever the electrode is in use.
4. Place the electrode in the electrode holder or suspend in air for 15 minutes to thoroughly wet the reference junction. Once the junction is wet, do not allow the electrode to dry out.
5. Shake down the electrode (as a clinical thermometer) to remove air bubbles.
6. Soak electrode in pH Electrode Storage Solution, Orion Cat. No. 810001, for one hour. If Storage Solution is not available, use 200 m pH buffer to which about 1 g KCl has been added, as a temporary substitute.
7. Connect electrode to meter.

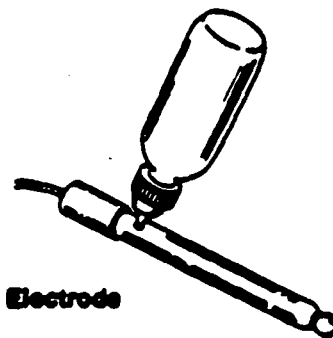


Figure 2
Filling an Electrode

3

Before Analysis

Sample Requirements

One of the benefits of the ROSS pH Electrode is that the filling solution composition may be changed depending on sample requirements.

The ROSS pH Electrode Filling Solution, Orion Cat. No. 810007 is 3M KCl. For solutions which precipitate in the presence of chloride ion, the ROSS pH Electrode could be filled with 10% KNO₃.

Samples should be aqueous if using epoxy body electrodes (e.g., Models 81-55 or 81-35).

In organic solutions, use an all-glass ROSS Electrode. For good results a minimum of 20% water must be present in the sample. If there is a great deal of drift when using the ROSS Electrode filled with ROSS Filling Solution (Orion Cat. No. 810007), try filling the ROSS Electrode with a mixture of 2 parts methanol and 8 parts ROSS Electrode Filling Solution.

Measuring Hints See Figure 3

- Always use fresh buffers for calibration. Choose buffers that are no more than 3 pH units apart.
- Check electrode slope daily by performing two-buffer calibration. Slope should be 92 to 102%.
- Only use ROSS Internal Filling Solution, Orion Cat. No. 810007, for ROSS Combination pH and Reference Electrodes. Do not use any filling solution which may contain silver.
- Remove filling hole cover during measurement to ensure uniform flow of filling solution.
- Between measurements, rinse electrodes with distilled water and then with the next solution to be measured.
- Stir all buffers and samples.
- Place a piece of insulating material (e.g., styrofoam or cardboard) between magnetic stirrer and beaker to prevent error from transfer of heat to sample. Since ROSS Electrodes respond faster than conventional electrodes, changes in pH which result from temperature changes will be noticed.
- Avoid rubbing or wiping electrode bulb, to reduce chance of error due to polarization.
- Model 81-35 may be used on any moist surface or in liquids. See Figure 4.
- Model 81-63 should not be forced into solids; cut an X into sample and insert electrode. Always immerse electrode to the same depth. See Figure 5.
- Model 81-66 is shipped with parafilm between the ground glass sleeve and cone. Carefully remove parafilm before use. Immerse the entire sleeve assembly when measuring. See Figure 6.

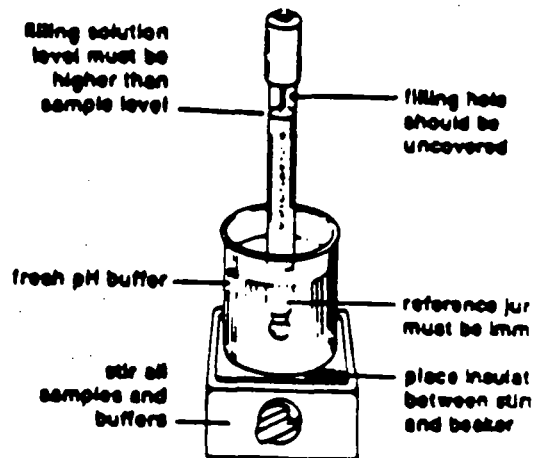


Figure 3
Measuring Hints

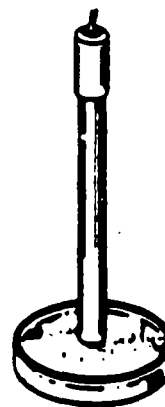


Figure 4
Use of Model 81-35



Figure 5
Use of Model



Figure 6
Use of Model 81-66

pH Calibration & Measurement

General Calibration Procedure

For detailed calibration and temperature compensation procedures, consult your meter instruction manual.

Single Buffer Calibration

1. Ensure that all buffers are at room temperature. If samples are at varying temperatures, temperature compensation is recommended. (See meter instruction manual)
2. Set up meter according to meter instruction manual.
3. Rinse electrode first with distilled water and then with the buffer being used for calibration (the buffer should be near the expected sample pH.) Place the electrode in the buffer.
4. Wait for a stable display. Set the meter to the pH value of the buffer at its measured temperature. See Table 1. (A table of pH values at various temperatures is supplied on the buffer bottle.) Proceed to pH Measurement section.

Table 1
pH Values of Buffers at Various Temperatures

Nominal value at 25°C	Temperature				
	0°C	5°C	10°C	20°C	30°C
1.68	1.67	1.67	1.67	1.67	1.68
3.78	3.86	3.84	3.82	3.79	3.77
4.01	4.00	4.00	4.00	4.00	4.02
6.86	6.98	6.95	6.92	6.87	6.85
7.00	7.11	7.08	7.06	7.01	6.98
7.41	7.53	7.50	7.47	7.43	7.40
9.18	9.46	9.40	9.33	9.23	9.14
10.01	10.32	10.25	10.18	10.06	9.97

6

Two Buffer Calibration

This procedure is recommended for precise measurement.

1. Ensure that all buffers are at the same temperature. If samples are at varying temperatures, temperature compensation is recommended. (See meter instruction manual).
2. Select two buffers which bracket the expected sample pH. The first should be near the electrode's isopotential point (pH 7) and the second near the sample pH (e.g., pH 4 or pH 10).
3. Rinse electrode first with distilled water and then with pH 7 buffer. Place the electrode in pH 7 buffer.
4. Wait for a stable display. Set the meter to the pH value of the buffer at its measured temperature. (A table of pH values at various temperatures is supplied on the buffer bottle.) See Table 1.
5. Rinse electrode first with distilled water and then with the second buffer. Place the electrode in the second buffer.
6. When display is stable, set meter to the pH value of the buffer as described in the meter instruction manual.
7. If all steps are performed correctly, proceed to pH Measurement section. If any of the above procedures does not work, refer to Troubleshooting.

pH Measurement

1. Calibrate the electrode as described in the calibration section.
2. Rinse the electrode with distilled water and then with sample.
3. Place the electrode in the sample.
4. When the display is stable, record sample pH.

40°C	50°C	60°C	70°C	80°C	90°C
1.69	1.71	1.72	1.74	1.77	1.79
3.75	3.75				
4.03	4.06	4.08	4.13	4.16	4.21
6.84	6.83	6.84	6.85	6.86	6.86
6.97	6.97				
7.38	7.37				
9.07	9.01	8.96	8.92	8.89	8.85
9.89	9.83				

7

Electrode Storage

To ensure a quick response and free-flowing liquid junction, the sensing element and reference junction must not be allowed to dry out.

Short-term Storage (up to one week)

Soak electrode in pH Electrode Storage Solution, Orion Cat. No. 910001. If ORION Storage Solution is not available, use about 200 ml pH 7 buffer to which about 1 gram KCl has been added, as a temporary substitute.

Long-term Storage

The reference chamber should be filled and the filling hole securely covered. Cover the sensing element and/or reference junction with its protective cap containing a few drops of storage solution. The Model 81-66 also requires that the ground glass sleeve and cone be separated and the liquid junction securely covered with a plastic film. Before returning the electrode to use, prepare it as a new electrode.

Electrode Maintenance

Weekly

1. Inspect the electrode for scratches, cracks, salt crystal build-up, or membrane/junction deposits.
2. Rinse off any salt build-up with distilled water and remove any membrane/junction deposits as directed in the cleaning procedures below.
3. Drain the reference chamber, flush it with fresh ROSS Filling Solution, Orion Cat. No. 810007, and refill the chamber.

Cleaning Electrode

General - Soak in 0.1M HCl or HNO₃ for half an hour, followed by soaking in storage solution for at least one hour.

Removal of Membrane/Junction Deposits

Protein - Soak in 1% pepsin in 0.1M HCl, for 15 minutes.*

Inorganic - Soak in 0.1M tetrasodium EDTA solution for 15 minutes.*

Grease and Oil - Rinse with mild detergent or methanol solution.*

* After any of these cleaning procedures, drain and refill the reference chamber and soak the electrode in storage solution for at least one hour.

Troubleshooting Guide

Follow a systematic procedure to isolate the problem. A pH measuring system can be divided into four components for ease in troubleshooting: pH meter, electrode, sample/application, and operator error.

pH meter

The meter is the component which is easiest to eliminate as a possible cause of error. ORION pH meters are provided with an instrument checkout procedure and a carrying strap for convenience in troubleshooting. Consult the pH meter instruction manual for directions.

Electrodes

To test electrode operation:

1. Connect electrode to a working meter.
2. Set function switch to absolute mV mode.
3. Immerse electrode in fresh pH 7 buffer.
4. Displayed value should be 0 ± 30 mV.
5. Rinse electrode and immerse in fresh pH 4 buffer.
6. Displayed value should be approximately 160 mV greater than in step 4.

If electrode fails this procedure, clean thoroughly as directed in Maintenance.

If electrode response is slow or drifting, drain and refill with fresh ROSS Filling Solution, Orion Cat. No. 810007.

Measuring Hints

If cleaning and maintenance fail to rejuvenate the electrode:

1. For separate pH and reference half cells, substitute each electrode (one at a time) with a known working electrode and repeat test procedure. By process of elimination, determine which electrode should be replaced.
2. For combination electrodes, replace the entire electrode.

Sample/Application

The electrode and meter may operate with buffers but not with your sample. In this case, check sample composition for interferences, incompatibilities, or temperature effects.

Operator Error

If trouble persists, review operating procedures. Recheck calibration and measurement sections, to be sure proper technique has been followed.

Troubleshooting (cont.)

Assistance

If after checking each component of your measuring system the source of the trouble remains unknown, call Orion's Technical Service Chemists:

In the United States (except Massachusetts, Alaska, and Hawaii) 1-800-225-1480. In Massachusetts, Alaska, and Hawaii or Canada, call 617-242-3900.

In Europe, the Middle East, and Africa contact your local authorized Orion dealer, or

ORION RESEARCH AG
Fählbrunnenstrasse 3
CH-8700 Kusnacht, Switzerland
TEL 01-910-7858 / TLX 57829

Elsewhere, contact your authorized Orion dealer or:

ORION RESEARCH INCORPORATED
Laboratory Products Group
The Schraft Center
529 Main Street, Boston, MA 02129 U.S.A.
TLX 4430019

ELECTRODE CHARACTERISTICS

Temperature Effects

The most common cause of error in pH measurement is temperature. Ordinary electrodes drift with large temperature changes. The ROSS pH Electrode eliminates these problems associated with the use of conventional electrodes in samples of varying temperature.

There are, however, two effects of temperature that should be kept in mind:

1. Electrode slope will change with varying temperature. This slope change may be compensated either manually, or automatically with an auto temperature compensator (ATC) probe and pre-designed pH meter. Consult your pH meter instruction manual for details.
2. Buffer and sample pH values vary with temperature because of their temperature dependent chemical equilibrium. The problem of differing pH values is easily solved by calibrating the electrode with characterized standard buffers whose true pH values at different temperatures are known. Buffer values at different temperatures are given in Table 1. The problem of the sample equilibrium varying with temperature in an uncharacterizable manner always remains. Therefore, pH values should be reported along with the temperature at which measurement was made.

Interferences

Sodium ion is the principal interference of the pH electrode causing increasing error at higher pH (lower hydrogen activities) and at higher temperatures. Because the ROSS pH membrane is composed of special low sodium glass, error due to sodium is negligible when measuring at pH values less than 12. When measuring at pH values greater than 12, add the correction value from the non-linear graph in Figure 7 to the observed pH reading.

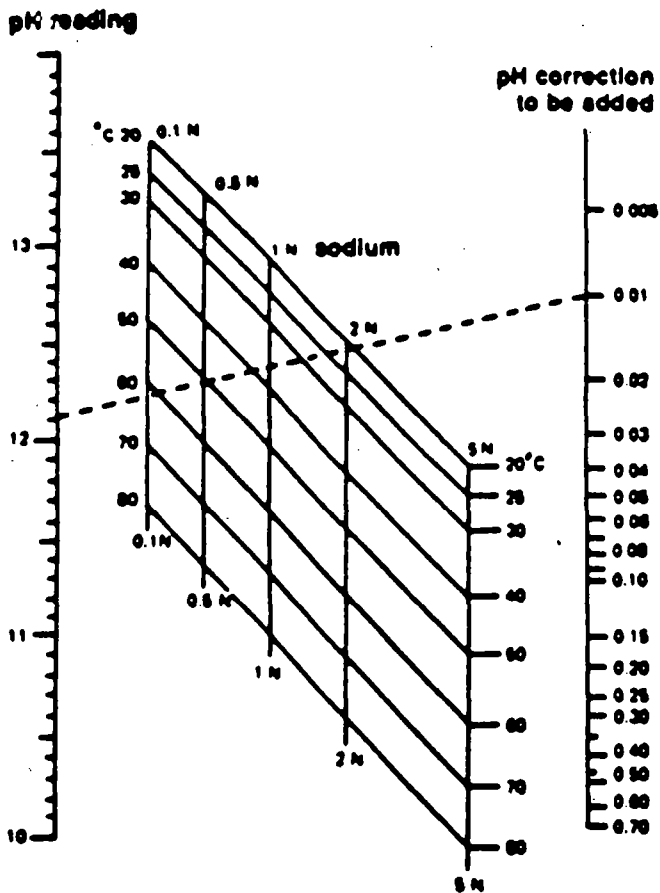


Figure 7
Typical Sodium Error Observed at pH > 12

Example:	
pH reading	12.10
Sodium concentration	0.5N
Temperature	50°C
Correction	0.01
Corrected pH reading	12.11

Laboratory instruments are warranted to be free from defects in material and workmanship for a period of twelve (12) months from the date of purchase by the user or eighteen (18) months from date of shipment from Orion, whichever is earlier provided when used under normal laboratory conditions and in accordance with the operating instructions and maintenance procedures in the instruction manual and when not having been subjected to accident, catastrophic misuse or abuse.

In the event of failure within the warranty period, Orion, its authorized distributor, will, at Orion's option, repair, replace product not conforming to this warranty, or refund the purchase price of the non-conforming product. There may be additional charges, including freight, for warranty service performed in some countries. For service, contact Orion or its authorized dealer. Orion reserves the right to ask for proof of purchase, such as the original invoice or packing slip.

Economy Line electrodes are warranted to be free from defects in material and workmanship for a period of three (3) months from date of purchase by customer or six (6) months from date of shipment if the electrode fails for any reason (including breakage) except abuse, provided the electrode is not used in solutions containing silver, sulfide, perchlorate, or hydrofluoric acid; or in solutions more than 1 molar in strong acid or base at temperatures above 50°C and providing the electrode is used at room temperature. (Use at extreme temperatures can shorten electrode life.) For service, Orion or its authorized dealer will replace product not conforming to this warranty or refund the purchase price of the nonconforming product.

ORDERING INFORMATION

Electrodes

ROSS Electrodes are available with a variety of connectors. For more information, consult your ORION pH Electrode Catalog and price list or your local ORION distributor.

Ion-selective electrodes and pH electrodes (excluding the Economy Line electrodes) are warranted to be free from defects in material and workmanship for a period of twelve (12) months from the date of purchase by the customer or eighteen (18) months from date of shipment from Orion, except this warranty does not cover etching of the sensing elements of Models 94-17, 96-17, 97-17, and 94-06 or the breakage of non-Economy Series pH electrodes. 93 Series sensing modules are warranted to give six (6) months of operation if placed in service before the date indicated on the package, except the nitrate sensing modules are warranted to give thirty (30) days of operation if placed in service before the date indicated on the package. Replacement parts for the 92 and 95 Series electrodes and 97-08 electrode (O-rings, membranes, filling solution, etc.) are warranted to be free of defects in material and workmanship for thirty (30) days from the date of shipment.

THE WARRANTIES DESCRIBED ABOVE ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES WHETHER STATUTORY, EXPRESS OR IMPLIED INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND ALL WARRANTIES ARISING FROM THE COURSE OF DEALING OR USAGE OF TRADE. THE BUYER'S SOLE AND EXCLUSIVE REMEDY IS FOR REPAIR OR REPLACEMENT OF THE NON-CONFORMING PRODUCT OR PART THEREOF, OR REFUND OF THE PURCHASE PRICE, BUT IN NO EVENT SHALL ORION (ITS CONTRACTORS AND SUPPLIERS OF ANY TIER) BE LIABLE TO THE BUYER OR ANY PERSON FOR ANY SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES WHETHER THE CLAIMS ARE BASED IN CONTRACT, IN TORT (INCLUDING NEGLIGENCE), OR OTHERWISE WITH RESPECT TO OR ARISING OUT OF THE PRODUCT FURNISHED HEREUNDER.

Representations and warranties made by any person, including its authorized dealers, representatives, and employees of Orion which alter or are in addition to the terms of this warranty shall not be binding upon Orion unless in writing and signed by one of its officers.

Model Number	Description	Type of Connector
800500	ROSS Reference Half Cell, glass body	Pin-Top
810100	ROSS pH Half Cell, glass body	U.S. Standard BNC
81018N	Same as above	BNC
810200	ROSS Combination pH Electrode, glass body	U.S. Standard BNC
81028N	Same as above	BNC
810300	Semimicro ROSS pH Electrode, glass body	U.S. Standard BNC
81038N	Same as above	BNC
810400	ROSS Combination pH Electrode, glass body with rugged bulb	U.S. Standard BNC
81048N	Same as above	BNC
811500	Semimicro ROSS Combination pH Electrode, epoxy body	U.S. Standard BNC
81158N	Same as above	BNC
813500	ROSS Combination Flat Surface pH Electrode, epoxy body	U.S. Standard BNC
81358N	Same as above	BNC
815500	ROSS Combination pH Electrode, epoxy body with bulb guard	U.S. Standard BNC
815600	Same as above	BNC
816300	ROSS Combination Spear-tip pH Electrode, glass body	U.S. Standard BNC
81638N	Same as above	BNC
816600	ROSS Combination pH Electrode, sleeve reference junction, glass body	U.S. Standard BNC
81668N	Same as above	BNC

Standard Measurement Operating Procedure for:

BACHARACH HPK COMBUSTIBLE GAS & OXYGEN INDICATOR

8.0 INTRODUCTION

This document describes procedures that field personnel should perform when taking measurements with the Bacharach HPK combustible gas and oxygen indicator. The procedures that should be observed by the CDM service technicians will be documented in the CDM Field Equipment Operation, Maintenance, and Calibration Manual.

8.1 PURPOSE OF MEASUREMENT

The Bacharach HPK-2 continuously measures oxygen and combustible gas concentrations. Field technicians monitor measure oxygen and combustibles in landfill gas to indicate the air-tightness of the landfill cap. The health and safety officer measures: 1) oxygen to evaluate oxygen deficiency hazards and 2) combustible gas to evaluate the potential for explosions and fires. Combustible gas measurements are also needed to determine the reliability of measurements on the HNu photoionization detector.

8.2 SUPPLIES AND EQUIPMENT

8.2.1 Equipment needed

- Bacharach HPK-2 oxygen/combustible gas meter
- HPK aspirator bulb - #347-017
- HPK battery charger - #360-218.1
- HPK short probe and nylon hose assembly #505-015
- HPK Gas Kit case #340-180
- Flammable gas regulator - 10 psi output
- Gas control needle valve for above
- 0 - 5 liter / minute gas delivery gauge for above

- Non-flammable gas regulator - 10 psi output
- Gas control needle valve for above
- 0 - 5 liter / minute gas delivery gauge for above
- Phillips head screwdrivers (1/8", 3/16", and 1/4")
- Flat blade screwdrivers (1/8", 3/16", and 1/4")
- Soldering iron
- Slip joint pliers
- 1/4" box wrench
- Volt/Amp/Ohm multimeter

8.2.2 Supplies needed

- 4 nickel cadmium, size D, rechargeable batteries
- Size K cylinder of high purity air
- Size K cylinder of high purity 100% methane
- Size B cylinder of 2.5% methane
- Distilled water
- 1/4" Tygon^R tubing - approximately 25'
- HPK combustible gas filaments (catalytic) - #800-011
- HPK combustible gas filaments (thermal) - #800-027
- HPK dust filter refills #550-070
- HPK oxygen cell reactivation kit #514-001
- Electrical solder

8.3 START-UP

- a. Place the instrument upright on a flat surface in an area free of combustibles. The instrument should be OFF.
- b. The needles on both meters should rest over zero. If not, adjust the Mechanical Zero screw, located at the base of the needle, with a phillips head screwdriver until the needle rests over the zero.
- c. Attach the HPK's water trap to its inlet.
- d. Attach the HPK sampling hose to the inlet of the water trap.

- e. Place a cotton filter in the wide part of the short probe, and screw the probe on to the sampling hose. Replace filters when they become wet or dirty.
- f. If the specific monitoring procedure for the station where the HPK will be used requires an aspirator bulb, attach one to the exhaust port of the instrument.
- g. Seal the end of the probe with your thumb. The HPK pump should almost stop. If it continues to pump without laboring, there is a leak in the sampling line. See Section 8.7.8.
- h. Set the Range Switch (the metal lever in the middle of the control panel) to the range on which the HPK will be used (normally 100% for landfill gas and 4% for ambient air measurements).
- i. Turn the Function Switch (the rotary control switch on the far right of the control panel) to VOLT TEST. Both the oxygen and combustible meters should deflect up-scale. The integral sampling pump should come on.
- j. Pull upwards on the Volt Adjust knob (inner left control knob) to set the needle on the combustibles meter just over the green "Set Voltage" arrow.
- k. If the needle will not rest on the green arrow, recharge the batteries (Section 8.7.2). Do not use the meter if the voltage can not be set to the green arrow.
- l. Turn the Function Switch to ON.
- m. Pull upwards on the Oxygen Calibrate knob (the far left control knob). Use it to place the needle of the oxygen meter just over the word "CALIBRATE" on the meter.

- n. If the meter can not be set to read 21%, replace the oxygen cell assembly (Section 8.7.6).
- o. Use the Zero Adjust (inner right control knob) to set the needle on the combustibles meter over the zero. Note: When the meter cannot be set to zero on fresh air, the active or reference filament may require replacement (Section 8.7.7).
- p. Calibrate the instrument (Section 8.4.2 or 8.4.3).

8.4 INSTRUMENT CALIBRATION

8.4.1 Frequency of Calibration

Test	Section Number	Calibration Standard	Frequency
Mechanical zero	8.3 (b)	Internal	Every power-up
Leak check	8.3 (g)	Flow blockage	1 / day
Voltage adjust	8.3 (j)	Internal	Every power-up
Oxygen calibration	8.3 (m)	Ambient air	Every power-up
Operational zero	8.3 (o)	Ambient air	Every power-up
Analytical zero	8.4.4	High-purity air	1 / week
Gas calibration	8.4.2	Ultra-pure methane	1 / day and when changing ranges
Combustible Calibration	8.4.3	2.5% methane in air	1 / day and when changing ranges
Gas flow rate	8.4.5	Flow meter	1 / month

Section: 8.0

Revision Number: 0

Date: 5/1/89

Lab calibration

Bacharach Service Dept. 1 / year

8.4.2 Combustibles Calibration (100% Range)

- a. Attach a gas pressure regulator set to 10 psi to a cylinder of high purity (99.9% minimum) methane. Attach a gas flow gauge and valve to the regulator.
- b. Perform start-up procedure (Section 8.3).
- c. Set the Range Switch to the 100% position.
- d. Attach a length of 1/4" Tygon^R tubing between the cylinder and the inlet of the HPK. This length of tubing may be used only for HPK calibration.
- e. Set the valve to release methane at the flow rate shown on the label of that HPK (Section 8.4.5). Flow meter procedures are described in Section 10.5.
- f. Read the position of the needle on the combustibles meter when it stops changing.
- g. If the needle does not rest over the 100 on the lower scale, adjust its position by turning the slotted shaft which is reached through a hole just below the Voltage Adjust Knob in the instrument case. Use a 3/16" flat-bladed screwdriver to turn the shaft. (Clockwise moves the needle up. Counterclockwise moves it down). CAUTION: If the control resists turning in one direction, it may have reached the limit of rotation. DO NOT force it. If this occurs, investigate the trouble as described in Section 8.7.7.
- h. While performing this procedure, confirm that the oxygen meter reads 0%. If the reading is over 1%, reactivate the Oxygen Cell Assembly as described in Section 8.7.6.

8.4.3 Combustibles Calibration (4% Range)

- a. Attach a high-purity gas regulator set to release 10 psi to a cylinder of 2.5% methane in air. Attach a gas flow gauge and valve to the regulator.
- b. Perform start-up procedure (Section 8.3).
- c. Set the Range Switch to the 4% position.
- d. Attach a length of 1/4" Tygon^R tubing between the cylinder and the inlet of the HPK. This length of tubing may be used only for HPK calibration.
- e. Set the valve to release gas at the flow rate that appears on the face of that HPK (Section 8.4.5). Flow meter procedures are described in Section 10.5.
- f. Read the position of the needle on the combustibles meter when it stops changing.
- g. If the needle does not rest over the line between the 2 and the 3 on the upper scale, adjust its position by turning the slotted shaft which is reached through a hole just below the Voltage Adjust knob in the instrument case. Use a 3/16" flat-bladed screwdriver to turn the shaft. (Clockwise moves the needle up. Counterclockwise moves it down.) Caution: If the control resists turning in one direction, it may have reached the limit of rotation. DO NOT force it. If this occurs, investigate the trouble as described in Section 8.7.7.

8.4.4 Analytical Zero

- a. Attach a high-purity gas regulator to a cylinder of high-purity compressed air. Attach a gas flow gauge and valve to the regulator.

- b. Perform the start-up procedure (Section 8.3).
- c. Set the Range Switch to the position in which the HPK will next be used.
- d. Attach a length of 1/4" Tygon^R tubing between the cylinder and the inlet of the HPK. This length of tubing may be used only for HPK calibration.
- e. Set the valve to release air at the flow rate that appears on the label on the face of that HPK (Section 8.4.5). Flow meter procedures are described in Section 10.5.
- f. Read the position of the needle on the combustibles meter when it stops changing.
- g. If the needle does not rest over the zero on the meter, adjust its position by rotating the Zero Adjust knob. Note: when the meter cannot be set to zero on fresh air, the active or reference filament may require replacement (Section 8.7.7).
- h. Calibrate the instrument (Section 8.4.2 or 8.4.3).
- i. Read the position of the needle on the oxygen meter.
- j. Pull upwards on the Oxygen Calibrate knob (the far left control knob). Use it to place the needle of the oxygen meter just over the word "CALIBRATE" on the meter.

8.4.5 Flow Rate Check

- a. Set the Function Control knob to ON.
- b. Attach the discharge port of an analytical flowmeter to the inlet of the HPK. Note: An SMP for flow rate measurement is presented in Section 10.5.

- c. Observe the flow rate as shown on the meter.
- d. Write the flow rate, in liters per minute, on a label.
- e. Place the label on the HPK instrument panel.
- f. If the flow rate is below 1.0 liter per minute, perform the charger circuit tests (Section 8.7.3).

8.5 FIELD MEASUREMENTS

8.5.1 Measuring Gas Quality (100% Range) and Oxygen

- a. Perform the start-up procedures (Section 8.3) every time you turn the HPK on. Calibrate the instrument (Section 8.4.2) each day before taking measurements.
- b. Attach a 12' length of 1/4" Tygon tubing to the exhaust port of the HPK. If you use an aspirator bulb, attach the tubing to the bulb outlet.
- c. Attach the probe to the landfill gas sampling port (described in Sections 1.1, 1.2, 1.3, 1.6, 1.7, and 1.8) with a length of 1/4" Tygon^R tubing. The pump should almost stop. If it doesn't, there is a leak in the sample line. Locate and repair the leak (Section 8.7.8) before proceeding.
- d. Open the sampling port.
- e. Watch closely for water in the sampling line. Turn the HPK off quickly if water enters its liquid trap.
- f. Read the combustible and oxygen meters when their needles stabilize.
- g. If the needles waver, record your estimate of the average meter

reading.

- h. Close the gas sampling port.
- i. Disconnect the Tygon^R tubing at the sampling port.
- j. Let the HPK vent with the pump running until the combustibles meter reads 0% before shutting it off.
- k. Take care not to expose the HPK to excessive moisture, dirt, or contamination. Do not place it on contaminated surfaces.

8.5.2 Measuring Explosivity (4% Range) and Oxygen

- a. Perform the start-up procedures (Section 8.3) every time you turn the HPK on. Calibrate the instrument (Section 8.4.3) each day before taking measurements.
- b. Sweep the tip of the HPK probe through the work area at chest height and at ground level.
- c. Read the combustible and oxygen meters continuously.
- d. Record the highest meter reading you observe while monitoring. Record the location of that high reading as well.
- e. Let the HPK vent in clean air with the pump running until the combustibles meter reads 0% before shutting it off.
- f. Take care not to expose the HPK to excessive moisture, dirt, or contamination. Do not place it on contaminated surfaces.

8.5.3 Calculation and Recording

- a. The HPK reads directly in percent of gas by volume. Write the numbers down as they appear.

- b. Any combustible gas concentration over 1.2% represents an explosion hazard (Section 3.1.5 of the SHERP).
- c. Any combustible gas concentration above 0.3% is cause to suspect the readings on the HNu photoionization meters [Section 5.5.4 (g)].

8.6 STORAGE

8.6.1 Active Storage

Between uses during the day, the HPK must be kept as listed below. The HPK is in "active storage" when you drive it between locations on a monitoring circuit.

- a. Turn the HPK off before storing it.
- b. You may leave the water trap, aspirator bulb, the sampling hose and the probe in place when storing, or remove them.
- c. The HPK may be kept in the passenger space of a car, truck, or van. It must be restrained against rolling when the vehicle is in motion.
- d. If the HPK is kept in the cargo space of a truck, it must be kept in a box (like the HPK Gas Kit case) that protects it from rain, mud, and direct sun.

8.6.2 Inactive Storage

When the HPK is stored overnight, or during a day on which it will not be used, it must be kept as listed below.

- a. Turn the HPK off before storing it.
- b. Carefully clean the HPK with a damp disposable towel to remove any visible dirt.

- c. The HPK should be stored in the equipment trailer when it is not in use.
- d. Place the HPK on charge (Section 8.7.2.1) for sixteen hours after each day of use.

8.7 PREVENTIVE MAINTENANCE, TROUBLE-SHOOTING AND SERVICING

8.7.1 Indicators of Instrument Malfunction

<u>SYMPTOM</u>	<u>PROBABLE CAUSE</u>	<u>CORRECTIVE ACTION</u>
4% range meter needle rises up-scale violently.	Active filament defective.	Replace active filament (Section 8.7.7).
4% range meter cannot be set to zero.	Active filament defective.	Replace active filament (Section 8.7.7).
100% range meter needle drops down-scale violently.	Thermal filament defective.	Replace thermal filament (Section 8.7.7).
100% range meter can't be set to zero.	Thermal filament defective.	Replace thermal filament (Section 8.7.7).
Calibration screw can't set meter to 100% (or 4%)	Dirty combustion chamber.	Clean combustion chamber (Section 8.7.5).
Volt Adjust knob can't set needle on green arrow.	Batteries undercharged.	Recharge batteries (Section 8.7:2.1).

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Batteries will not hold a charge.	Batteries inserted improperly.	Test battery circuit. (Section 8.7.2.2).
	Batteries defective.	Replace batteries (Section 8.7.2.3).
	Charger Defective.	Test charger circuit (Section 8.7.3). Replace the charger (Section 8.8).
	Pump motor defective.	Replace the pump motor (Section 8.8).
Oxygen meter cannot be set to "CALIBRATE".	Oxygen cell electrolyte spent.	Reactivate oxygen cell (Section 8.7.6).
Oxygen reading above 1% with inert gas.	Oxygen cell electrolyte spent.	Reactivate oxygen cell (Section 8.7.6).
Oxygen meter cannot be set to "CALIBRATE" And O ₂ cell tests discontinuous [Section 8.7.6 (d)].	Oxygen cell defective.	Replace oxygen cell.
Oxygen reading above 1% with inert gas.	Oxygen cell defective.	
Combustibles meter doesn't respond during start-up or calibration.	Faulty meter.	Send to Bacharach for repair (Section 8.8).
Range Valve leaks, plugs, or turns stiffly.	Dirty valve body.	Clean valve (Section 8.7.4).

8.7.2 Normal Battery Maintenance

8.7.2.1 Battery Charging

- a. Set Function Control knob to OFF.
- b. Don't charge the batteries unless the instrument panel is firmly in place.
- c. Insert charger plug into the charging jacks on the side of the instrument case below the combustibles meter. Be certain the plug marked with red goes into the jack marked with red, and the black plug enters the black hole.
- d. Plug the charger line cord into a 115V AC outlet.
- e. Touch the side of the charger after it has been operating for 30 minutes. If it does not feel warm, perform the charger circuit tests (Section 8.7.3).
- f. The batteries should charge for 16 to 20 hours. If the HPK will not be used on the weekend, arrange for the security personnel to disconnect the charger on Saturday morning.
- g. At the end of the charge period, unplug the charger power cord. Then remove the charger plug from the charging jacks on the HPK.
- h. Re-calibrate the HPK (Section 8.4.2 or 8.4.3).

8.7.2.2 Battery Circuit Tests

- a. Set the range selector of a multimeter to the 10 volt scale. Place probes in the multimeter jacks as indicated on the multimeter.
- b. Set the Function Control knob to OFF.

- c. Insert the multimeter probes in the instrument charging jacks on the side of the instrument case under the combustibles meter.
- d. The multimeter should indicate 5 volts.
- e. Set the Function Control knob to ON.
- f. The voltage reading on the multimeter should drop to 2.5 - 2.6 volts.
- g. Failure to obtain these readings indicates depleted batteries, a short circuit, or open electrical connection. Most "battery problems" are traceable to charger malfunction or contact problems.
- h. Once a month, inspect the batteries for deterioration by removing them from the storage compartment. Be careful to return the batteries to the battery holder as shown on the side of the battery case.

8.7.2.3 Battery Replacement

- a. Set Function Control knob to OFF.
- b. Loosen the captive hold-down screws on the meter panel.
- c. Remove the meter panel from the instrument case. The batteries will be visible inside the case.
- d. Remove the batteries.
- e. Clean the silver battery contacts on the meter panel and in the instrument case with a rough cloth or fine sandpaper.
- f. Insert the new batteries in the case.
- g. When replacing batteries, be certain to reinstall them in the

position indicated on the side of the battery compartment.

- h. Charge the batteries (Section 8.7.2.1)
- i. While Bacharach puts D-sized nickel cadmium batteries in the HPK, Alkaline type D-cell batteries may also be used.

8.7.3 Charger Circuit Tests

- a. Perform battery circuit tests (Section 8.7.2.2).
- b. Plug charger power cord into 115V AC outlet. Place multimeter probes on the charger pins (red on red, black on black). The multimeter should indicate approximately 5.5 volts (unloaded voltage).
- c. Set the HPK Function Control Knob to OFF.
- d. Insert charger plug into the charging jacks on the side of the instrument case below the combustibles meter. Be certain the plug marked with red goes into the jack marked with red, and the black plug enters the black hole.
- e. Place the multimeter range selector to 500 milliamp (ma).
- f. Connect the the negative (- black) multimeter probe to the red (+) charging jack of the HPK and the positive (+ red) multimeter probe to the remaining exposed pin on the charger. With Charger connected to 115V AC, the multimeter should indicate a charge rate of 120 to 150 ma. If the multimeter indicates no current, replace the charger.
- g. Set the Function Control knob to ON. (Never charge the batteries with the HPK on. The power consumption is greater than the charger delivery rate).

- h. Multimeter should indicate approximately 250 ma. If the multimeter indicates 300 ma or more, send the HPK to Bacharach for repair.

8.7.4 Range Valve Cleaning

- a. Loosen the captive hold-down screws on the meter panel.
- b. Remove the meter panel from the instrument case. The batteries will be visible inside the case.
- c. Slide the "C" washer off of the bottom of the range valve stem.
- d. Pull the range valve stem out of the valve body.
- e. Clean the valve stem with a clean laboratory tissue.
- f. Clean the valve body with cotton swabs.
- g. Do not apply lubricant to the range valve.

8.7.5 Combustion Chamber Cleaning

- a. Fill a tedlar bag with a freon gas (like chlorofluoromethane).
- b. Vent the HPK outdoors. Step (f) below generates small quantities of hydrogen chloride gas.
- c. Set the Function Control knob to ON.
- d. Twist the Voltage Adjust knob as far clockwise as it will go.
- e. Attach the tedlar bag to the HPK probe with a short piece of 1/4" Tygon^R tubing. Note: This length of tubing must be used for no other purpose.
- f. Allow the HPK to draw the freon from the tedlar bag for 10 seconds.

- g. Detach the bag from the probe. Flush the HPK with air for 30 seconds.
- h. Set the HPK aside for twelve hours.
- i. Perform start-up (Section 8.3) and calibration (Section 8.4.2 or 8.4.3) before using.

8.7.6 Oxygen Cell Reactivation

Reactivation Kit 514-001 is all that is required to completely reactivate the oxygen cell. The Kit contains a cap gasket with Teflon membrane, zinc electrode with O-ring, nylon screw with seal, KCl solution, nylon pad and brush. To reactivate the cell, proceed as follows:

- a. Loosen the captive hold-down screws on the meter panel.
- b. Remove the meter panel from the instrument case. The batteries will be visible inside the case.
- c. Unplug oxygen cell from the printed circuit board and disconnect the plastic tubing from the cell inlet and outlet nipples.
- d. Check for electrical continuity between the gold electrode and the banana plug. If the cell shows a resistance higher than 200 ohms, replace the cell completely.
- e. Remove the nylon screw and seal ring on the electrical plug side of the cell.
- f. Unscrew the zinc electrode (banana plug nearest the blue dot on the side of cell). Remove it together with its O-Ring seal. Discard the zinc electrode, the screw, the O-ring and the seal.
- g. Drain all the solution from the cell and completely fill with fresh

KCl solution through either opening.

- h. Remove cap and gasket with membrane by removing the six screws which hold the cap in place. Discard the gasket with membrane.
- i. Wash the cell thoroughly with cold, clean water. Use the brush to remove any white substance that may remain on the gold electrode. DO NOT USE ANY SOAP OR DETERGENT.
- j. Any white substance that remains after brushing can be removed with the abrasive nylon pad. The gold electrode should be handled very carefully and only slight pressure applied in cleaning with the nylon pad.
- k. Wash again with the brush and water.
- l. Put one drop of KCl solution on top of the gold electrode and put new gasket with membrane in place. The side of the gasket with the Teflon membrane should face the gold electrode.
- m. Replace the cap, observing the direction of the sampling nipples. Nipples should point away from the label on the cell body.
- n. Tighten all screws until the cap shoulder is flush with the cell body. The cell is now dry charged, and can be stored as long as desirable.
- o. Fill the cell with KCl solution, through the opening for the nylon screw.
- p. If the old O-ring is still in the zinc electrode opening, remove it.
- q. Place the new O-ring on the zinc electrode, screw the zinc electrode into the cell, and tighten it with a small wrench.
- r. Plug the fill hole with nylon screw and new seal ring (310-035).

The cell is now fully activated.

- s. Re-calibrate (Section 8.4.2 or 8.4.3).

8.7.7 Filament Replacement

8.7.7.1 Replacing the Combustion Filament

If the HPK has been in use for a considerable period of time, or in moist or dusty conditions, it is frequently desirable to replace the filament flame arrestor assembly in combination.

- a. Loosen the captive hold-down screws on the meter panel.
- b. Remove the meter panel from the instrument case. The batteries will be visible inside the case.
- c. Unplug oxygen cell from the printed circuit board and disconnect the plastic tubing from the cell inlet and outlet nipples.
- d. Remove the five screws holding the brass plate to the underside of the panel.
- e. Remove the filament leads from the subpanel terminals.
- f. Remove the flame arrestor assembly from the subpanel.
- g. When replacing the filaments only, and re-using the flame arrestor:
 - Remove and inspect the flame arrestor
 - Check for dust, corrosion or other damage
 - Replace gasket if it has deteriorated
 - Install a new filament in place of the old one, by screwing the

new filament into the flame arrestor plate to compress the O-ring gasket as tightly as possible using the thumb and finger

- When inserting filament be very careful not to touch or distort the platinum coil
- h. Place flame arrestor / filament assembly on to the subpanel.
- i. Cross tighten the five retention screws to apply even pressure to the flame arrestor gasket.
- j. Perform start-up (Section 8.3)
- k. Re-calibrate (Section 8.4.2 or 8.4.3)

8.7.7.2 Replacing the Reference Filament

- a. First un-solder the black wire at subpanel.
- b. Unplug the oxygen cell.
- c. Then unscrew the knurled reference filament base from its cavity, using a pair of pliers.
- d. Install the new filament in the same position as the old one.
- e. Tighten with pliers, and solder wire to subpanel.
- f. Perform start-up (Section 8.3).
- g. Re-calibrate (Section 8.4.2 or 8.4.3).

8.7.8 Leaks in the Sampling Line

- a. Remove the short probe and sampling hose. Place a rubber cork over the water trap inlet.

- b. If the motor almost stops, fix the leak in the line or probe. Do not perform the rest of this procedure if the leak is fixed.
- c. Remove the water trap. Block the instrument inlet with the cork.
- d. If the motor almost stops, fix the leak in the water trap or its connection. Do not perform the rest of this procedure if the leak is fixed.
- e. Loosen the captive hold-down screws on the meter panel.
- f. Remove the meter panel from the instrument case. Disconnect the gas line from the pump.
- g. If the motor almost stops, fix the leak in the gas line. If the pump continues unimpeded, replace the pump (Section 8.8).
- h. Perform start-up (Section 8.3).
- i. Re-calibrate (Section 8.4.2 or 8.4.3)

8.7.9 Oxygen Cell Contamination by Foreign Liquids

If any liquid has been accidentally introduced into the sampling line and thus into the sampling chamber of the cell, it will be necessary to flush the system out with distilled water as soon as possible. To do this, use the following procedure:

- a. Loosen the captive hold-down screws on the meter panel.
- b. Remove the meter panel from the instrument case. The batteries will be visible inside the case.
- c. Unplug oxygen cell from the printed circuit board and disconnect the plastic tubing from the cell inlet and outlet nipples.

- d. Drain the liquid out.
- e. Pour distilled water into one sampling nipple until it comes out of the other.
- f. Drain water out.
- g. Flush the cell with distilled water several times.
- h. Insert the cell into the printed circuit board, observing plug color coding (the blue dot on the cell should align with the blue dot on the board).
- i. Connect one end of the cell to the inlet and the other directly to the sample pump with the tubing from step (c). Bypass the combustibles reaction chamber.
- j. Set the Function Control knob to ON. Flush the sampling chamber with air for five minutes.
- k. The cell should now register normal output and is ready for use.
- l. Reconnect sample tubing so that outlet oxygen cell goes to reaction chamber, and outlet of reaction chamber goes to pump inlet (or aspirator bulb).

8.8 Other Types of Service

All other types of repair may be performed only by the CDM or Bacharach authorized service personnel. The HPK must receive a preventive maintenance check from one of these authorized service personnel at least once a month.

Standard Measurement Operating Procedure for:

OVA FLAME IONIZATION DETECTOR

6.0 INTRODUCTION

This document describes procedures that field personnel should perform when using the Foxboro Century 128 OVA flame ionization detector. The procedures that should be observed by the CDM service technicians will be documented in the CDM Field Equipment Operation, Maintenance and Calibration Manual.

6.1 PURPOSE OF MEASUREMENT

At the OII site the OVA Flame Ionization Detector is used to:

1. Analyze gas samples from the North and South parcel gas monitoring wells;
2. Measure the vapor exposure of site personnel;
3. Detect surface emissions from landfill cracks and fissures to aid in determining need for landfill cover repair;
4. Screen off-site soils for suitability as landfill cover material (contaminated soils are rejected); and
5. Detect leaks from landfill gas transport systems.

OII site personnel do not use the OVA as a portable gas chromatograph. GC use will not be discussed in this procedure.

6.2 SUPPLIES AND EQUIPMENT

6.2.1 Equipment needed

- Foxboro Century Model 128 Organic Vapor Analyzer
- Carrying case and straps
- OVA Charger
- Maintenance and tool kit
- Hydrogen filling hose
- Hex key (supplied with instrument)
- 3/16" flat screw driver
- Nickel or quarter
- Stiff wire (about 12" of coat hanger, cleaned)
- 12" adjustable crescent wrench
- Open end box wrenches: 3/8", 7/16", 1/2" and 15/16"
- Channel-lock pliers
- Small wire brush

6.2.2 Supplies needed

- 3/16" Tygon^R tubing
- Teflon tape dope
- Spare glow plug

- Spare dust filters
- Calibration gas: 80 ± 20 ppm methane in air
- Calibration gas: 500 ± 100 ppm methane in air
- Cylinder of hydrogen gas
- Cylinder brace
- Detergent / water solution
- Methyl alcohol
- Paper towels
- Cotton tipped swab

6.3 START UP PROCEDURE

- a. Set the OVA on a flat surface.
- b. Remove the lid by releasing the latch and pulling the lid up along its hinges.
- c. Attach the probe to the main instrument package by aligning the plug and screwing the hose on. Align the spring clamp on the readout jack with the notch in the plug on the sidepack. Install the sample line L-connector parallel to the electronic connector.
- d. Insert the close-area sampler firmly against the red gasket at the base of its socket in the probe body. Use the telescoping tubular sampler to test spaces you want to avoid.
- e. Tighten the probe compression fitting on the sampler.
- f. Pull up on the Instrument Switch and move it to BATT. If the needle on the meter deflects past the BATTERY OK white line on the probe, the OVA can operate at least four hours before it needs recharging. If it does not, charge the instrument before using it (Section 6.7.2.).
- g. Pull up on the Instrument Switch and move it to ON.
- h. Allow the OVA to warm up for five minutes.
- i. Pull up on the Pump Switch and move it to ON. Place the main package in a vertical position, so that the Sample Flow Rate Rotameter ball floats. The rotameter should read between 1.5 and 2.25. If flow is less than 1.5, check for flow blockages (Section 6.7.4)
- j. Cover the inlet of the probe with your thumb. The pump should almost stop and the rotameter float should drop to zero. If flow continues, investigate for leak (Section 6.7.5.2).
- k. Set the Range Switch (in the "CALIBRATION" box) to the X10 position.
- l. Use the Adjust Knob to set the needle just below 0. Set the Alarm Volume Knob so that you can hear the Flame out alarm. If you can't, see Section 6.7.1.
- m. Use the Adjust Knob to set the needle to the 5 position.
- n. Turn the Alarm Level Knob (on the probe) until the audible alarm just comes on.
- o. Open the H₂ TANK Valve and the H₂ SUPPLY Valve slowly three turns. The H₂ SUPPLY Gauge should read between 9 and 10.5 psi. For eight hours of operation, the H₂ TANK Gauge should read at least 1500 psi. If hydrogen pressure falls below 500 psi, recharge the hydrogen tank (Section 6.7.3).
- p. Wait approximately one minute.

- q. Set the needle back to 0 with the Adjust Knob. You should hear the flame out alarm.
- r. Depress the igniter button for 3 seconds. You should hear a soft popping sound or see a sudden sharp positive deflection of the needle when the detector lights. Do not depress the igniter button for more than five seconds. If the detector does not light, wait for one minute before attempting to light it again.
- s. Allow the OVA to warm up at least 5 minutes before taking measurements.
- t. To avoid a false flame-out alarm, set the meter to 1 ppm with the Adjust knob and make differential readings from there.
- u. Test whether the OVA responds to organic solvent by holding a solvent-based marking pen in front of the probe inlet. A positive deflection of the meter indicates the flame is on.
- v. Calibrate the OVA (Section 6.4.2)

6.4 INSTRUMENT CALIBRATION

6.4.1 Frequency of Calibration and Maintenance

Test	SOP Number	Calibration Standard	Frequency
Calibrate	6.4.2, 6.4.3	Methane in air	1 / day
Alarm function	6.3 (l-n)	Internal	Every power-up
Operational Check	6.3 (u)	Marking Pen	Every power-up
Leak check	6.3 (j)	Flow blockage	1 / day
Analytical zero	6.4.4	High-purity air	1 / month
Sampling Probes	6.7.5	Cleaning	2 / month
Flame arrestor filter	6.7.6	Cleaning	1 / month

6.4.2 Field Calibration

- a. Perform the start up procedure (Section 6.3).
- b. Set range switch on X10.
- c. Set the needle to zero with the adjust knob. Note: this step is an operational zero. It should not be performed in air that yields a positive reading on the OVA (see Section 6.4.4).
- d. Fill a tedlar bag with a gas standard (e.g. 100 ppm methane in air) that is National Institute of Standards and Technology (NIST) traceable. Use this tedlar bag only for calibration.
- e. Attach clean 3/16" Tygon^R tubing from bag to probe. Don't use this tubing for any other purpose.
- f. Open the valve on the tedlar bag.
- g. Unlock the Gas Select knob by sliding the lock control lever to the twelve o'clock position on the knob.
- h. Set the Gas Select knob to the position that places the needle in the proper position (e.g. over the 7.8 for 78 ppm calibration gas).
- i. Lock the Gas Select knob.
- j. Record the calibration gas, its concentration, and the Gas Select setting in the site safety log book or on the data sheet.

6.4.3 Calibration To A Gas Other Than Methane

The OVA may be calibrated to any certified hydrocarbon calibration gas. This procedure is provided special applications such as vinyl chloride monitoring.

- a. Perform the start up procedure (Section 6.3).
- b. Set range switch on X10.
- c. Set the needle to zero with the adjust knob. Note: this step is an operational zero. It should not be performed in air that yields a positive reading on the OVA (see Section 6.4.4)
- d. Fill and flush a tedlar bag with a gas standard (e.g. 10 ppm vinyl chloride in air) that is National Institute of Standards and Technology (NIST) traceable. Fill it and flush it again. Use this tedlar bag only for this gas standard.
- e. Fill the bag with two to three liters of the gas. If the gas is toxic, these steps must be done in a fume hood.
- *. It is safer to use a flow-regulated gas cylinder with a traceable calibration gas to calibrate the OVA, especially if the gas is toxic (e.g., vinyl chloride).
- f. Attach clean 3/16" Tygon^R tubing from the bag (or cylinder) to the OVA probe. Don't use this tubing for any other purpose.
- g. Open the valve on the tedlar bag (or cylinder).
- h. Unlock the Gas Select Knob by sliding the Lock Control Lever to the twelve o'clock position on the knob.
- i. Set the Gas Select Knob to the position that places the needle in the proper position (e.g. over the 7.8 for a 78 ppm gas standard).
- j. Lock the Gas Select knob.
- k. Record the calibration gas, its concentration, and the Gas Select setting in the site safety log book or on the data sheet.
- l. Attach a new calibration sticker to the OVA. Make certain that the instrument is clearly marked as to the gas for which it is calibrated. All subsequent instrument readings must be expressed as ppm of the gas used (e.g., 20 ppm benzene equivalent).

6.5 FIELD MEASUREMENTS

6.5.1 Health and Safety Measurement

- a. Perform the start up procedure (Section 6.3).
- b. Perform the calibration procedure (6.4.2).
- c. Set the needle to 1 with the Adjust Knob.
- d. Start investigations of ambient air with the Range Switch in the X1 position. Switch the range setting as needed to the lowest range that yields a reading below full scale.
- e. Monitor employee exposure in the breathing zone. Hold the probe about 4'-5' from the ground. Monitor enclosed areas with the probe before you enter them.
- f. Perform the operational check [Section 6.3 (u)] with a marking pen whenever you are unsure the OVA is working.
- g. Do not allow the OVA to contact contaminated surfaces.

- h. With the exception of the the probe inlet and the exhaust, the OVA may be wrapped in clear plastic during field monitoring to protect it from contaminants or moisture (in the event of precipitation). During storage (Section 6.6.3), remove the plastic covering to minimize condensation.
- i. Perform the shut down procedure (Section 6.6.1) when finished.

6.5.2 Gas Bag Sampling

- a. Perform the start-up procedure (Section 6.3).
- b. Perform the calibration procedure (Section 6.4.2), using a 100 ppm methane standard.
- c. Carry the OVA on your shoulder, or place it on a surface known to be clean (such as the tabletops in the equipment trailer).
- d. Allow the instrument to stabilize for a minute after calibration.
- e. Set the needle to zero. Gas bag testing may be done with the alarm volume turned off.
- f. Set the Range Switch to X100.
- g. You may pre-test the gas bag for methane with the HPK as described in Section 1.6.9.
- h. Methane levels above 0.2% will surely swamp the OVA's detector.
- i. Attach the OVA probe to the vapor source or gas sample bag with a short piece of Tygon^R tubing. Do not attach the HNu to a source that varies from atmospheric pressure by more than 5" of water pressure.
- j. Open the valve on the bag.
- k. Change the range setting to the lowest range that yields a reading below full scale.
- l. Record the gas concentration on the data sheet.
- m. Close the valve on the bag.
- n. Disconnect the tubing from the bag.
- o. When you are finished with the measurements, follow the shut down procedure (Section 6.6.1).

6.5.3 "Clean" Soil Fill - Off-Site Analysis

- a. Transport the OVA to the fill location.
- b. If there are no holes in the fill, dig some. Allow vapor to accumulate in the holes for ten minutes before testing them.
- c. Perform the start-up procedure (Section 6.3).
- d. Perform the calibration procedure (Section 6.4.2) using a 500 ppm methane standard.
- e. Observe and record background concentration.
- f. Use the probe to test the air near the soil surface and in existing trenches or test holes at various locations in the fill dirt pile. Record the readings.
- g. Reject the fill if any reading exceeds 500 ppm methane.
- h. Perform the shut down procedure (Section 6.6.1) when you are finished taking measurements.

6.5.4 Leak Detection

- a. Perform the start-up procedure (Section 6.3).
- b. Perform the calibration procedure (Section 6.4.2) using a 100 ppm methane standard.
- c. Set the alarm to 2 ppm [Section 6.3 (1-n)].
- d. In the area of the leak, set the needle to 1 ppm with the Adjust Knob.
- e. Place the probe near the lines, flanges, and fittings where leaks are suspected. Move the probe slowly over suspected leak points.
- f. If the alarm goes off, decrease its volume. Move the probe slowly back and forth in the area to find the peak concentration, which should correspond to the source of the leak.
- g. When you are finished taking measurements, perform the shut down procedure (Section 6.6.1)

6.5.5 Environmental Factors that Affect Measurements

- a. The OVA is designed to sample air or vapors only. Do not allow any liquids or solids to get into the probe or meter assembly.
- b. Temperature can effect the efficiency of the detector. Record the temperature at which you are working.
- c. The OVA responds to methane. Because the OVA can not distinguish toxic vapors from methane, using an OVA to determine toxicity exposure on landfills often causes a false perception of hazard.

6.6 STORAGE AND CLEANING

6.6.1 Shut Down Procedure

- a. Close the H₂ TANK Valve.
- b. Close the H₂ SUPPLY Valve.
- c. Move the Instrument Switch to OFF.
- d. Wait 5 seconds.
- e. Move Pump Switch to OFF.
- f. Carefully clean the outside of the OVA with a damp (not dripping wet) paper towel to remove any visible dirt.

6.6.2 Active Storage

Between uses during the day, the OVA must be kept as listed below. The OVA is in "active storage" when you drive it between locations on a monitoring circuit.

- a. Perform the shut down procedure (Section 6.6.1) before storing it.
- b. The OVA may be kept in the passenger space of a car, truck, or van. It must be restrained against rolling when the vehicle is in motion.
- c. If the OVA is kept in the cargo space of a truck, the probe must be removed from the sidepack, and the OVA must kept in a box (like the case) that protects it from rain, mud, and direct sun.

6.6.3 Inactive Storage

When the OVA is stored overnight, or during a day on which it will not be used, it must be kept as listed below.

- a. Perform the shut down procedure (Section 6.6.1).
- b. The OVA should be stored in the equipment trailer when it is not in use.
- c. Place the OVA on charge (Section 6.7.2.1) for sixteen hours after each day of use.
- d. Periodically observe the hydrogen tank pressure gauge. A decrease of more than 150 psi/hour indicates a significant leak in the hydrogen supply system.

6.7 TROUBLE-SHOOTING AND SERVICING

6.7.1 Indicators of Instrument Malfunction

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
Low sample flow rate	Plugged probe tube	Clean tube (Section 6.7.6)
	Clogged dust filters	Replace or clean filters (Section 6.7.4).
	Clogged flame arrestor	Replace or clean filters (Section 6.7.4).
	Broken pump	Send OVA to Foxboro (Section 6.8).
	Problems in sidepack	Send OVA to Foxboro (Section 6.8).
Flame will not light	Sample flow too low	See above
	Glow plug defective	Send OVA to Foxboro (Section 6.8).
	Hydrogen line frozen	Warm unit. Use dry hydrogen gas in cold temperatures.
	Fuel jet is misaligned	Remove flame arrestor. Re-insert it.
Flame-out alarm does not sound when flame dies.		Screw Mixer/Burner Assembly in or out.
	Volume too low	Turn Volume Knob clockwise.

	OVA out of calibration	Re-calibrate (Section 6.4.2, 6.4.3)
	Dirty flame chamber	Clean chamber using a swab and methyl alcohol (6.7.6)
	Defective electronics	Send OVA to Foxboro (Section 6.8).
False flame-out alarm	Instrument "zeroed" to high ambient level	In X1 range, adjust meter to 1 ppm Zero to "lowest expected ambient level".
Meter responds slowly or doesn't respond	Leaks in sample line	Check for leaks (Section 6.7.5)
	Mechanical or electrical problems	Send OVA to Foxboro (Section 6.8).
Meter recovers slowly in clean air	Dirty sample lines	Clean sample lines by blowing out with clean air from SCBA (Section 6.7.7)
	Dirty Particle filters	Flushing with high purity air from SCBA or bake at 250°F.
	Dirty Flame Arrestor	Flushing with high purity air from SCBA or bake at 250°F.
	Dirty flame chamber	Clean chamber using a swab and methyl alcohol (6.7.6)
False high background reading	Dirty hydrogen	Use hydrocarbon-free hydrogen. Check for contaminated fittings on filling hose assembly. Remove the exhaust port and clean sample inlet filter with a small wire brush or a knife blade.
	Dirty sample input lines	Flush with clean air from SCBA.

	Dirty particle filters	Flush with clean air from SCBA or bake at 250°F.
	Dirty flame arrestor	Flush with clean air from SCBA or bake at 250°F.
	Dirty flame chamber	Clean chamber using a swab and methyl alcohol (6.7.6)
Pump runs without Pump Switch on	Short circuit in pump	Send OVA to Foxboro (Section 6.8)
No power to pump or electronics	Weak battery	Recharge battery pack. Replace battery pack.
Hydrogen pressure drops when valves are shut	Leaky H ₂ valve stems Other problems	Tighten packing nuts Send OVA to Foxboro (Section 6.8)
H ₂ SUPPLY Gauge reads too low or too high	mis-set pressure reducers	Send OVA to Foxboro (Section 6.8)
Can't Calibrate OVA with GAS SELECT Knob	mis-set internal reducers	Send OVA to Foxboro (Section 6.8)

6.7.2 Battery Charging

Perform the following procedure in the equipment trailer.

- a. Remove RECHARGER Connector cap by pressing down and twisting counter-clockwise.
- b. Set battery charger switch to Off.
- c. Attach the connector from the charger to the RECHARGER Connector on the BATTERY PACK cover.
- d. Insert the charger's AC plug into a standard 115 v AC wall outlet.
- e. Move the battery charger switch to the On position. The light above the switch should light.
- f. The needle on the charger's meter indicates current flow when it is fully deflected to the left. When the meter pointer is over the charged marker, the battery has a full charge.
- g. The OVA needs at least one hour of charging for every hour of operation. Overnight charging is recommended. The batteries cannot be damaged by charging for long periods.
- h. When the OVA is needed, turn the battery charger switch to OFF and disconnect the charger from the battery assembly.
- i. Once every 6 months, the instrument should be allowed to completely run down, and then fully recharged.

6.7.3 Hydrogen Refilling

If the H₂ TANK pressure falls below 500 psi, recharge the hydrogen tank from the cylinder of zero grade hydrogen in the support zone. Do not perform this procedure while there are ignition sources, such as lighted cigarettes in the area.

- a. Lift and move the Instrument Switch to OFF.
- b. Attach the hydrogen filling hose securely to the cylinder of zero grade hydrogen with the 15/16" wrench.
- c. Remove the OVA fill cap cover (below the H₂ REFILL Valve).
- d. Attach the filling hose to the instrument fill connection with the 3/8" box wrench.
- e. Check to ensure that all of the valves on the instrument are closed.
- f. Open the supply valve on the hydrogen cylinder.
- g. Check for hydrogen leaks in the hose and fittings. Tighten the connections if necessary.
- h. Turn the FILL/BLEED Valve on the hose to BLEED for five seconds.
- i. Turn the FILL/BLEED Valve to OFF.
- j. Open the H₂ REFILL Valve on the instrument slightly.
- k. Check for hydrogen leaks. Tighten the connections if necessary.
- l. Open the H₂ TANK Valve on the instrument panel.
- m. Turn the FILL/BLEED Valve to FILL.
- n. It takes about two minutes to fill the hydrogen tank.
- o. After the hydrogen tank is filled, close the cylinder and OVA valves.
- p. Set the filling hose to BLEED.
- q. Disconnect the hose from the instrument using the 3/8" box wrench.
- r. Disconnect the hose from the hydrogen cylinder.

6.7.4 Particle Filter Cleaning

6.7.4.1 Probe Inlet Filter Cleaning

- a. Twist the compression nut on the close area sampler clockwise and remove the sampler from its socket in the probe.
- b. Unscrew the joint in the sampler body that is marked with Teflon tape.
- c. Drop the filter out on your hand.
- d. Look at a light source through the sampler tube. If the tube is clogged, clean it (Section 6.7.6)
- e. Tap the filter, hollow side down, on a clean tabletop.
- f. Scrub the surface of the filter with the wire brush from the OVA tool kit.
- g. If the filter is contaminated with organics, you may soak them off with methyl alcohol, or bake them off at 250°F.
- h. If you use solvent on the filter, blow it out with clean air from a compressed air cylinder. Dry the filter completely before placing it back in the sampler.
- i. Place the spring in the fat part of the sampler.
- j. Place the filter in the fat part of the sampler. The hollow side must face out, so that air flows into the filter cup.

- k. Screw the sampler body back together. If the Teflon tape dope is worn, replace it.
- l. Perform the start-up (Section 6.3) and calibration procedures (Section 6.4.2).

6.7.4.2 Sidepack Inlet Filter Cleaning

- a. Remove the probe's electronic and sample line connections from the sidepack.
- b. Unscrew the sample line coupling from the sidepack with a 7/16" wrench.
- c. Remove the filter and spring by tilting the sidepack.
- d. Clean the filter as described in Section 6.7.4.1 (e-h).
- e. Reinsert the filter; spring first and cup side out.
- f. Check that the O-ring on the coupling is intact. If it is not, replace with a spare from the OVA tool kit.
- g. Screw the coupling back in.
- h. Re-calibrate (Section 6.4.2).

6.7.4.3 Combustion Chamber Flame Arrestor Cleaning

- a. Turn the OVA off (Section 6.6.1).
- b. Remove the black safety cover from the exhaust port at the bottom of the OVA with a hex key.
- c. Unscrew the flame arrestor in a counter-clockwise direction. Use channel-locks only if you can't remove the flame arrestor by hand.
- d. Clean the filter as described in Section 6.7.4.1 (e-h).
- e. Screw the flame arrestor back into its socket. Do not use tools to tighten the flame arrestor.
- f. Replace the safety cover. The hex screws on the cover should barely feel tight.

6.7.4.4 Combustion Chamber Inlet Filter Cleaning

- a. Turn the OVA off (Section 6.6.1).
- b. Remove the flame arrestor [Section 6.7.4.3 (b-c)]
- c. Locate the final filter, a porous metal surface deep in the combustion chamber.
- d. Scrub the final filter in place with the wire brush from the OVA tool kit.
- e. Replace the flame arrestor and safety cap [Section 6.7.4.3 (e-f)]

6.7.5 Repair Gas and Air Leaks

6.7.5.1 Hydrogen System Leaks

- a. With the OVA turned off (Section 6.6.1), and the H₂ TANK Valve open, observe the level on the H₂ TANK Gauge. If the reading the next morning is significantly lower (drops more than 350 psi), there is a leak in the hydrogen system.
- b. With the pump off and the H₂ valves open, listen for leaking gas.
- c. Apply a soap bubble solution to the hydrogen valve stems, the GC

fittings, and the hydrogen refill cap. Bubbling solution indicates leaking gas.

- d. Tighten the valve packing nuts or compression fittings at which bubbling occurs. Because you can permanently damage the OVA by over-tightening, tighten these fittings a little bit a time.
- e. If the above procedures do not locate the leak, send the OVA to Foxboro for factory servicing (Section 6.8).

6.7.5.2 Air System Leaks

- a. Perform a leak check [Section 6.3 (j)].
- b. After each of the following steps, perform a leak check. If the pump stops, or rotameter drops to zero, no further steps are needed.
- c. Moisten your thumb and repeat the leak check.
- d. Twist the compression nut on the close area sampler clockwise and remove the sampler from its socket in the probe.
- e. Hold the base of the close-area sampler firmly against the red gasket at the base of its socket. Tighten the compression nut.
- f. If the system still leaks, remove the sample line at the sidepack coupling.
- g. Place your thumb over the coupling. If the leak does not stop, tighten the coupling with a 7/16" wrench.
- h. If the above steps do not correct the leak, send the unit to Foxboro for repair (Section 6.8).

6.7.6 Clean Plugged Sampling Probes

- a. Dismantle the close area sampler [Section 6.7.4.1 (a-d)].
- b. Push visible blockages out of the sampler tube with a length of stiff wire.
- c. Blow loose particles out with clean compressed air.
- d. Clean the outside of the probe with a detergent solution and a paper towel.
- e. Wash the probe with organic solvent only if it has heavy organic contamination.
- f. If solvent is used, wash the probe with detergent and water, then bake it in the sun for an hour to eliminate residual hydrocarbons before reassembly.
- g. Reassemble the sampler [Section 6.7.4.1 (i-k)].
- h. Perform the start-up (Section 6.3) and calibration procedures (Section 6.4.2).

6.7.7 Replace Charcoal Filter

- a. Loosen the end caps on the charcoal filter holder, a silver cylinder on the face of the OVA, with a set of channel lock pliers.
- . Withdraw the charcoal cartridge from the holder and dispose of the charcoal.
- . Refill the cartridge with fresh charcoal Foxboro P/N CSC004 or equivalent. Fill the cartridge completely.
- . Insert the cartridge back into the holder.
- . Replace the end caps on the holder. Tighten the end caps just past

finger tight with the channel lock pliers.

- . Check the tightness of the end caps with detergent water [Section 6.5.1 (c-d)].

6.7.8 Replace Igniter Plug

- . Perform the shut down procedure (Section 6.6.1)
- . Turn the four screws on the face of the OVA 1/4 turn counterclockwise to release it from the case.
- . Remove the igniter button shield by rotating it clockwise.
- . Remove the OVA from its case by lifting the face plate while pulling the plastic case out to allow the igniter button to pass.
- . Perform the start-up procedure [Section 6.3 (a-p)]. You may omit the leak check and alarm volume steps.
- . Look for glow on plug when the Ignite button is depressed.
- . If plug does not glow, unscrew it with the 5/16" open end wrench only Do not use a crescent wrench, since stripped threads require major repair.
- . Screw a new glow plug in the socket - tighten slightly snug only, to avoid stripping threads.
- . Check for glow on new plug. Look for evidence of ignition [Section 6.3 (p)]. If the plug glows, but the flame does not ignite, see Section 6.7.1.
- . Perform the shut down procedure (Section 6.6.1)
- . Place the OVA back in its case.
- . Tighten the four case screws.

6.7.9 Clean Combustion Chamber

- a. Perform the shut down procedure (Section 6.6.1).
- b. Remove the flame arrestor [Section 6.7.4.3 (b-c)].
- c. Moisten a cotton swab with one or two drops of water only.
- d. Swab around the electrode and the chamber to remove visible particles.
- e. Run the OVA pump for 5 - 10 minutes to dry the chamber.
- f. Replace the flame arrestor [Section 6.7.4.3 (e-f)].

6.8 OTHER TYPES OF SERVICE

While the OVA often requires types of service not addressed in this manual, the procedures needed should not be conducted by personnel who have not been trained by Foxboro. When the methods listed in this manual fail to make the OVA operate satisfactorily, send the OVA for repair to:

Foxboro Company
P.O. Box 5449
151 Woodward Avenue
South Norwalk, CT 06856

Call Foxboro ahead of time for a return authorization at (203) 853-1616 or (800) 321 0322.

APPENDIX E

LABORATORY QUALITY ASSURANCE MANUALS

APPENDIX E - CONTENTS

- . Agriculture and Priority Pollutants Laboratories (APPL).
- . Coast to Coast Analytical Services.
- . Tracer Research.

**AGRICULTURE
&
PRIORITY
POLLUTANTS
LABORATORIES
INC.**

**QUALITY
ASSURANCE
MANUAL**

MARCH 1990

QUALITY ASSURANCE MANUAL

1990

Agriculture & Priority Pollutants Laboratories, Inc

APPL, Inc.
4203 W. Swift Ave.
Fresno, California 93722
(209) 275-2175

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QUALITY POLICY

The object of Agriculture & Priority Pollutants Laboratories, Inc. (APPL, Inc.) is to provide high-quality data that is accurate, reliable and adequate for the intended purposes.

SCOPE

The purpose of a Quality Control program is to monitor the analytical process. This manual is designed to inform all employees working at Agriculture and Priority Pollutants Laboratories, Inc. (APPL, Inc.) what is required for consistently precise and accurate data. By following the guidelines presented here, the quality of all work can be maintained at the highest possible levels.

The complex nature and pitfalls of the analytical procedures require a set of built-in controls to prevent or detect incorrect results. In a legal action it is not unusual that the testimony of the analyst is evaluated on the strength or weakness of the operating quality control program.

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LABORATORY

APPL, Inc. is located in Fresno, California and is housed in an 8,000 square foot building. The facility was designed and built for the specific needs of an analytical laboratory. The services offered include GCMS, LCMS, GC, ICAP and Volatile analysis.

APPL, Inc. is certified by the State of California Department of Health Services Hazardous Waste Testing Laboratory, Department of Public Health Laboratories Services Sanitation and Radiation Laboratory-Approved Water Laboratory and the California Department of Food and Agriculture pesticide residue analysis.

The laboratory is broken down into 7 areas. Each of these areas are on their own separate positive air flow systems from one another. The areas are as follows: Sample Receiving, Organic Extraction, Inorganic Extraction, Organic Instrumentation, Inorganic Instrumentation, Volatile Organic Analysis and GC/MS.

Sample receiving is located for easy access from the entrance of the laboratory. This room has the capacity of storing large numbers of samples. The

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sample tracking is started at the time samples are received. Three full time employees are on hand to receive, store and dispose of samples. All employees are trained for the sample tracking system, MacIntosh Plus System, Omnis III software.

The organic extraction laboratory is next to the sample receiving. All organic extraction takes place in this laboratory. The equipment used include soxhlet extraction units, mechanical shakers, and various types of specific glassware suited to the matrix needs. Seven employees work in this section, four full time and three part time, with one full time supervisor.

The inorganic extraction laboratory houses all the equipment for inorganic analysis; hot plates, analytical balances, pH meters, ion chromatograph and specific glassware for inorganic needs. Five employees work in this section two full time, three part time and one full time inorganic section supervisor.

The volatile laboratory has gas chromatographs equipped with purge and trap units all with auto samples. All sample analyses performed in this section are

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performed by a laboratory automation system. Two full time employees work in this section.

The organic instrumentation laboratory has nine gas chromatographs equipped with 10 ECDs, 4 NPDs and 4 FIDs. This room also houses the LCMS which is run by two full time employees fully trained for LCMS analysis. Four full time employees also work in this section, three full time and one part time.

The inorganic instrumentation laboratory has an ICAP and atomic absorption spectrophotometer. These instruments are run by one full time section supervisor.

The GC/MS room houses 2 mass spectrometers, one dedicated to volatile analysis and one dedicated to semi-volatile analysis. They are operated by two full time employees.

The reception area, offices, file room and lounge take up the rest of the laboratory square footage.

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STAFF

Laboratory Directory - Authorizes final reports, monitors project status, coordinates sample logistics between laboratory and client, consults with client on analytical procedures, overall supervision of personnel. Director sees that the day to day operation of the laboratory is smooth and efficient.

Quality Control Director - Reviews all organic and inorganic analysis to insure compliance with QC guidelines, analytical data validation and reduction, monitors EPA performance programs, performs in-house audits. Also is assistant project manager for specific clients.

Health and Safety Officer - Institutes and monitors programs and training, tracks all hazardous/potentially hazardous samples and wastes, performs laboratory safety audits.

Sample Custodian - Supervises sample receiving personnel, monitors distribution and disposition of samples and Chain of Custody, maintains records for samples tracking and storage integrity, coordinates

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TRAINING

Training of new personnel is the responsibility of the supervisor or senior analyst in that section.

Summaries of on the job training and outside education and technical experience information are kept in the personnel files. These files are maintained by the manager.

Annual reviews are done on all employees. These reviews are done by the supervisors or the laboratory director which ever is more appropriate. Goals are set and discussed at the time of the review. The employee and reviewer sign the review form. Each year the old review is discussed to see if goals have been met or changed.

When an employee attends special training or education seminars a brief summary is written by the employee and filed in their personnel file.

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shipping of all samples.

Organic Supervisor - Oversees all operation of organic section; extraction procedures, instrumentation, and personnel. Trouble shooter for section and the Laboratory Automation System manager.

Inorganic Supervisor - Oversees all inorganic operations. ICAP and AA analyst. Coordinates sample flow and employee work load.

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EQUIPMENT AND CALIBRATION PROCEDURES

Major instrumentation used at APPL, Inc. include 2 Hewlett-Packard Gas Chromatograph/Mass spectrometers, one dedicated to volatile analysis and the second dedicated to semi-volatile analysis. The first GC/MS was installed in October 1985 and ran both volatile and semi-volatile analysis. A Tekmar auto sampler was added in December 1986. The second GC/MS was installed in April 1987.

Calibration is done daily in accordance with EPA approved methodology and instrument manufactures instructions prior to any analysis.

Initial calibration consists of injecting all TCL compounds at 5 concentrations. Concentration of standards used are listed in the CLP. Average response factors are generated using the internal standards specified in the CLP. Relative standard deviation in the response factors for all TCL compounds must be less than or equal to 30%.

Once the initial calibration criteria is met, a daily calibration check is performed every 12 hours or

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once per day. All TCL compounds are injected and the response factors are calculated. The response factors are compared to the %RSD of the initial check and must be within plus or minus 10%. The response of the internal standards and the surrogate compounds are plotted daily on Shewart Control Charts and must remain within 95% confidence levels.

The mass spectrometers are tuned every 12 hours or once per day. The tuning parameters have been specified by the EPA using 1-bromo-4-fluorobenzene (BFB) for volatiles and Decafluorotriphenylphosphine (DFTPP) for semi-volatiles. The criteria for tuning parameters is presented in Table 1.

The 2 GC/MS instruments have full maintenance and service agreements. In house maintenance and servicing records are kept in a bound lab book found next to each instrument. Spare parts are keep on hand in case of equipment failure. Downtime will be minimized by proper use and maintenance of the equipment.

Located in the organic instrumentation laboratory are 9 gas chromatographs equipped with 10 electron capture

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detectors, 4 nitrogen-phosphorus detectors and 4 flame ionization detectors. 8 GCs are Hewlett-Packard 5890A gas chromatographs and 1 is a Hewlett-Packard 5880 gas chromatograph. The 5880 GC was installed in February 1983. The 5890 GCs were installed from December 1984 through June 1989. Two 5890A GCs are dedicated to organochlorinated pesticide analysis, two are dedicated to organophosphorus pesticide analysis, one is dedicated to phenoxy herbicide analysis, one is dedicated to EDB/DBCP analysis, one is dedicated to 8015 analysis, one is used for total hydrocarbons analysis and phenol analysis, the 5880 GC is dedicated to special projects. All instruments have maintenance agreements. In house maintenance is logged in bound log books kept beside each of the instruments. These in house maintenance procedures are explained in detail in several APPL standard operating procedures.

Organochlorinated pesticide calibration is done using a stock calibration standard consisting of aldrin, dieldrin, DDT and a surrogate standard, Deca PCB. It is prepared at 3 concentration levels. To each calibration

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standard concentration a known amount of internal standard, Tetrachloro-m-xylene, is added. The response factors are calculated according to CLP and the present relative standard deviation must be less than or equal to 20% for aldrin, dieldrin, DDT and Deca-PCB. This calibration is done every 72 hours. If the %RSD is greater than 10% a fresh calibration standard is made and the calibration is repeated according to APPL standard operating procedures. Two standard mixes containing the TRCL pesticides are injected every 15 samples alternating between the 2 mixes.

Organophosphorus pesticides calibration is done using stock calibration standard consisting of trifluralin, methyl parathion, DEF and a surrogate standard, Terbutylazine. It is prepared at 3 concentration levels. To each calibration standard a known amount of internal standard, Barban, is added. The response factors are calculated and the percent relative standard deviation must be equal to or less than 25% for trifluralin, methyl parathion, DEF and terbutylazine. This calibration is done every 72

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hours. If the %RSD is greater than 25% a fresh calibration standard is made and the calibration is repeated according to APPL standard operating procedures.

Herbicide, total hydrocarbons, DBCP and EDB calibration is done using a minimum of 3 concentration levels. The calibration mix for herbicides consists of silvex, 2,4-D, 2,4,5-T and dacthal (surrogate). The calibration and standard mix for total hydrocarbons consists of gasoline, kerosene and diesel. The calibration and standard mixes for DBCP/EDB analysis consists of DBCP and EDB. The response factors are calculated and must be less than or equal to 25%.

Also located in the organic instrumentation laboratory is a Hewlett-Packard 5988A Thermospray LC/MS. Prior to the determination of each set of samples the mass spectrometer is tuned to optimize performance, sensitivity, and mass spectral resolution. Tuning involves the introduction of a chemical known as a tuning compound into the mass spectrometer. Various parameters are adjusted until the mass spectrometer's

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performance is optimized over the expected mass range of the samples.

Located in the Volatile organic analysis (VOA) laboratory are 3 Hewlett-Packard 5890 gas chromatographs. One GC is equipped with a Tekmar LSC 2 purge and trap and a Tekmar ALS 10 stage autosampler. The second GC is equipped with a Tekmar 4000 purge and trap and a Tekmar ALS 10 stage autosampler. The third GC is equipped with a Tekmar LSC 200 purge and trap and a Tekmar ALS 2016 16 stage autosampler. The first VOA instrument was installed in April 1984. The VOA instrument was installed in November 1986. The third VOA instrument was installed in July 1988. All VOA instruments have service agreements. In house maintenance is logged in bound log books located beside each of the 3 instruments. This maintenance log book is referenced in APPL standard operating procedures.

Initial calibration for external standard is done by preparing a minimum of 3 concentration levels for each parameter of interest by adding 20 μ L of one or more secondary dilution standards to 100 mL of reagent water. Each calibration standard is analyzed and area

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response versus the concentration is tabulated. The ratio of response to concentration (calibration factor) is a constant over the working range, less than or equal to 10% relative standard deviation.

The inorganic instrumentation includes a Thermo Jarrel Ash inductively coupled argon plasma simultaneous spectrophotometer (ICAP) and a Varian 1475 atomic absorption spectrophotometer (AA). The AA was installed in September 1983 and the ICAP was installed in December 1987.

The instruments are calibrated according to CLP standards are prepared by diluting stock solutions. They are prepared fresh each time an analysis is to be made. At least 3 concentrations are prepared in an appropriate range. After initial calibration a continuing calibration verification is analyzed at least 10% frequency or every 2 hours. The same continuing calibration standard is used throughout the analysis run. Control limits for initial and continuing calibration verification and listed in Table 2.

To verify linearity an ICAP standard at least 2

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times the detection limit is analyzed at the beginning and at the end of each sample analysis run.

A calibration blank is analyzed at each wavelength after every initial and continuing calibration verification, at a frequency of 10% or every 2 hours during a run.

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TEST METHODS

APPL is capable of analyzing a wide variety of matrices for various pesticides, herbicides and inorganic parameters. Several test methods are used. They are found in the following references:

"Test Methods for Evaluating Solid Waste" (SW-846), 2nd edition, Update I (1984), Update II (1985), 3rd edition (1986), USEPA

"Guidelined Established Test Procedures for Analysis of Pollutants Under the Clean Water Act" 40 CFR, Part 136, (1984).

"Methods for the Determination of Organic Compounds in Drinking Water" EPA/600/4-88/39 (1988), USEPA.

"Standard Methods for the Examination of Water and Wastewater", 16th edition, American Public Health Association, American Water Works Association, Water Pollution Control Federation, Washington D.C. (1985).

"Recommended Methods of Analysis for the Organic Compounds Requested for AB 1803", 5th edition (1986).

All procedures that take place at APPL are covered by the above mentioned references or by APPL standard operating procedures. Standard operating procedures (SOP) cover quality control, shipping & receiving, organic and inorganic training, methods, special projects and office management. All SOPs are written in

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three parts. Introduction - contains a brief summary of what the SOP is all about. Instructions - contains detailed instructions on how to do the specific task so that a qualified person could do that procedure by following the SOP. Salutation - describes persons qualified to perform the SOP procedures. All SOPs contain a minimum of 2 signatures. A copy of every SOP is kept on the main bookshelf in the laboratory and are available to any employee at any time. A copy of section specific SOPs are kept in that section and are maintained by the section head.

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PERFORMANCE & SYSTEM AUDITS

External audits include the two EPA sponsored programs; Water Supply Study (WS) from Cincinnati and the Water Pollution Laboratory Performance Evaluation Study (WP) from Cincinnati. The first one provides water samples for organochlorine and organophosphorus pesticides along with herbicides, carbamates, volatiles, and inorganic parameters. The analysis is performed using the EPA 500 series methods for drinking water. The second provides water samples for organochlorine pesticides, volatile halocarbons, volatile aromatics, herbicides and inorganic parameters. The analysis is performed using the EPA 600 series methods. Both programs are biannual.

It is the QC Directors responsibility to see that samples are handled on a timely basis. After the results have been turned in to the agencies and a report has been issued to APPL, Inc. it is the QC Directors responsibility to notify each analyst of his or her performance. If the results are not within the specified limits, the QC data run at that time is extensively reviewed.

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Internal performance evaluations audits include split samples, field duplicates and field blanks which are run on every 10th sample. The identities of these audits will be known after the analysis has been completed and reported. EPA QC checks are also used as internal performance audits and are run on a quarterly basis.

Internal audit checks are done once per month or at intervals adequate to assure the integrity of the project. These audits will show the date of the audit, who performed the audit, the project audited, type of analysis, findings and problems, corrective action taken and the anticipated date for re-inspection. A sample is chosen at random. This sample can be at any point of completion. The QC director will perform these internal audits. If the QC director is unavailable the project manager will perform the audits.

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STATISTICAL ASSESSMENT OF DATA QUALITY

Routine procedures taken from EPA methodology will be used to assess all data generated in terms of accuracy, precision and completeness.

Accuracy is the nearness of a result or the mean of a set of results to the true value. Accuracy is expressed in terms of percent recovery for a spiked sample. Percent recovery equals the concentration found divided by the true concentration times 100.

Shewhart Control Charts are initially plotted using at least 5 spike recoveries. The mean percent recovery (\bar{X}) and the standard deviation (s) is calculated. Upper and lower control limits (UCL, LCL) are established by adding and subtracting 3 times the standard deviation from the mean. Spike analysis are performed on 10% of samples received or at least once per batch of samples.

Precision refers to the agreement or reproducibility of a set of replicate matrix spike results. Precision is usually expressed as the

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relative percent difference.

$$\% \text{ difference} = \frac{2(A-B)}{(A+B)} \times 100$$

Since the least difference between a pair of duplicates can be zero, that value forms the baseline of the control chart. The control limit will be 3 times the standard deviation.

Completeness is the ratio of acceptable laboratory results to the total number of analysis performed.

$$C = \frac{(1 - \text{number of defective results})}{\text{total number of requested analysis}} \times 100$$

Completeness value will be at least 95%.

CORRECTIVE ACTION

Corrective action will be initiated when the following problems arise:

- 1) Any data point beyond the UCL or LCL on a control chart.
- 2) 7 successive points on the same side of the mean on a control chart.
- 3) Less than 50% of the data points fall within plus or minus one relative standard deviation of the mean.
- 4) Unacceptable results on performance evaluation audits
- 5) Unacceptable results on inter/intralaboratory comparison studies

The first step is to repeat the analysis on the spike/spike duplicate which failed, if this set of data doesn't fail then the analysis may be treated as a random error and disregarded. If the repeated analysis continues to show error a laboratory control spike/spike duplicate is analyzed. If this analysis is in control then the out of control matrix/matrix spike duplicate can be attributed to matrix interference. If the laboratory

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control spike/spike duplicate is out of control the

following measurements are to be taken:

- a) Stop analysis
- b) Check calculations
- c) Check instruments for proper performance through accuracy and precision
- d) Verify standards
- e) Assure the purity of reagent water
- f) Identify and resolve the problem
- g) Increase frequency of quality assurance checks to ensure analysis is back in control
- h) Document the problem and solution
- i) Discard all analysis since the last in-control data point.

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QUALITY ASSURANCE REPORT TO MANAGEMENT

Monthly reports will be submitted in writing to the Laboratory Director from the Quality Control Director. The monthly report will contain an assesment of the data accuracy, precision and completeness. Significant quality assurance problems and recommendations will be reported verbally as they arise.

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SOURCES AND PREPARATION OF STANDARDS

The reagents, standards and reference material required for the methods used at APPL are kept in specific locations for each section. All organic standards are located in a refrigerator that contain only standards. A standard refrigerator log is used to record when a standard is removed from the refrigerator for use and when it is replaced and who the user was. The section head is responsible for the standards, to make sure they do not go past an expiration date and to make sure that there is enough standard.

All VOA standards are stored in a VOA specific refrigerator located in the VOA room. A log is kept of which standards are on hand.

All GC/MS standards are stored in a refrigerator located in the mass spectrometer room. A log is kept of which standards are on hand and their use.

All inorganic standards and reagents are stored in the inorganic extraction room. Shelf life is recorded to show when reordering is necessary. The inorganic supervisor is responsible for the standards and

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reagents.

All standards that are received at the laboratory are recorded in a bound lab book located at the quality control director's desk. An SOP outlines the steps to take when recording a standard. The QC director distributes the standards to the appropriate section head.

Preparation of working standards is done by the section head. The procedure for preparing and documenting standards is covered in APPL SOPs.

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SAMPLE CUSTODY PROCEDURES

Upon arrival, all samples are inspected for damage. Any sample container found leaking, broken or damaged in any way is immediately reported to the sample custodian. Samples in containers not appropriately preserved or in containers other than those recommended by the EPA will be noted on receiving documentation. The client will be informed by the laboratory.

All samples, after inspection are issued a unique APPL, Inc. number. The numbers are numeric and are logged in the "Sample Receiving Book". The lab number is affixed to the sample container. A sample analysis sheet is then filled out for each set of samples. See Appendix 1. The information contained on the analysis sheet is entered into the laboratory tracking system, MacIntosh Plus System, Omnis III software. A daily printout is used in all sections to keep track of the sample load. Each section head is responsible to follow the sample tracking in their section. This information is also entered into the "Sample Analysis Required" log book. The information contained in this

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book is a simplified version of the analysis sheet in a bound volume. Client reference, analysis required, APPL number and analysis sheet number are then readily available during computer down time. A copy of each analysis sheet is distributed to all pertinent sections. Once the sample has been properly received it is cooled to 4°C.

Insuring the integrity of the chain-of-custody for a sample is of the utmost importance. The number of individuals handling the sample must be kept to a minimum. When samples arrive with a chain-of-custody form, see Appendix 2, the form is signed by the receiving officer, dated, time noted, copied and returned to the client. A copy of the chain-of-custody is filed in chronological order in a chain-of-custody file. A copy is also attached to the sample analysis sheet to be cross checked for reporting purposes.

When the sample is being analyzed, every piece of glassware is labeled with its unique laboratory number. The final vial containing the prepared sample is labeled with the same number and the instrument analyzing the

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sample is programmed with the laboratory number to insure proper reporting for each sample.

All samples are logged into and out of the refrigerators. The date, time and the persons initials are recorded in this log book located in the sample receiving area. The only exception to this procedure is that volatile samples are stored separately from all other samples. All refrigerators are on a temperature monitoring system which is checked daily.

All samples are kept up to a maximum of 60 days after the final reports are sent to the client. Samples will be returned to the client when ever possible. Samples that are not returned will be disposed of properly, to the correct waste disposal site as determined by the maximum contaminant levels found.

All procedures in sample receiving, handling and shipping are covered in APPL SOPs for that section. A sample flow chart is shown in Table 2.

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DATA VALIDATION

Validity of all data generated will be determined based on the precision and accuracy assessment. All data calculations will be checked and rechecked a second time by the analyst. All raw data will be clearly marked for proper identification. The validation consist of data generation, reduction and two levels of review. The data reduction and validation process is documented and initialed by the analyst. The following points are reviewed: Sample preparation, analysis information, QC samples are within the correct limits and documentation is complete. If the QC data doesn't meet the criteria the sample is re-analyzed. Professional judgement and experience to evaluate the validity of the reported results is used. Reports submitted will have sufficient back-up QC data available for review. Laboratory reports will be checked and signed by the analyst who performed the work and will also be signed by the laboratory director or the QC director.

A laboratory automation system is used to analyze volatile samples, organochlorinated pesticides, organophosphorus pesticides and herbicides. To make

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sure the LAS is working properly, calibration of the instruments as specified in the methods is done every 72 hours. The laboratory automation system manager runs checks to make sure the system is functioning properly.

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INTERNAL QUALITY CONTROL CHECKS & FREQUENCY

Minimum laboratory quality control checks will include: blanks, spikes, spike duplicates, standards, internal standards, QC Check samples, reagent checks, surrogate standards as specified by methodology and control charts.

Method blanks will consist of laboratory pure deionized water. For volatile analysis the deionized water will be boiled 15 minutes. The method blanks will be carried through the entire analytical scheme. The method volume will be approximately equal to the sample volume. Method blanks will be run every 10th sample or once with every batch of samples.

Matrix spikes and matrix spike duplicates will be run every 10th sample or once with every batch of samples. This data will be documented as precision on control charts. If spikes exceed control limits increased precision data is produced until analysis is back in control. If matrix spike and spike duplicates

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fail QC requirements a laboratory control spike/spike duplicate will be analyzed. This is to check the extraction procedure and the instrumentation.

Control charts are maintained daily on each instrument for standards used. Standards which do not fall within 2 standard deviations of the mean will not be used for analysis.

Internal standards are used during GC and GC/MS analysis whenever they are compatible with the analysis and methodology used.

Quality control samples from the EPA are analyzed quarterly. Along with EPA check samples APPL, Inc participates in two EPA sponsored programs; Water Supply Study, EMSL-Cincinnati and the Water Pollution Laboratory Performance Evaluation, EMSL-Cincinnati. Both the above programs are twice yearly.

All incoming reagents are logged into a bound lab book. Lot numbers are recorded along with a space to log date opened to insure the shelf life isn't exceeded. Reagents are tested periodically to insure against laboratory interference.

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Surrogate standards will be spiked into each blank, sample and matrix spike according to EPA methodology.

QC documentation following the Shewhart Control Chart format will be maintained for precision and accuracy.

TABLE 1

BFB KEY ABUNDANCE CRITERIA

<u>Mass</u>	<u>Abundance Criteria</u>
50	15 to 40% of mass 95
75	30 to 60% of mass 95
95	Base peak, 100% relative abundance
96	5 to 9% of mass 95
173	<2% of mass 174
174	>50% of mass 95
175	5 to 9% of mass 174
176	>95% but < 101% of mass 174
177	5 to 9% of mass 176

DFTPP KEY MASSES AND ABUNDANCE CRITERIA

<u>Mass</u>	<u>Abundance Criteria</u>
51	30 to 60% of mass 198
68	<2% of mass 69
70	<2% of mass 69
127	40 to 60% of mass 198
197	<1% of mass 198
198	Base peak, 100% relative abundance
199	5 to 9% of mass 198
275	10 to 30% of mass 198
365	>1% of mass 198
441	Present but less than mass 433
442	>40% of mass 198
443	17 to 43% of mass 442

TABLE 2

SAMPLE FLOW CHART

Sample Receiving

- Check and document physical condition of sample upon receipt
- Verify sample documentation
- Log into sample information system
- Distribute pertinent information to analytical sections

Sample Storage

- Sample is stored in accordance to standard EPA guidelines or specific client instructions
- Monitor all storage areas
- Maintain documentation for sample distribution/sample return

Analytical Sections

- Requested analysis are verified and performed with all work documented
- Unused sample is returned to sample receiving

Sample Archiving

- Sample is archived 60 days from finalized report date, then returned to client or arranged for disposal

TABLE 3

<u>Compound</u>	<u>Container</u>	<u>Preservative</u>	<u>Holding Time</u>
Volatile conc. waste samples	Widemouth glass with Teflon liner 8-oz.	None	14 days
Volatile water samples	2-40mL vials with Teflon lined septum caps	4 drops conc HCl Cool, 4°C	14 days
Volatile sludge, soil samples	Widemouth glass with Teflon liner 4-oz.	Cool, 4°C	14 days
Semivolatatile conc. waste samples	Widemouth glass with Teflon liner 8-oz.	None	14 days
Semivolatatile water samples	1 gal amber glass with Teflon liner	Cool, 4°C	Extracted within 7 days and analyzed within 40 days
Semivolatatile sludge, soil	Widemouth glass with Teflon liner 8-oz.	Cool, 4°C	14 days

Received By: _____

Appendix 1

SAMPLE ANALYSIS SHEET

R-

Client: _____

Sample Date: _____

Address: _____

Date Received: _____ Time: _____

City: _____ Zip: _____

Delivered By: _____

Attention: _____

DUE DATE: _____
(In RED Ink)

Phone#: _____

EXTRACT NO LATER: _____

Client Job, Project#,
or Location: _____

Time In/Color: _____

PO# (If available): _____

Chain of Custody: yes ___ no ___

Client ID

APPL ID

Analysis Requested

Samples remained chilled in shipping containers until received & placed in refrigerator/freezer: yes ___ no ___

Additional copies or comments: _____

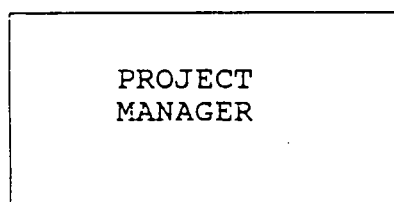
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Invoice#:

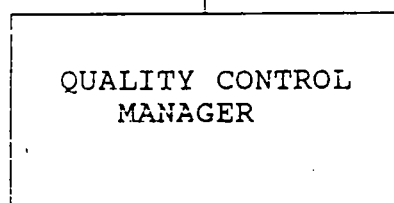
of Samples to whom:

APPENDIX 3

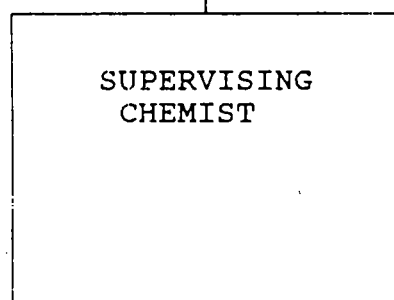
ORGANIZATION CHART



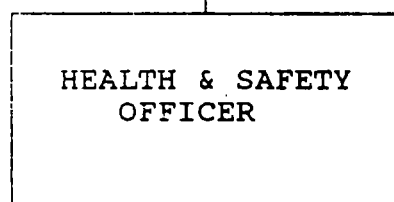
- 0) Authorizes final report after quality control supervisor approval
- 0) Monitors project status
- 0) Coordinates sample logistics between lab and client
- 0) Consults with client on analytical procedures
- 0) Check daily GC/MS calibration reports



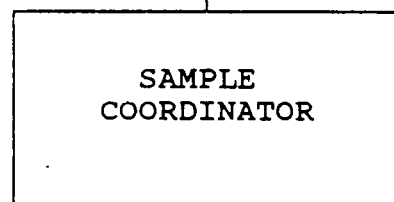
- 0) Reviews all organic analysis to insure compliance with quality control guidelines
- 0) Implements quality control check programs
- 0) Analytical data validation and reduction
- 0) Prepares and circulate in-house blind spikes
- 0) Updates certifications with various government agencies



- 0) Supervise sectional chemists and technicians
- 0) Initiate and monitor quality control programs
- 0) Insure sectional instrumentation maintenance programs
- 0) Generate instrument calibration reports
- 0) Monitor analysis of field and quality control samples, matrix spikes, and duplicates



- 0) Institutes and monitors safety programs and training
- 0) Tracks all hazardous/potentially hazardous samples and wastes
- 0) Performs laboratory safety audits



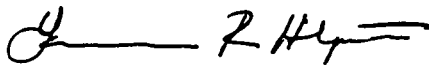
- 0) Supervises sample-receiving personnel
- 0) Monitor distribution and disposition of samples and chain-of-custodies
- 0) Maintaines records for sample tracking and storage integrity
- 0) Coordinates shipping of all samples

Coast-to-Coast Analytical Services, Inc.

QUALITY ASSURANCE MANUAL
and
QUALITY CONTROL PROGRAMS

REVISION DATE:

August 1990



Laurence R. Hilpert, Ph.D.
Vice President/QA Officer

906028

COAST-TO-COAST ANALYTICAL SERVICES

QUALITY ASSURANCE PROGRAM

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SECTION 1.0 - PROJECT DESCRIPTION

Coast-to-Coast Analytical Services, Inc. (CCAS) proposes to supply analytical support for projects dealing with environmental sampling and analysis of air, water, soil, wastewater, and petroleum products. Projects which CCAS is capable of supporting may include, but are not limited to the following general descriptions:

1. Buried Tank Investigations
2. California AB 2588 Air Studies
3. Wastewater Pilot Studies
4. Toxicity Bioassay Studies
5. Groundwater Monitoring
6. Hazardous Waste Investigations
7. Soil Gas Studies
8. BTU Value of Gas Determination
9. Compliance Monitoring
10. Expert Testimony

EPA-style or other project-specific data reporting formats can be developed in support of your individual work orders. However, it is our experience that these are generally not necessary.

SECTION 2.0 - PROJECT ORGANIZATION & RESPONSIBILITY

CCAS employs a Project Manager system to assure that all work performed by the laboratory is properly managed and otherwise attended to. Qualified Project Managers are selected from among the senior technical officers of the company according to the nature of the job itself. The Project Manager is responsible for the review of the initial work requests, the assignment of resources and the review of both the quality assurance data and the data used to generate the reports.

For example, when a typical request to provide analytical services is delivered to the laboratory, the Sample Control Officer selects a Project Manager. Large clients are often served by preselected Project Managers such as Dr. Mary Havlicek, Dr. Stephen Havlicek or Dr. Laurence Hilpert. A copy of the work order developed from the chain of custody document is sent to the Project Manager for his/her immediate review. Any changes noted as a result of this review are sent back to both the Sample Control Officer and the departments within which the analyses are to be performed. If

questions arise, the client is called. An acknowledgement that describes the work to be performed is returned to the client. The Project Manager is responsible for polling the Laboratory Information Management System (LIMS) in order to verify that the work is being executed in timely fashion. The Group Leaders and Department Heads are responsible for notifying the Project Managers regarding any difficulties which may be complicating the analyses themselves (i.e., a special matrix problem) or which might delay the delivery of the results. The analysts are responsible for performing the analysis, performing the necessary quality assurance work and maintaining the "paper trail" which serves to verify that all procedures were in control while a set of samples were being analyzed. The analyst is also required to inform his/her Group Leader if problems or delays are likely. Thus it can be seen that project performance is a team effort at CCAS. This system provides for quality review at the following four levels:

1. The Analyst - first level review
2. The Group Leader/Department Head - second level review
3. The Project Manager - third level review
4. Signature Review - fourth line review

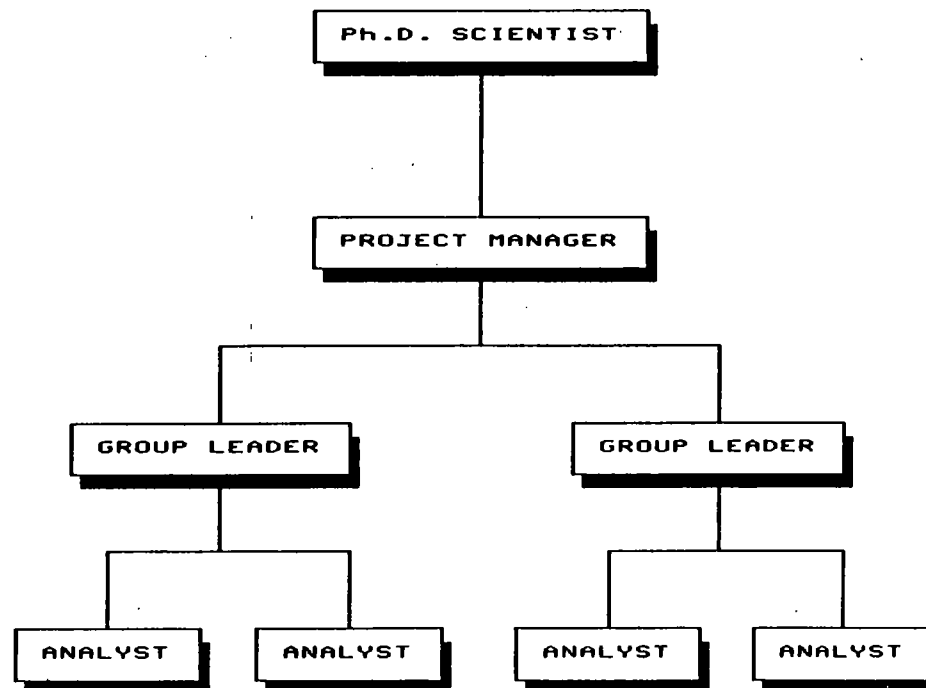
A diagram showing each of these levels, the typical CCAS project organization and the levels of responsibility within a typical project is provided as Exhibit 1.

SECTION 3.0 - QUALITY ASSURANCE OBJECTIVES

The first objective of the Quality Assurance Program at CCAS is to provide data of known quality. The second objective is to provide data of the highest quality permitted by the intended use to which the data will be put. The third objective is to improve the quality of all data leaving the laboratory, regardless of intended use. The methods and organizational structures designed to achieve these worthy objectives are discussed in the sections which follow.

Quality as used to describe the analytical services provided by CCAS means the production of results which are accurate, valid and precise. This is reflected in the commitment CCAS' technical resources to the Quality Assurance Program. For example, Dr. Laurence R. Hilpert who serves as the CCAS Quality Assurance Officer holds the rank of Vice President and is therefore fully authorized to direct Quality Assurance measures within all departments at all branches of the Company. Prior to joining CCAS three years ago, Dr. Hilpert was employed by the National Bureau of Standards, now known as the National Institute for Science and Technology (NIST), for 11 years where he was responsible for the certification of Standard Reference Materials for the Organic Analytical Research Division. Aspects of QA/QC programs utilized

EXHIBIT 1



at NBS are now being applied at CCAS. In many cases, these criteria exceed those specified by EPA.

While the level of Quality Assurance automatically supplied at Coast-to-Coast is more than sufficient for most intended uses, additional documentation or special report formats can be provided upon request. Charges for additional documentation range from nominal for such records as injection records, chromatograms and calibration curves to considerable for presentation of results in full EPA CLP-style format. Quality assurance data already supplied at no additional charge include:

1. Blanks
2. Duplicates
3. Spikes
4. Surrogate Recoveries (when appropriate)

SECTION 4.0 - SAMPLING PROCEDURES

CCAS employs certified sampling technicians and uses approved sampling methods and guidelines as described in SW-846, third edition, second revision (December 1988); in the Handbook for Analytical Quality Control in Water and Wastewater Laboratories; in Standard Methods for the Examination of Water and Wastewater, 17th edition; in the NIOSH manual and in such individual methods as are separately provided by EPA (i.e. the TO series of air methods).

CCAS is able to provide both direct sampling assistance and free over-the-phone sampling consultation whichever best meets the client's needs. Our field sampling crew includes six OSHA-certified personnel with considerable experience in the collection of samples of a diverse nature. Sampling equipment such as bailers, pumps, SUMMA electropolished stainless steel canisters, and even a meteorological station are available for rental to those clients who wish to conduct their own sampling.

In cases in which one is needed, CCAS is able to develop a representative sampling plan which might include such provisions as:

1. The selection of appropriate sampling locations
2. The use of field screening protocols
3. The measurement of important supporting data
4. A statistically sound estimation of the number of samples required.
5. A listing of acceptable conditions for sampling

6. The selection of matrices/media to be sampled
7. The selection of appropriate sample containers
8. The selection of safe, effective preservatives
9. The determination of the appropriate sampling frequency and/or duration
10. Chain of custody documentation
11. Composite vs grab sampling
12. The selection of which parameters are to be measured & where
13. The use of field filtration

CCAS has been able to develop special sampling and analytical protocols for parameters not yet described in an official publication. This capability is becoming more significant in the light of recent legislation such as Proposition 65 and AB 2588 regulating parameters for which no methods presently exist.

SECTION 5.0 - SAMPLE CUSTODY

Sample Control is the department which documents the receipt of incoming samples and initiates all paperwork regarding samples. CCAS is presently operating a computerized LIMS system in parallel with a manual logbook system. The present schedule anticipates complete computerization by April 1990.

Upon arrival to the lab the priority of the sample is determined for order of processing. Samples with short holding times take first priority. Next in line are samples with longer holding times, but which were brought in to the lab late and are quickly approaching that holding time. Then the RUSH samples are processed, then any other sample received.

Samples awaiting processing are held in a refrigerator used only for that purpose. The refrigerator is kept locked at all times to maintain security and to keep the samples from being mistaken for samples already processed. An exception to this is when the samples are received in sealed coolers in which case they are not unsealed until they are processed. Samples with short holding times do not usually come to the lab this way and those that do are from certain clients, so CCAS asks to be advised in advance to open these and process them first.

Documentation received with the sample is then reviewed for accuracy and completeness of information regarding the client, the sampler, the description of the samples, the date sampled, and any special request, such as turnaround time, detection limits required, etc. If the samples come to the lab with a chain of custody, as is recommended, the chain of custody document is signed by the Sample Control Officer after it is determined that all samples listed on that chain of custody have arrived. Notes regarding the condition of the samples, such as seals being intact, or bottles not received, or bottles received broken, are made by the Sample Control Officer on the chain-of-custody document. Inconsistencies require an immediate call to the client.

The samples are then organized to determine what, and how many containers of each sample are received. The samples are then logged into the LIMS system and/or the sample logbook. Each sample is given a unique log number, with a description (for example, some analyses require three bottles for one sample, which would be numbered nnnn-1, nnnn-2, nnnn-3). Information entered into the LIMS logbook includes the date and time received by the lab, the client's name, the sampler's name, the description of the sample, the date and time sampled, the sample destination, each analysis requested, the initials of the person logging in the sample, each type of container the sample is in, and any additional notes regarding that sample, such as a turnaround time. "RUSH" samples are highlighted and/or specially designated so as to be conspicuous.

Once the sample is logged in, the sample containers are clearly marked with the correlating sample number. The sample log numbers are also recorded on the chain of custody for future reference. In the near future, bar coding will be brought on line as a part of the LIMS system.

A billing sheet is generated by the Sample Control Officer which is used for several purposes. The accounting department uses it for invoicing, the project manager receives a copy for tracking purposes and the client immediately receives a copy which serves as confirmation that his request has been properly understood. Later the office personnel mark off the results which have been completed and reported. Any paperwork regarding the samples is attached to the billing sheet, including the original chain of custody, any Work Notification Notices, any Task Request Forms, any completed original worksheets, all the computer-generated results, and a copy of the invoice.

Worksheets are then prepared by Sample Control to notify various groups within the lab of the required analyses. The worksheet includes information such as the client's name, the sampler's name, the sample number, the date and time collected, the date and time received, the turnaround time required, and the sample location. If a sample is a RUSH, the turnaround time is highlighted to make sure it is noticed by lab personnel. The analysis requested, the holding time for that analysis, the EPA Method number, and the

detection limit are also listed as the work is completed, both on the work order and by direct entry into the LIMS system. The analyst initials the work order, dates it, and records the results obtained by entering the information into the LIMS system.

Following log-in, but prior to analysis, a proper location for the storage of the sample is then determined by the Sample Control Officer. Similar sample types are stored in the same locked refrigerators. When the samples are placed in the refrigerator, the sample numbers are logged into the refrigerator log book. This logbook includes information regarding the subsample number, the location, the container type, the analysis needed, the initials of the person logging them in, and the date logged in. Once the sample is stored, the worksheets are distributed to the proper departments, and key personnel are notified of any unusual or important information such as rushes, unusual matrices, unusual analyses, samples approaching their holding times, or especially hazardous samples. When an analyst needs a sample, he/she refers to the log book and enters the date the sample is checked out and his/her initials. Upon returning the sample to the refrigerator, he/she records the date returned. Again, this function will be computerized and incorporated into the LIMS system.

Samples known to be extremely hazardous are identified by placing fluorescent red "dots" on the sample container, on the worksheets, on the billing sheet, on the chain of custody, and in the log book. All received samples are thoroughly scanned by a radiation meter to detect possible levels of radioactivity.

The proper sampling containers, with preservatives where appropriate, are provided to the client free of charge. This is to promote the use of the proper containers and preservatives which provide more accurate results.

The sample containers and preservatives which are provided include:

- Bacteria - Disposable sterilized bag with a tablet of Sodium Thiosulfate or reusable sterilized plastic jar with some Sodium Thiosulfate.
- Wet Lab work - A plastic bottle without preservative.
- COD, NH₃,TKN - An 8 oz. plastic bottle with Sulfuric Acid (2ml).
- Oil & Grease - A 1-L amber glass bottle with Sulfuric Acid (5 ml).
- Phenols - An amber liter glass bottle with Phosphoric Acid.
- MBAS - 8 oz. plastic bottle with KH₂PO₄ solution.

- Silver (High level) - A 4 oz. glass amber bottle with Sodium Hydroxide and Sodium Thiosulfate.
- Any Metals - A 500 ml amber bottle with Nitric Acid (5 ml).
- A 4 oz plastic bottle with Nitric Acid (2 ml).
- Chlorinated Water for VOA - Two glass vials with septum seal & sodium thiosulfate.
- Volatile Organics - Two glass vials with septum seal.
- inc. 602s for non-sterile samples - Two glass vials with septum seal and sodium sulfate (ASTM - recommended, cleared with DOHS for use by CCAS; safer than HCl suggested by EPA).
- plus - Two plastic "guard bottles" with charcoal inside which the glass vials are placed inside to prevent cross-contamination.
- TOC - A 40 ml glass vial with a septum seal and no preservative.
- TOX - A 250 ml amber glass bottle with a septum seal and no preservative.
- Extractables - A 1-L liter amber glass bottle with Teflon-lined cap.
- Variety Soils - A glass "widemouth" jar with Teflon-lined lid; or a 40 ml glass vial with Teflon-lined septum sealed cap; or a Shelby tube of brass ring-capped with snug plastic caps which have been underwrapped with Teflon tape.
- Cyanide - A 1-L plastic bottle with Sodium Hydroxide (5 ml 50%).
- Sulfides - A 1-L plastic bottle with Zinc Acetate (5 ml 10%).

Once the sample is two months past the holding time, it is disposed of, returned to the client, or stored indefinitely. This practice allows the client ample time to review the data and request further analyses, if desired.

See Exhibit 2 for holding times, preservatives and recommended container types.

TABLE 2-16. REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES

Name	Container ¹	Preservation	Maximum holding time
Bacterial Tests:			
Coliform, fecal and total	P, G	Cool, 4°C, 0.008% Na ₂ S ₂ O ₃	6 hours
Fecal streptococci	P, G	Cool, 4°C, 0.008% Na ₂ S ₂ O ₃	6 hours
Inorganic Tests:			
Acidity	P, G	Cool, 4°C	14 days
Alkalinity	P, G	Cool, 4°C	14 days
Ammonia	P, G	Cool, 4°C, H ₂ SO ₄ to pH2	28 days
Biochemical oxygen demand	P, G	Cool, 4°C	48 hours
Bromide	P, G	None required	28 days
Biochemical oxygen demand, carbonaceous	P, G	Cool, 4°C	48 hours
Chemical oxygen demand	P, G	Cool, 4°C, H ₂ SO ₄ to pH2	28 days
Chloride	P, G	None required	28 days
Chlorine, total residual	P, G	None required	Analyze immediately
Color	P, G	Cool, 4°C	48 hours
Cyanide, total and amenable to chlorination	P, G	Cool, 4°C, NaOH to pH12, 0.6g ascorbic acid	14 days
Fluoride	P	None required	28 days
Hardness	P, G	HNO ₃ to pH2, H ₂ SO ₄ to pH2	6 months
Hydrogen ion (pH)	P, G	None required	Analyze immediately
Kjeldahl and organic nitrogen	P, G	Cool, 4°C, H ₂ SO ₄ to pH2	28 days
Metals:			
Chromium VI	P, G	Cool, 4°C	24 hours
Mercury	P, G	HNO ₃ to pH2	28 days
Metals, except chromium VI and mercury	P, G	HNO ₃ to pH2	6 months
Nitrate	P, G	Cool, 4°C	48 hours
Nitrate-nitrite	P, G	Cool, 4°C, H ₂ SO ₄ to pH2	28 days
Nitrite	P, G	Cool, 4°C	48 hours
Oil and grease	G	Cool, 4°C, H ₂ SO ₄ to pH2	28 days
Organic carbon	P, G	Cool, 4°C, HCl or H ₂ SO ₄ to pH2	28 days
Orthophosphate	P, G	Filter immediately, cool, 4°C	48 hours
Oxygen, Dissolved Probe Winkler	G Bottle and top do	None required	Analyze immediately
Phenols	G only	Fix on site and store in dark	8 hours
Phosphorus (elemental)	G	Cool, 4°C, H ₂ SO ₄ to pH2	28 days
Phosphorus, total	G	Cool, 4°C	48 hours
Residue, total	P, G	Cool, 4°C, H ₂ SO ₄ to pH2	28 days
Residue, Filterable	P, G	Cool, 4°C	7 days
Residue, Nonfilterable (TSS)	P, G	Cool, 4°C	7 days
Residue, Settleable	P, G	Cool, 4°C	7 days
Residue, volatile	P, G	Cool, 4°C	48 hours
Silica	P	Cool, 4°C	7 days
Specific conductance	P, G	Cool, 4°C	28 days

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Includes Revision 1
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TABLE 2-16. REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES (CONTINUED)

Name	Container ¹	Preservation	Maximum holding time
Sulfate	P, G	Cool, 4°C	28 days
Sulfide	P, G	Cool, 4°C, add zinc acetate plus sodium hydroxide to pH 9	7 days
Sulfite	P, G	None required	Analyze immediately
Surfactants	P, G	Cool, 4°C	48 hours
Temperature	P, G	None required	Analyze
Turbidity	P, G	Cool, 4°C	48 hours
<u>Organic Tests:</u>			
Purgeable Halocarbons	G, Teflon-lined septum	Cool, 4°C, 0.008% Na ₂ S ₂ O ₃	14 days
Purgeable aromatic hydrocarbons	G, Teflon-lined septum	Cool, 4°C, 0.008% Na ₂ S ₂ O ₃ , HCl to pH 2	14 days
Acrolein and acrylonitrile	G, Teflon-lined septum	Cool, 4°C, 0.008% Na ₂ S ₂ O ₃ , Adjust pH to 4-5	14 days
Phenols	G, Teflon-lined cap	Cool, 4°C, 0.008% Na ₂ S ₂ O ₃	7 days until extraction, 40 days after extraction
Benzidines	G, Teflon-lined cap	Cool, 4°C, 0.008% Na ₂ S ₂ O ₃	7 days until extraction
Phthalate esters	G, Teflon-lined cap	Cool, 4°C	7 days until extraction, 40 days after extraction
Nitrosamines	G, Teflon-lined cap	Cool, 4°C, store in dark, 0.008% Na ₂ S ₂ O ₃	40 days after extraction
PCBs, acrylonitrile	G, Teflon-lined cap	Cool, 4°C	40 days after extraction
Nitroaromatics and isophorone	G, Teflon-lined cap	Cool, 4°C, 0.008% Na ₂ S ₂ O ₃ store in dark	40 days after extraction
Polynuclear aromatic hydrocarbons	G, Teflon-lined cap	Cool, 4°C, 0.008% Na ₂ S ₂ O ₃ store in dark	40 days after extraction
Haloethers	G, Teflon-lined cap	Cool, 4°C, 0.008% Na ₂ S ₂ O ₃	40 days after extraction
Chlorinated hydrocarbons	G, Teflon-lined cap	Cool, 4°C	40 days after extraction
TCDD	G, Teflon-lined cap	Cool, 4°C, 0.008% Na ₂ S ₂ O ₃	40 days after extraction
Total organic halogens	G, Teflon-lined cap	Cool, 4°C; H ₂ SO ₄ to pH < 2	7 days
<u>Pesticides Tests:</u>			
Pesticides	G, Teflon-lined cap	Cool, 4°C, pH 5-9	40 days after extraction
<u>Radiological Tests:</u>			
Alpha, beta and radium	P, G	HNO ₃ to pH 2	6 months

¹Polyethylene (P) or Glass (G)

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Date September 1986
From SW-846
Includes Revision 1
December 1987

SECTION 6.0 - CALIBRATION PROCEDURES & FREQUENCY

The calibration of laboratory instruments is performed at the specified frequency and within acceptance limits published by EPA (i.e. the response factors and relative percent deviations for EPA methods 8240 & 8270). In cases in which specific guidelines are not available, CCAS applies either the manufacturer's recommended guidelines or in-house guidelines. Where calibration frequencies are not specified by the method itself, verification is generally established at least once daily following the initial development of a multipoint calibration curve.

Where available, calibrations are carried out using certified reference materials. Although these can be very expensive as is the case for certified National Bureau of Standards traceable specialty gas standards, the additional accuracy and credibility are well worth the cost. More importantly, CCAS analysts are trained to detect calibration problems at the bench and realize that these must be corrected before carrying on with any additional analyses. Guidelines have been developed and affixed to such equipment as GC/MS systems specifically to assist the analysts in detecting problems in cases in which data are typically processed by persons other than those operating the equipment.

A selection of representative calibration curves and reports is provided as Appendix A.

SECTION 7.0 - ANALYTICAL PROCEDURES

CCAS employs analytical methods described in the following references:

1. SW-846, third edition, second revision, December 1987
2. Standard Methods for the Examination of Water and Wastewater, 17th edition, 1989
3. Methods for the Chemical Analysis of Water and Wastes, EPA-600/4-79/020, 1983
4. Annual Book of ASTM Standards
5. EPA Compendium Series Methods for the Analysis of Air, 1988
6. AOAC Official Methods of Analysis, 15th edition, 1990
7. NIOSH Manual of Analytical Methods, third edition, 1987
8. Code of Federal Regulations 40, Revised 1985

If special protocols such as may be required by regulation in the absence of well-established methods (i.e. Proposition 65 and AB 2588) are desired, CCAS is uniquely well-qualified to develop them.

For example, CCAS is presently under contract to the State Air Resources Board to develop methods needed to quantitatively determine ethylene oxide at global background levels. As is typical in such cases, CCAS begins, if possible, with the modification of an existing EPA method. This step ensures a more acceptable reception when the documentation of the method is presented to the regulators. As a member of EPA's Technical Assistance Team and EPA's Air Toxics Workgroup, CCAS has added credibility even when there are no related EPA protocols to modify.

Dr. Hilpert, CCAS' Quality Assurance Officer, is responsible for maintaining the company's Manual of Standard Operating Procedures (SOP). This manual is a collection of published analytical protocols, plus comments, cautions and equipment-specific instructions. Trainees are required to read and understand specific SOPs before being internally certified to perform a given analysis. Analysts are regularly given updates of those SOPs relating to the analyses they are certified to perform. Department heads maintain copies of all SOPs applying to their departments while the Laboratory Directors and higher ranking officers have complete copies of all SOPs. The SOP system ensures that all analyses are performed to the same high standards throughout the Company. More importantly, no analyst is allowed to deviate from the approved SOP without the prior approval of the Quality Assurance Officer. Failure to follow a SOP can be cause for dismissal.

Procedures applied are always identified by reference to an EPA method or by reference to some other specific source on all CCAS analytical reports. Senior CCAS technical staff are always available to assist clients by discussing the merits of all methods performed by the laboratory. By guiding the client in the selection of an appropriate method, CCAS believes that we will be able to provide a more complete and valuable service.

SECTION 8.0 - DATA REDUCTION, VALIDATION & REPORTING

The lines of responsibility for data reduction, validation, and reporting are clearly delineated - everyone is responsible for generating valid data. An elaborate system of internal recordkeeping has been designed which allows the Quality Assurance Officer (Dr. Hilpert) to determine when the sample came in, how it came in, who collected it, who received it, who prepared the work order, where and how the sample was stored, who had each sample, when he had it, how much he used and what he did with it. Sample preparation records are kept which show both the date of preparation and the person who prepared it. Volumes of reagents added, concentration factors and comments are written in the preparation logbooks. Sample analysis logbooks are kept for each instrument which show the date analyzed and who ran the equipment. If data are transcribed or calculations are made, the time of transcription or calculation and the analyst's initials are written on a hard copy of the calculation or transcription which is maintained as a permanent record. Standard preparation records are

similarly documented in special departmental logbooks created for this purpose.

Thus, it is clear that everyone is responsible for quality at CCAS. Their various roles have already been explained in Section 2. Documentation of this responsibility is what makes the QA/QC system particularly effective. In addition to the workstation and instrument logbook documentation, those providing second and third level data review (group leaders/department heads and Project Managers) must sign and date their work. Similarly, data reduction staff such as the GC/MS data processing group led by Dr. Rafael Espinosa (formerly of the National Bureau of Standards) must initial their work in order to maintain accountability. Even the word processing technician who prepares the report must put his initials on the final report! Ultimately the senior scientist signing the report has final responsibility. The documentation of these responsibilities is also being incorporated into the LIMS system which will collect the records all in one place, thereby facilitating retrieval.

Data collected from several different departments are separately evaluated first by the analyst, second by the department head, then collectively by the Project Manager, and finally by the signer of the reports. The collective review may include a check of the ion balance, examination for compatible constituents and whether or not the results make sense. The latter part of the evaluation process, which might be described as certification, includes the review of the quality assurance data. Among the questions considered are:

1. Is the full method blank acceptable?
2. Is the duplicate sufficiently precise?
3. Is the calibration validated?
4. Is an acceptable spike recovery obtained?
5. Do the number of significant figures reflect the precision of the method?
6. Is the method of analysis correctly stated?
7. Is the method of sample preparation correctly stated?
8. Are correct holding times observed?
9. Are the units correct?
10. Are the practical quantitation limits correct?
11. Is an acceptable value obtained for the Certified Reference Material?
12. Are surrogate recoveries acceptable?

Only after all questions have been satisfactorily answered are the data considered to be validated. At that point, the report is signed and transmitted to the client. For those elements of the evaluation involving the LIMS system, password protection further prevents the release of improperly reviewed data.

Written acceptance criteria for blanks, the CCAS spikes, duplicates, and reference samples make it easier for our analysts to identify and correct suspect data. Multiple person review increases the opportunity to eliminate data of suspect quality. Ph.D./Senior Scientist review applies experience regarding sensitivity to detect suspect data.

SECTION 9.0 - INTERNAL QUALITY CONTROL CHECKS

Internal quality control checks include, but are not limited to those items which are discussed separately in the paragraphs which follow. It should be further noted that these are documented as part of the Company's record keeping practices and are therefore available for use in validating the quality of all results generated by CCAS laboratory facilities. Furthermore, many of these quality control checks incorporate numerical acceptance criteria which require corrective action if exceeded.

9.1 Instrument Performance Criteria - Where available, published instrument performance criteria such as those developed by EPA for use in connection with the methods for volatile and semivolatile organics analysis are employed to verify that instruments are performing according to specifications. These method-specific criteria are provided as Exhibits 3 and 4 respectively. In-house criteria, serving the same purpose have been developed for other instrumentation and are generally based on the manufacturer's specifications.

9.2 Reasonableness - This highly significant criteria is often overlooked by regulatory documents - presumably because it is subjective rather than quantitative in nature. Furthermore, since the assessment of reasonableness requires experience, not all laboratories are equally qualified to provide this form of internal quality assurance. Reasonableness considers such things as the relationship to other samples from a given site, comparison of the current data with historical data, a knowledge of environmental degradation processes, a knowledge of the composition of commercial products such as fuels, solvents and pesticides which may be released to the environment. The key ingredient in CCAS' ability to provide this element of internal quality control is experience. For this reason, all CCAS-released reports are reviewed by an experienced Ph.D. scientist before signing. The experience-based criterion applied may best be summed up as follows: "If it doesn't make sense, it is probably WRONG!"

TABLE 3. BFB KEY ION ABUNDANCE CRITERIA

Mass	Ion Abundance Criteria
50	15 to 40% of mass 95
75	30 to 60% of mass 95
95	base peak, 100% relative abundance
96	5 to 9% of mass 95
173	less than 2% of mass 174
174	greater than 50% of mass 95
175	5 to 9% of mass 174
176	greater than 95% but less than 101% of mass 174
177	5 to 9% of mass 176

Exhibit 4

TABLE 3. DFTPP KEY IONS AND ION ABUNDANCE CRITERIA^a

Mass	Ion Abundance Criteria
51	30-60% of mass 198
68	<2% of mass 69
70	<2% of mass 69
127	40-60% of mass 198
197	<1% of mass 198
198	Base peak, 100% relative abundance
199	5-9% of mass 198
275	10-30% of mass 198
365	>1% of mass 198
441	Present but less than mass 443
442	>40% of mass 198
443	17-23% of mass 442

^aJ.W. Eichelberger, L.E. Harris, and W.L. Budde. "Reference Compound to Calibrate Ion Abundance Measurement in Gas Chromatography-Mass Spectrometry", *Analytical Chemistry*, 47, 995 (1975).

9.3 Control Charts - Method-specific matrix-specific quality control charts have been developed by each of our laboratories for each of the parameters they determine. These are updated on a monthly basis and released to the analysts, group leaders, department heads, project managers, technical officers of the company and to the Quality Assurance Officer. These graphical representations allow analysts at the bench to immediately determine if an analysis is out of control so that corrective action will not be delayed. At higher levels of review, they serve to validate the data as it is being reviewed. A large number of example control charts may be found in Appendix B.

9.4 Surrogate Spikes - Wherever possible, compounds closely related to the analytes but not having commercial use are added to every sample prior to sample preparation. The recovery of these materials demonstrate that losses have not occurred during sample preparation and that analytes of a similar nature could have been recovered from that sample. Acceptance criteria are posted on each instrument thereby promoting early problem detection.

9.5 Replicate Samples - Results from replicate sample analyses are a measure of precision. One sample in ten is split for duplicate analysis in order to verify that acceptable precision is achieved. If more than one sample matrix is involved, the above criteria apply to each sample matrix. If acceptable precision is not verified, further analyses are halted until a cause has been identified and corrective action taken. If samples are expected to be clean, duplicate water spikes are performed in order to evaluate precision.

9.6 Spiked Samples - Results from spiked sample analyses are a measure of accuracy. One sample in ten is spiked with several of the Priority Pollutants in the compound class or classes under investigation. If more than one sample matrix is involved, the above criteria apply to each sample matrix. Spike recoveries are calculated by the method detailed in ASTM Method D 3856, Section 11.5.4, Annual Book of ASTM Standards, Volume 11.01, Water, (1986). CCAS usually selects the same sample used for the replicate analysis. In this way, CCAS can base the percent recovery upon the amount added and the mean of the duplicate determinations and thereby minimize the effect of precision upon the determination of accuracy. Again, if acceptable recoveries are not obtained, further analyses are halted until a cause has been identified and corrective action taken.

9.7 Certified Reference Standards - CCAS analyzes US EPA and NBS certified reference materials along with the samples in order to certify the accuracy of results. In order to establish CA state certification for drinking water analysis, CCAS analyzed performance evaluation samples from the California Department of Health Services. CCAS achieved a perfect score for all of the parameters included in the test. Such standards are sometimes also submitted to us by our clients. Since the expected results for standards of this type generated in-house are known, problems may

be detected and corrected at a very early stage. Results not within the acceptance range are investigated, and corrective action taken to insure that results are within the acceptable range prior to the analysis of further samples.

9.8 Internal Standards - Known amounts of internal standards are added to every sample or sample extract for organics analysis. This technique permits CCAS to compensate for minor changes in instrument performance by relating analyte concentrations to the response of the internal standards. Values for the internal standard response outside the acceptance range established for each instrument constitute grounds for rejecting the data. Since these ranges are posted right on the instrument, immediate problem detection is possible. The analyst is then required to determine the cause of the problem and correct it before reanalyzing the samples.

9.9 Daily Standard and Blank Runs - Each day's runs are preceded by instrument tuning, initialization of analytical parameters, standard runs containing all of the analytes to be determined plus the internal standards, surrogates, and blank runs. Hard copies and computerized records of all such runs are maintained. The blank run is compared with acceptance criteria established for the laboratory. If an acceptable blank is not obtained, the problem must be corrected before samples are processed.

9.10 Verification of Results with an Alternative Method - The range of capabilities available at CCAS often makes it possible to determine a given parameter by one or more alternate methods. For example, calcium may be determined by atomic absorption, EDTA titration, ion chromatography, or inductively-coupled-plasma spectroscopy. Fuel-related materials may be determined by gas chromatography using either flame ionization detection or selective ion mass spectrometry. Purgeable organics in soil may be extracted by headspace or purge-and-trap techniques. Polychlorinated biphenyls may be determined by gas chromatography followed by electron capture detection or by selective ion mass spectrometric detection. When results are in question or are known to be the subject of legal action, they are verified with another method.

9.11 Logbooks - Logbooks documenting the preparation of standard and surrogate solutions are maintained. Information regarding the source of the standard, lot number, weight or volume of standard used, date prepared and name of preparer are included. Solvents used to prepare standard and surrogate solutions are checked for purity prior to use. Logbooks documenting the use of each analytical instrument are maintained; a description of every sample (including standards, duplicates, spikes and blanks) is recorded in the log book as the samples are analyzed. Likewise, logbooks documenting periodic maintenance and repairs to each instrument are maintained.

SECTION 10.0 PERFORMANCE & SYSTEM AUDITS

The Quality Assurance Officer and/or other corporate executives conduct both performance and systems audits of the laboratory in order to ensure that data of a defensible quality are produced at all times. As part of its laboratory certification program, the State of California also conducts both performance and systems audits. In addition, an independent accreditation service, the American Association for Laboratory Accreditation visited CCAS in the Fall of 1989 and conducted a comprehensive systems audit prior to issuing accreditation.

Performance audits are quantitative in nature and are designed to evaluate specific analytical measurement systems. They may be open or blind and may originate with the laboratory, with the client or with a regulatory agency. Samples of a known composition are obtained from EPA, the National Institute of Science and Technology (NIST, formerly the National Bureau of Standards), or from a commercial source such as ERA. These are analyzed along with our regular sample workload. Results are compared with acceptance limits and communicated to the analysts following the completion of the work. Correct results are acknowledged publicly within the laboratory to promote a general appreciation for quality while incorrect results are addressed by a formal notice with a request for corrective action. An example report generated by a "blind" performance audit is provided as Exhibit 5.

Systems audits are qualitative reviews of the laboratory quality control measurement system designed to verify that these systems are being used appropriately. A partial systems audit might be as simple as a short question and answer session with a group or department. These might reveal procedural misunderstandings which could be corrected on the spot and/or by rewriting the Standard Operating Procedure (SOP) with improved clarity.

Systems audits may be carried out at any stage of an analytical program. For example, CCAS certifies analysts for proficiency in the procedures which they are to perform before allowing them to perform them. This activity represents a kind of one-on-one systems audit. Analyst certifications are reviewed annually, as individual procedures are revised, or as new procedures are added. These are all examples of systems audits.

Items addressed in a typical systems audit include a comparison between actual laboratory practice and the protocol as written in the standard operating procedure. While most such audits serve only to verify that laboratory procedures are in control, they are the best way to discover evolutionary variations from the SOP that need to be incorporated formally into the SOP or eliminated. These reviews also provide analysts with an opportunity to communicate problems associated with the existing SOPs.

Exhibit 5
 Example Report
 Blind Performance Audit

AIR, WATER and HAZARDOUS WASTE LABORATORY CERTIFIED by CALIFORNIA DEPT of HEALTH SERVICES

Central
Coast
Analytical
Services

Central Coast
Analytical Services
141 Suburban Road , Suite C-4
San Luis Obispo, California 93401
(805) 543-2553
EPA METHOD 508/608/8080 - PESTICIDES AND PCB'S

Lab Number: F-11135dup
 Collected: 08/24/89
 Received: 08/24/89
 Tested: 09/07/89
 Collected by: Unknown

General Auto Supply

SAMPLE DESCRIPTION:
 ERA Check Sample, Lot #522,
 Water, Submitted Blind as
 General Auto Supply

Duplicate Analysis

Compound Analyzed	Detection Limit (PQL*) (ug/L)	Conc. (ug/L)	True Value (ug/L)	Acceptance Range (ug/L)	Percent Recovery
Heptachlor	0.01	0.13	0.17	0.061-0.18	76.
Aldrin	0.01	0.17	0.24	0.10-0.29	71.
p.p'DDE	0.01	0.22	0.23	0.071-0.32	96.
p.p'DDT	0.01	0.47	0.47	0.17-0.68	100.

* Practical Quantitation Limit

Compounds listed as "not found" would have been reported if present at or above the listed detection limits. Sample was extracted 08/28/89 by EPA Method 3510.

ECD#1
 09/18/89
 F11135du.wr1/74
 MH/ss/ss/ss

Respectfully submitted,

Mary Havlicek
 Mary Havlicek, Ph.D.
 President

SECTION 11.0 - PREVENTATIVE MAINTENANCE

Coast-to-Coast Analytical Services, Inc. has opted to purchase service contracts on selected major instrumentation to ensure the availability of regularly-scheduled and periodic maintenance. Since even the typical 72-hour guaranteed response time is not sufficient for the modern laboratory, CCAS has begun to rely to a greater extent on expanded in-house supplies of spare parts, on improved in-house repair capabilities and on the availability of backup instrument instrumentation from the same manufacturer. For example, when one of the GC/MS systems develops a problem, CCAS is generally able to quickly isolate the problem by swapping boards with one of the operating instruments. The malfunctioning part is then ordered by overnight delivery service, thus often suffering only one day of downtime.

In-house preventative maintenance such as filter changes, pump-oil replacement, cleaning of optics, etc. is documented in instrument-specific maintenance logbooks kept with each instrument. Scheduled preventative maintenance is similarly recorded as are in-house and commercial repairs.

SECTION 12.0

PROCEDURES USED TO ASSESS PRECISION, ACCURACY & COMPLETENESS

12.1 Precision - Measures the dispersion of repeated measurements of the same parameter in the same sample from one another. The tools employed to routinely assess precision at CCAS include:

- a. Duplicate Analyses
- b. Duplicate Matrix Spikes (also measure accuracy)
- c. Duplicate Samples
- d. Calibration Curves
- e. Quality Control Charts (also measure accuracy)

12.2 Accuracy - Measures the deviation of the reported value from the true value. The tools employed to routinely assess accuracy at CCAS include:

- a. Certified Reference Materials
- b. Commercial Performance Evaluation Samples
- c. Laboratory Control Samples
- d. Spikes
- e. Matrix Spike Duplicates (also measure precision)
- f. Sensibility
- g. Confirmation by an Independent Method
- h. Quality Control Charts (also measure precision)

12.3 Completeness -The QA definition of completeness refers to the degree to which valid data are produced under a particular QA program. Appropriately enough, expressed as a percentage, the job is

never done. Since the QA objectives discussed within and generally adopted by EPA are based on the 95 percent confidence level, about 5 percent of the tests fail EVEN WHEN THE SITUATION IS FUNCTIONING PROPERLY. Thus the QA target for completeness is 95 percent. The actual percent of samples reported vs. samples received, of course will be closer to 100 percent since the statistical 5 percent, plus the real "out-of-control" results will be repeated, if possible, and matched with acceptable QA data. The measurements used to describe completeness may be calculated according to one of the two formulas presented below:

- A. Results provided divided by samples submitted expressed as a percent.
- B. Accepted results generated divided by number of analyses performed.

Typically CCAS' customers are concerned only with the first definition.

SECTION 13.0 - CORRECTIVE ACTIONS

The detection of a Quality Assurance problem at CCAS, as explained above, may arise at the bench, during review by the Group Leader/ Department Head, by the Project Manager or by the Ph.D. chemist who signs the reports. It is the responsibility of the detecting party to initiate corrective action by completing an "Analysis Out of Control" form. In use for more than a year, these forms have developed the positive acceptance required to make the system a success. Forms are now generated routinely by bench analysts, middle managers and senior technical staff. They are sent upward through the ranks as well as downward and are generally recognized as a form of communication designed to improve quality. A blank form is presented as Exhibit 6. It should be noted that because a written response is required, the CCAS system documents not only problems but also solutions. The following are among the items which must be inspected and, if a problem is discovered, for which corrective action is required.

13.1 Calibrations/Instrument Responses - Analysts must initiate retests and take corrective actions anytime these are out of limits. Since valid data cannot be generated in the absence of a proper instrument response, detection of problems must be immediate and corrective action is absolutely required before analyses can be resumed. For these reasons, acceptance criteria of this type are posted right on the instrument. Detection of a problem is most often achieved by the analyst him/herself.

13.2 Instrument Blanks - Results provided for all analytes must be below the reported practical quantitation limits. Analytes for which a signal is noted but for which the signal is too weak to provide a value above the practical quantitation limit may be

reported either as "not found" or with a calculated value and a footnote explaining that such levels are reported only in the blank. CCAS prefers the latter format since it provides more information, but allows the client to express a preference. Required actions typically begin with a rerun under the same conditions. If the rerun is acceptable, it is concluded that carryover was the cause and no further action is required. If the rerun is also unacceptable, it is concluded that the analytical system is contaminated. More serious corrective actions such as cleaning the system, replacing sample contact parts, etc. must then be undertaken before analyses can be resumed. Here again, detection of a problem is most often achieved by the analyst.

13.3 Method Blanks - Method blanks differ from instrument blanks in that they are brought through all sample preparation steps prior to being introduced to the instrument. They therefore describe contamination which may originate in the laboratory as well as within the instrument. The reporting options are the same as have already been described in the previous subsection. Values at or above the practical quantitation limit require corrective action. In this case, a comparison with the corresponding instrument blank may permit the problem to be isolated. If the instrument is implicated, the corrective actions described in the previous subsection apply. If the sample preparation is suspect, an immediate systems audit may pinpoint the source of the problem. If not, further isolation may be necessary. This is accomplished by the use of reagent blanks and sample preparation step blanks.

13.4 Travel Blanks - Travel blanks are containers of analyte-free water supplied to the client by the laboratory and sent back to the laboratory unopened. They serve to detect incidental contamination arising from shipment and storage prior to analysis. If a comparison to the instrument and method blank indicate that the problem is indeed due to shipment and storage, corrective actions might include the replacement of shipping containers, the cleaning of refrigerators, etc.

13.5 Field Blanks - These are employed to detect contamination arising from contact with sampling equipment, during shipment or during storage. Since they also detect contamination originating during sample preparation and analysis, an unacceptable result requires isolation by comparison with the method blank, the travel blank and the instrument blank. If these are clean, the client is advised that a sampling problem may exist. Appropriate corrective actions include the use of properly cleaned samplers, pumps, bailers, etc.

13.6 Spikes - Unacceptable spike data include all points beyond the upper or lower control limits on the Quality Control Charts or three points in a row above or below the mean when at least one is near the warning limit. Potential corrective actions include a systems review between the analyst, the data processor, the person preparing the spike and the group leader. If a surrogate of the same class as the analyte for which a poor recovery was noted is present, it may serve as an indicator of a matrix problem. When

such is the case and a duplicate spike provides a low recovery, the likely cause is a matrix effect and analyses may be resumed. Otherwise, analyses are suspended while the issue is resolved.

13.7 Duplicates - Unacceptable precision may indicate a non-homogeneous sample, a dirty instrument, or an instrument malfunction that compromises reproducibility. Corrective actions again include a systems review with the analyst and group leader plus the physical reexamination of the sample. The signal-to-noise ratio of the instrument should be examined as its deterioration indicates that cleaning may be needed or troubleshooting procedures undertaken. Analyses are to be suspended until the source of the problem has been identified and corrected.

13.8 Sensibility - Unusual results are generally detected by the Project Manager or signing Ph.D. chemist since a higher level of experience is needed to make observations of this type. Because these senior staff have access to all of the analytical data which relate to a project, they are also able to develop an overview of the situation that allows them to spot potential inconsistencies between separate analytical tests involving the same analytes. Examples of data which don't make sense would include groundwater thought to be contaminated with gasoline but having a suspiciously low BTX (a possible indication of diesel), or a narrow range petroleum distillate described as diesel (probably Stoddard solvent). Corrective actions usually involve reruns, discussions with the client, performing additional tests, etc. If otherwise sensible results are of a sensational nature, the above actions may be supplemented by resampling, reanalysis or even splitting samples with another laboratory. In this case, the concern is that any results which had the potential to require costly remediative actions by the client should not be released without extremely thorough documentation.

13.9 Other Corrective Actions - Instruments suffering from high problem rates or failing to meet performance criteria may be sent back to the manufacturer. Trainees failing to achieve proficiency may be dismissed and analysts repeatedly found to be the source of "out of control" situations are retrained or dismissed. Methods which are the subject of frequent "out of control" notices may be revised, replaced or abandoned.

SECTION 14 - QA REPORTS TO MANAGEMENT

Within CCAS, QA doesn't just report to management, QA IS management. Dr. Hilpert is an Officer of the Company, holds the rank of Vice President and reports only to the President. He is authorized to enter into contracts for the company and as such is one of the only three persons to be empowered. He becomes heavily involved in major project management as well as in the upgrading of staff through in-house training.

Exhibit 6



Air, Water & Hazardous Waste Sampling, Analysis & Consultation
Certified Hazardous Waste, Chemistry, Bacteriology & Bioassay Laboratories

141 Suburban Road	•	San Luis Obispo, CA 93401	•	(805) 543-2553	•	Fax (805) 543-2685
751 S. Kellogg, Suite A	•	Goleta, CA 93117	•	(805) 964-7838	•	Fax (805) 967-4386
1885 North Kelly Road	•	Napa, CA 94558	•	(707) 257-7211	•	Fax (707) 226-1001
9333 Tech Center Dr., Ste. 800	•	Sacramento, CA 95826	•	(916) 368-1333	•	Fax (916) 362-2484
2400 Cumberland Dr.	•	Valparaiso, Indiana 46383	•	(219) 464-2389	•	Fax (219) 462-2953

ANALYSIS OUT OF CONTROL FORM

Department: _____

Date: _____

Technician: _____

Symptoms/Problems:

Samples Affected:

Corrective Actions Taken:

Date: _____ By: _____

In addition to reporting to our management, CCAS' Quality Assurance Program is prepared to report to YOUR management. With every batch of reports you will receive:

1. Blank Report (minimum one, cost zero)
2. Spike Report (minimum one, cost zero)
3. Full Duplicate Analysis (minimum one, cost zero)
4. Travel Blank Report (if appropriate, cost 1/2)

In addition, at nominal cost based on time and materials a client can elect to receive an overall monthly quality assurance report summarizing his quality assurance results for the month and including relevant instrument performance documentation, copies of the chain of custody documents, task-specific case narratives and a discussion of any conclusions CCAS may be able to draw from the data such as depth relationships, source relationships, area would be confined to the data and its interpretation since CCAS staff members are analysts and would not wish to include legal, medical or engineering conclusions.

SECTION 15 - ANALYST CERTIFICATION

All analysts at CCAS are certified by their supervisor for proficiency in the analytical procedures which they perform. Copies of all current analyst certifications are maintained by department managers as well as in the employee's personnel folder. CCAS requires that analysts know and adhere to all aspects of the analytical methods as well as EPA recommended holding times and preservatives for constituents. Analysts are notified immediately of any changes in analytical procedures. Certifications are reviewed annually or whenever modifications or changes to procedures are implemented. CCAS reports the date of analysis and the analysts' initials as well as the extraction procedure and analytical methods used on all analytical reports. An example of the Analyst Certification form is provided as Exhibit 7.

EXHIBIT 7

ANALYST QUALIFICATION FORM

NAME _____

DATE _____

List EPA or SM Number or Description of Test or Job Below

Attach photocopy of work done or else describe it here. (Calibration curves and raw data for procedures as well as results and QA/QC data must be included.)

Analyst knows: sample prep holding time preservation interferences
 hazardous properties of reagents & samples proper disposal methods
 safety procedures calculations startup shutdown repair

Instrument/Equipment Used _____

Note any restrictions _____

Signature of Supervisor

Date

Copy must be given to: lab manager, lab director, department supervisor, analyst.
Original must be placed in analyst's personnel file.

**TRACER RESEARCH CORPORATION'S
SAMPLING PROCEDURES
AND
QA/QC PROCEDURES**

PREPARED BY:

TRACER RESEARCH CORPORATION



SOIL GAS SAMPLING PROCEDURE

I. Probe Placement

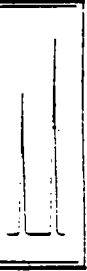
- A) A clean probe (pipe) is removed from the "clean" storage tube on top of the van.
- B) The soil gas probe is placed in the jaws of hydraulic pusher/puller mechanism.
- C) A sampling point is put on the bottom of the probe.
- D) The hydraulic pushing mechanism is used to push the probe into the ground.
- E) If the pusher mechanism will not push the probe into the ground a sufficient depth for sampling, the hydraulic hammer is used to pound the probe into the ground.

II. Sample Extraction

- A) An adaptor (Figure 1) is put onto the top of the soil gas probe.
- B) The vacuum pump is hooked onto the adaptor.
- C) The vacuum pump is turned on and used to evacuate soil gas.
- D) Evacuation will be at least 30 seconds but never more than 5 minutes for samples having evacuation pressures less than 15 inches of mercury. Evacuation times will be at least 1 minute, but no more than 5 minutes for probes reading greater than 15 inches of mercury.
- E) Gauges on the vacuum pump are checked for inches of mercury.
 - 1. Gauge must read at least 2 inches of mercury less than maximum vacuum to be extracting sufficient soil gas to collect a valid sample.

III. Sample Collection

- A) With vacuum pump running, a hypodermic syringe needle is inserted through the silicone rubber and down into the metal tubing of adaptor



(Figure 1).

- B) Gas samples should only contact metal surfaces and never contact potentially sorbing materials (i.e., tubing, hose, pump diaphragm).
- C) The syringe is purged with soil gas then, without removing syringe needle from adaptor, a 2-10 mL soil gas sample is collected.
- D) The syringe and needle are removed from the adaptor and the end of the needle is capped.
- E) If necessary, a second 10 mL sample is collected using the same procedure.

IV. Deactivation of Sampling Apparatus

- A) The vacuum pump is turned off and unhooked from the adaptor.
- B) The adaptor is removed and stored with equipment to be cleaned.
- C) Using the hydraulic puller mechanism, the probe is removed from the ground.
- D) The probe is stored in the "dirty" probe tube on top of the van.
- E) The probe hole is backfilled, if required.

V. Log Book and U.S. EPA Field Sheet Notations For Sampling (Figures 2A-2D)

- A) Time (military notation)
- B) Sample number (use client's numbering system)
- C) Location (approximate description - i.e., street names)
- D) Sampling depth
- E) Evacuation time before sampling
- F) Inches of mercury on vacuum pump gauge
- G) Probe and adaptor numbers
- H) Number of sampling points used

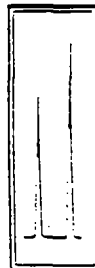
- I) Observations (i.e., ground conditions, concrete, asphalt, soil appearance, surface water, odors, vegetation, etc.)
- J) Backfill procedure and materials, if used.

VI. Other Recordkeeping

- A) Client-provided data sheets are filled out, if required
- B) Sample location is marked on the site map

VII. Determination of Sampling Locations

- A) Initial sample locations will be determined by client (perhaps after consultation with TRC personnel) prior to start of job.
- B) Remaining sample locations may be determined by:
 - 1) Client
 - a) Entire job sampling locations set up on grid system.
 - b) Client decides location of remaining sample locations based on results of initial study, or
 - 2) Client and TRC Personnel
 - a) Client and TRC personnel decide location of remaining sample locations based on results of initial sample locations.



ANALYTICAL PROCEDURES

- I. Varian 3300 Gas Chromatograph
 - A) Equipped with Electron Capture Detectors (ECD), Flame Ionization Detectors (FID), Photo Ionization Detectors (PID) and/or Thermal Conductivity (TC) Detectors.
 - B) The chromatographic column used by TRC for the analysis of halocarbons is a 1/8" diameter packed column containing Alltech OV-101. This nicely separates most of the tri-chloro and tetra-chloro compounds that are encountered in soil gas investigations. The di-chloro compounds tend to elute ahead of the tri-chloro and tetra-chloro compounds, thus creating no interference. In the event that assurance of the identity of a compound in any particular sample is needed, it will be analyzed on a SP-1000 column after the OV-101 analysis.

- II. Two Spectra Physics SP4270 Computing Integrators.

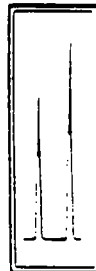
The integrators are used to plot the chromatogram and measure the size of the chromatographic peaks. The integrators compute and record the area of each peak. The peak areas are used directly in calculation of contaminant concentration.

- III. Chemical Standards From ChemServices, Inc. of Westchester, Pennsylvania.
 - A) TRC uses analytical standards that are preanalyzed, of certified purities and lot numbered for quality control assurance. Each vial is marked with an expiration date. All analytical standards are the highest grade available. Certified purities are typically 99%.
 - B) The Quality Assurance procedures used by ChemService were described by the Laboratory Supervisor, Dr. Lyle Phipper:

- 1) The primary measurement equipment at ChemServices, the analytical balance, is serviced by the Mettler Balance Company on an annual basis and recalibrated with NBS traceable weights.
- 2) All chemicals purchased for use in making the standards are checked for purity by means of gas chromatography using a thermal conductivity detector. Their chemicals are purified as needed.
- 3) The information on the purification and analysis of the standards is made available upon request for any item they ship when the item is identified by lot number. All standards and chemicals are shipped with their lot numbers printed on them. The standards used by TRC are made up in a two step dilution of the pure chemical furnished by ChemServices.

IV. Analytical Supplies

1. Sufficient 2 and 10 cc glass and Hamilton syringes so that none have to be reused without first being cleaned.
2. Disposable lab supplies, where appropriate.
3. Glassware to prepare aqueous standards.
4. Miscellaneous laboratory supplies.



QA/QC PROCEDURES

I. Standards

A) A fresh standard is prepared each day. The standards are made by serial dilution.

1) First, a stock solution containing the standard in methanol is prepared at TRC offices in Tucson. The stock solution is prepared by pipetting the pure chemical into 250 mL of methanol in a volumetric flask at room temperature. The absolute mass is determined from the product of volume and density calculated at room temperature. Hamilton microliter syringes, with a manufacturer's stated accuracy of + or - 1%, are used for pipetting. Information on density is obtained from the CRC Handbook of Physics and Chemistry. Once the stock solution is prepared, typically in concentration range of 50-1000 mg/L, a working standard is prepared in water each day. The solute in the stock solution has a strong affinity to remain in methanol so there is no need to refrigerate the stock solution. Additionally, the solute tends not to biodegrade or volatilize out of the stock solution.

2) The working standards are prepared in 40 mL VOA septum vials by diluting the appropriate ug/L quantity of the standard solution into 40 mL of water.

B) The standard water is analyzed for contamination before making the aqueous standard each day.

C) The aqueous standard is prepared in a clean vial using the same syringe each day. The syringe should only be used for that standard.

D) Final dilution of the calibration standards are made in water in a VOA vial having a Teflon coated septum cap instead of in a volumetric flask in order to have the standard in a container with no air exposure. The VOA bottle permits mixing of the standard solution and subsequent syringe sampling all day long without opening the bottle or exposing it to air. The measurement uncertainty inherent in the use of a VOA bottle instead of a volumetric flask is approximately + or - 1%.

E) The aqueous standard will contain the compounds of interest in the range of 5 to 100 ug/L depending on the detectability of the individual components. The standard will be analyzed at least three times at the beginning of each day to determine the mean response factor (RF) for each component (Figure 3). The standard will be injected again after every fifth sample to check detector response and chromatographic performance of the instrument throughout the day.

F) The RF allows conversion of peak areas into concentrations for the contaminants of interest. The RF used is changed if the standard response varies 25%. If the standard injections vary by more than 25% the standard injections are repeated. If the mean of the two standard injections represents greater than 25% difference then a third standard is injected and a new RF is calculated from the three standard injections. A new data sheet is started with the new RF's and calibration data.

$$\% \text{ difference} = \frac{\text{A area} - \text{B area}}{\text{A area}}$$

Where ; A = mean peak area of standard injection from first calibration
 B = peak area of subsequent standard injection

G) The low ug/L aqueous standards that are made fresh daily need not be refrigerated during the day because they do not change significantly in a 24



hour period. On numerous occasions the unrefrigerated 24 hour old standards have been compared with fresh standards and no difference has been measurable. If the standards were made at high ppm levels in water, the problem of volatilization would probably be more pronounced in the absence of refrigeration.

H) Primary standards are kept in the hotel room when on a project.

I) A client may provide analytical standards for additional calibration and verification.

II. Syringe Blanks

A) Each uL syringe is blanked before use.

B) 2 cc (glass) syringes will each be blanked if ambient air concentrations are elevated (greater than or equal to 0.01 ug/L) for components of interest.

C) If ambient air concentrations are <0.01 ug/L for components of interest, a representative sample of at least two syringes are blanked at the beginning of each day. If representative syringes have no detectable contamination remaining syringes need not be blanked. If any of representative syringes show contamination, all 2 cc syringes must be blanked prior to use.

D) Syringe blanks are run with air or nitrogen.

E) If it is necessary for any syringe to be used again before cleaning, it is blanked prior to its second use.

III. System Blanks

A) System blanks are ambient air drawn through the probe and complete sampling apparatus (probe adaptor and 10 cc syringe) and analyzed by the same procedure as a soil gas sample. The probe is above the ground.

B) One system blank is run at the beginning of each day and compared to a concurrently sampled air analyses.

C) A system blank is run before reusing any sampling system component.

IV. Ambient Air Samples

A) Ambient air samples are collected and analyzed a minimum of two times daily to monitor safety of the work environment and to establish site background concentrations, if any, for contaminants of interest.

B) All ambient air samples shall be documented (Figure 3).

V. Samples

A) All unknown samples will be analyzed at least twice.

B) More unknown samples will be run until reproducibility is within 25%, computed as follows:

$$\text{Difference} = \frac{A - B}{(A + B)/2}$$

Where; A is first measurement result

B is second measurement result

If the difference is greater than .25, a subsequent sample will be run until two measurements are made that have a difference of .25 or less. Those two measurements will be used in the final calculation for that sample.

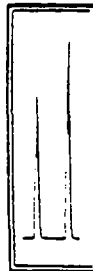
C) The injection volume should be adjusted so that mass of analyte is as near as possible to that which is contained in the standard, at least within a factor of ten.

D) Whenever possible the attenuation for unknown samples is kept constant through the day (so as to provide a visual check of integrations).

E) A water plug is used as a gas seal in uL syringes

F) A seal is established between syringes when subsampling

G) At very high concentrations air dilutions are acceptable once concentration of contaminants in air have been established.



- H) All sample analysis are documented (Figure 3).
- I) Separate data sheets are used if chromatographic conditions change
- J) Everything is labeled in ug/L, mg/L, etc. PPM and PPB notations are to be avoided.

VI. Daily System Preparation (Figure 4).

- A) Integrators parameters are initialized
 - 1. Pt. evaluation
 - 2. Attenuation
 - 3. Peak markers
 - 4. Auto zero
 - 5. Baseline offset (min. 10% of full scale)
- B) The baseline is checked for drift, noise, etc.
- C) System parameters are set.
 - 1. Gas flows (Note: N₂, air, H₂ tank pressure on Page 1 of chromatograms).
 - 2. Temperatures
 - a) Injector
 - b) Column
 - c) Detector
- D) After last analysis of the day conditioned septa are rotated into injection ports used during the day and replaced with fresh septa.
- E) Column and injector temperatures are run up to bake out residual contamination.
- F) Syringes are cleaned each day
 - 1. 2 and 10 cc syringes are cleaned with Alconox or equivalent detergent and brush

2. uL syringes are cleaned daily with IPA or MeOH and purged with N₂. Syringe Kleen is used to remove metal deposits in the barrel.
3. Syringes are baked out overnight in the oven of the gas chromatograph at a minimum temperature of 60°C.

VII. Sample Splits

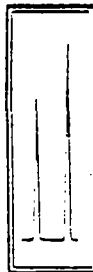
If desired, TRC's clients or any party, with the approval of TRC's client, may use sample splits to verify TRC's soil gas or groundwater sampling results.

A) Sample splits may be collected in two valve, flow through-type all-glass or internally electroplated stainless steel containers for analysis within 10 days of collection.

1. Flow through sample collection bottles should be cleaned by purging with nitrogen at 100°C for at least 30 minutes. Once clean, the bottles should be stored filled with nitrogen at ambient pressure.
2. Sample bottles are filled by placing them in the sample stream between the probe and the vacuum pump. Five sample bottle volumes should be drawn through the container before the final sample is collected. The sample should be at ambient pressure.

B) Sample splits can be provided in 10 cc glass syringes for immediate analysis in the field by the party requesting the sample splits.

C) Splits of the aqueous standards or the methanol standards used by TRC for instrument calibration may be analyzed by the party requesting sample splits.



Figures 1 through 4

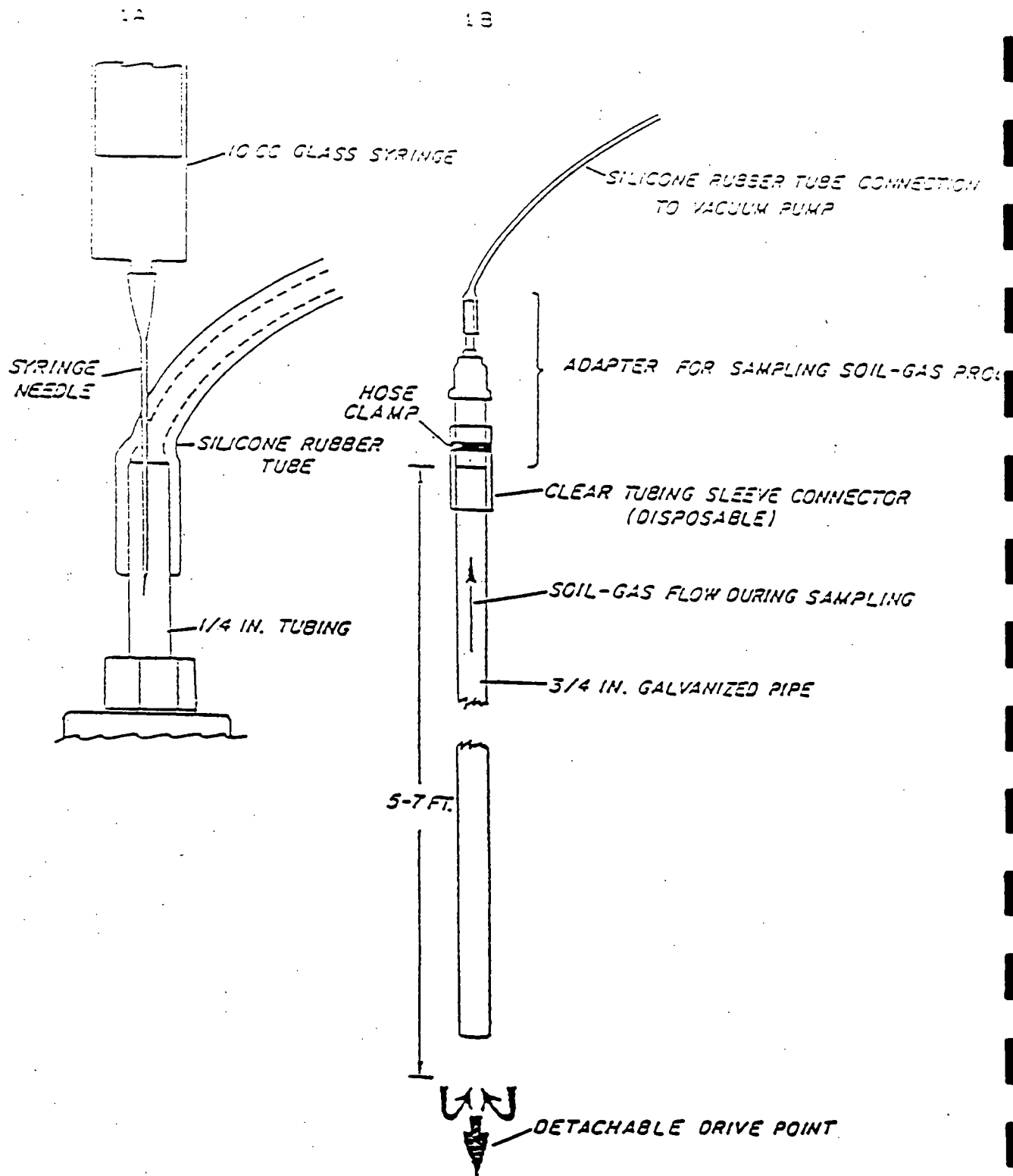


FIGURE 1. SAMPLING APPARATUS

- 1A. CLOSE-UP OF SYRINGE SOIL GAS SAMPLING THROUGH EVACUATION LINE
 1B. DIAGRAM OF SOIL GAS SAMPLING PROBE WITH ADAPTOR FOR SAMPLING AND EVACUATION OF THE PROBE AFTER IT IS DRIVEN INTO THE GROUND

VAN # 1
PLATE # 40A-274

SOIL GAS INVESTIGATION BACKGROUND INFORMATION

SITE NAME: DAVIDSON CHEMICAL
LOCATION: 14500 WEST AVENUE N. LANTHERN SOUTH DAKOTA
DATES OF INVESTIGATION: 2/16 - 2/18/99
CLIENT NAME & ADDRESS: SLANDENBURG ENVIRONMENTAL
602 HARRISON RD
WHEELER SD 57667
FIELD REPRESENTATIVE(S) FOR CLIENT: JOE DANDELLOT
PERSON TO WHOM REPORT AND QUESTIONS
SHOULD BE DIRECTED: SARAH WENDEL
PHONE: (731) 972-1003
CREW: CHEMIST S. CAUSLES GEOLOGIST M. RIVERNI

REPORT TO INCLUDE (CIRCLE):

- A. QA/QC-PROCEDURES-DATA ONLY OF
 B. FULL REPORT WITH CONTOUR MAPS AND INTERPRETATION

PURPOSE OF INVESTIGATION

DETERMINE EXTENT OF CONTAMINATION FROM STORAGE TANK SILL

SAMPLE

TARGET VOCs

<u>TC1</u>		
<u>TC2</u>		
<u>TC3</u>		

GROUNDWATER INFORMATION:

DEPTH TO WATER: 12-16' DIRECTION: NE

SOURCES OF CONTAMINATION

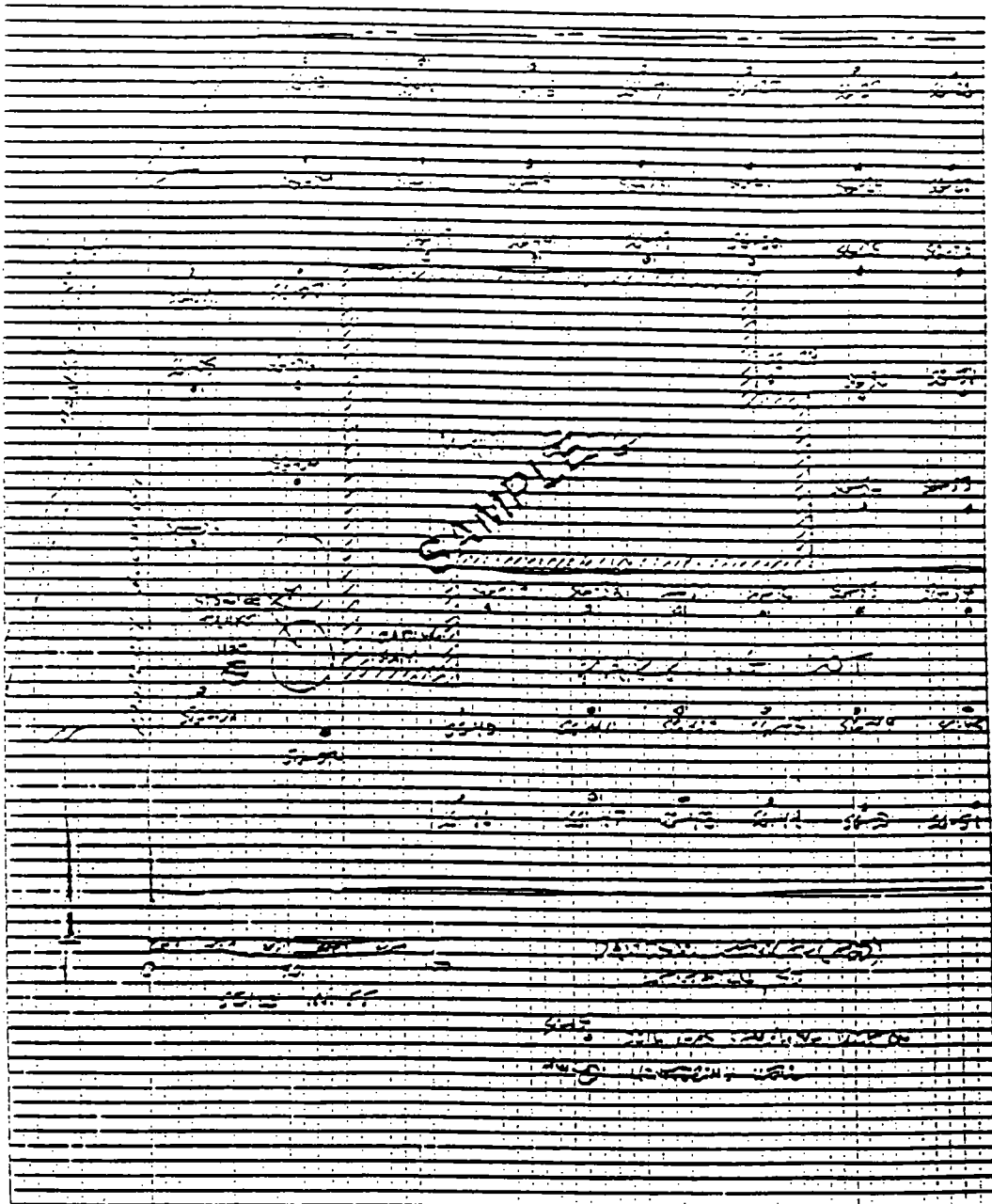
LIQUID USED SOLVENTS IN PHOTO-ETCHING PROCESS IN MANUFACTURE OF
PERSONAL CIRCUIT BOARD. STORAGE TANK CRACKED AND LEAKED FROM
APPROX. 100-100' WHEN EQUIPMENT SHUT DOWN. SOLVENT WAS RECOVERED
IN RTG.

GEOLOGIC SETTING:(e.g. soil type, subsurface geology, etc.)

WATER & CLAY TILL (10'); FRACTURED ARGILLITE ROCK 10'

FIGURE 2A
FIELD LOGBOOK - BACKGROUND INFORMATION

S I T E M A P



SITE MAPS TO INCLUDE: SITE NAME, SCALE, NORTH ARROW, SOIL GAS LOCATIONS & NUMBERS, CULTURAL AND NATURAL FEATURES TO IDENTIFY

FIGURE 13
FIELD LOGBOOK - SITE MAP

DATE : 2-16-89
LOCATION : DAVIDSON CHEMICAL, HANTHORN, SD
CLIENT : GRANDENBURG ENV.

GC Operator: S. CHARLES Field Assistant: M. FAVERONI
Weather : 12°F SNOW SQUALLS, CLOUDS & RAIN

FIELD HOURS

Arrive on site : 0730 Lunch hours : 1
Depart off site : 1730 Downtime hours¹ : 0
Standby hours² : 0
Hours on site
(B - A) : 10

DECONTAMINATION

Probe Decontamination Syringe Decontamination
Total hours: 1/4 Total hours : 1/2
DC Verified by GC operator M. Faveroni Verified by field assistant

DAILY SUMMARY

Calibration	Sampling	Analysis
Time start : 0730	Max vacuum : 23 in Hg	Total system
Time end : 0830	Probes used : 13	blanks : 1
Total hours: 1	Points used : 20	Total air
	Soil gas samples	samples : 3
	collected : 18	
	Water samples	
	collected : 0	

Field data and gas standards checked by M. Faveroni
Data checking hours: 1/2

- 1 - Downtime includes time spent repairing sampling & analytic equipment; note times and explanation on following field data pages
- 2 - Standby includes time available for sampling but waiting for client; note times and explanation on following field data pages

TRACER RESEARCH CORPORATION
 JOD- DAVIDSON CHEMICAL, LAUTHOR, SOUTH DAKOTA
 1 DATE- 16 FEBRUARY 1989
 CHEMIST- S CIMARLES
 GEOLOGIST- M FINERDII

DETECTOR A (0 or 1)	DETECTOR B (0 or 1)	RETENTION TIMES	SAMPLE INJECTION (uL)	COMP 1	COMP 2	COMP 3						
1	0	0.70	5	1.1	1.7	5						
STANDARD CONCENTRATION (ug/L):				3: 10	5	10						
AREA RESPONSE 1:	95310	2000456	1140076									
FROM INJECTION 2:	103603	1956743	1114123									
3:	107190	2150570	1126570									
RESPONSE FACTOR:	5 -1.90E-16	1.23E-17	4.43E-17									
COMPONENT NAME	F113	TCR	TCE									
2												
SAMPLE	TIME(N/D)	INJ A	INJ B	AREA	CONC.	MEAN	AREA	CONC.	MEAN	AREA	CONC.	MEAN
6	11	5	12	14	ERR		ERR			ERR		
H2O BLANK	753			-1000	-0.09797	<0.1	-1000	-0.00245	<0.002	-1000	-0.00005	<.000
7		1000		-1000	-0.00010	<0.0005	-1000	-0.00001	<.00001	-1000	-0.00001	<.00001
NIR SAMPLE 8	023	1000		2000	0.000979	0.001	4702	0.000057	.00006	12569	0.000556	0.0006
SYSTEM BLANK 9	015	1000		2000	0.000979	0.001	5560	0.000060	.00007	10724	0.000121	0.0005
SG01-5'	911	1000		15312	0.007513	0.000	5400	0.000066	.00007	351625	0.015560	0.02
SG01-5'	917	1000		17906	0.000011		5074	0.000072		410552	0.010160	
10			13	15	ERR		ERR			ERR		
MS-10	955	1		3124	1.677304	2	-1000	-0.01227	<0.01	40320	1.793490	2
MS-10	1003	1		3650	1.780099		-1000	-0.01227		41715	1.970706	

FIGURE 3.
 EXPLANATION OF FIELD DATA SHEET

1. Site and staff information.
2. Name of compound.
3. Concentration of analyte in calibration standard.
4. Peak areas obtained from standard injections during calibration.
5. Response factor (RF) for compound obtained from three calibration runs. The RFs are used for calculation of actual concentrations and are included on each data sheet.
6. Water blank verifies purity of standard water and cleanliness of injection system.
7. Nitrogen blank verifies decontamination of syringes and analytical equip.
8. Air sample gives ambient concentrations for comparison with system blank.
9. System blank verifies decontamination of sampling equipment.
10. Sample ID number; 0001-5' (soil gas sample 1 taken 0' below grade), 01-10 (water sample).
11. Time of analysis identifies the chromatogram from which the data was taken.
12. Amount of sample injection - used for concentration calculation.
13. Peak area - raw data produced by the computing integrator that is proportional to the mass of analyte in the sample.
14. Actual concentration present in the sample rounded to 1 significant figure.
15. Mean concentration of duplicate injections.

REASON
 DATE " 01-27-89
 TIME " 15:43
 PE= 1. RE= 1. MH= 0.
 PRESS ENTER TO SKIP ENTRY
 FILE NAME=" STD
 TIME FUNCTION VALUE
 TT= .01 TF=" RC TV= 1
 TT= .01 TF=" RC TV= 1
 TT=

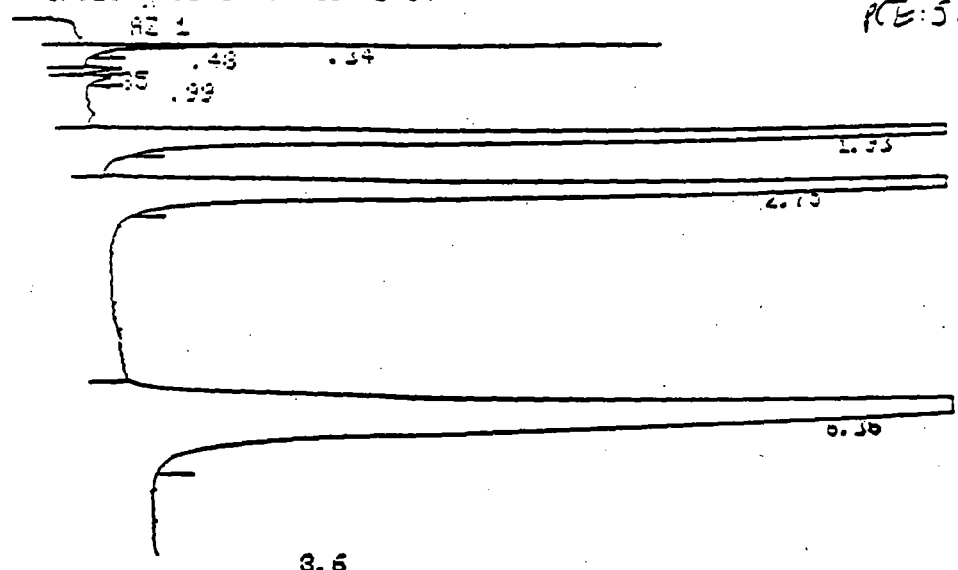
Column <u>OV-101</u>	Detector <u>FL</u>
Length <u>6'</u>	Voltage <u>250</u>
Oia. <u>1/8"</u>	Sensit. _____
Liquid Phase <u>OV-101</u>	Flow Rate, ml/min _____
Wt % <u>10</u>	Hydrogen <u>Air</u>
Support <u>Chromasorb</u>	Scavange _____
Mesh <u>60/80</u>	Split _____
Carrier Gas <u>N₂</u>	Temperature, °C _____
Regulator <u>30</u>	Det. <u>250</u>
Inlet Press <u>25</u> psig	Column Initial <u>250</u>
Rate <u>30</u> ml/min	Final _____
CHART SPEED <u>1</u>	Rate _____
SAMPLE _____	Solvent _____
Size _____	Concn. _____
Operator <u>Ch. L. Harris</u>	Date _____

METHOD NUMBER: MN=

END OF DIALOG
 AT= 32
 OF= 28
 PT= 1000

50°C STOS₂ TCAS
 TC= 10 / 29/L
 PCB= 5

CHANNEL A INJECT 01-27-89 15:43:04



STD 01-27-89 15:43:04 CH= "A" PS= 1.

FILE	METHOD	RUN	INDEX
1	0.	1	1
PEAK#	AREA%	RT	AREA BC
1	0.377	0.34	13779 02
2	1.754	0.43	64194 03
3	0.154	0.85	6011 01
4	0.152	0.99	5547 01
5	25.061	1.93	917708 01
6	26.951	2.75	986147 01
7	45.521	6.36	1553628 01
TOTAL	100.		3659014

FIGURE 4
CHROMATOGRAM DOCUMENTATION