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NS. Nadel
4-4-4

Ms. Nancy Nadel
US EPA Region IX
75 Hawthorne St.
San Francisco, CA 94105

April 8, 1992

Re: Omega Draft RFI Workplan

Dear Nancy,

You will find enclosed Omega's Draft RFI Workplan. This is our response to the Consent Order RCRA # 09 91 005 requirement for an RFI Workplan.

After you you had an opportunity to review the document, please let me know your responses.

Yours,

Dennis R. O'Meara

6C

Enclosure

**Omega Recovery Services**
12504 East Whittier Boulevard / Whittier, California 90602 / (213) 698-0991 / FAX (213) 696-1908

# RCRA FACILITY INVESTIGATION WORKPLAN FOR OMEGA CHEMICAL CORP

WHITTIER, CALIFORNIA
APRIL 5, 1992

Submitted to EPA REGION IX

Prepared by
Dennis R. O'Meara
Omega Chemical Corp.
12504 E. Whittier Blvd.
Whittier, California 90602

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# APPENDIX

## PROCEDURES AND METHODS

Special Considerations for Sampling of Organics in Groundwater
Procedures for Water Level Measurement
General Soil Sampling Procedures
Slug Test Procedure
Sampling Procedures for Monitoring Wells
General Considerations for Monitoring Well Installation
Considerations for Sample Withdrawal from Wells
Subsurface Soil Sampling
General Procedures for Surface And Shallow Depth Soil Sampling

# 1.0 INTRODUCTION

This current conditions report is submitted to the U.S. Environmental Protection Agency (EPA) on behalf of Omega Chemical Corp. (Omega). The report provides information pertinent to the facility located at 12504 E. Whittier Blvd., Whittier, California . The report is is submitted in response to the Administrative Order on Consent US. EPA Docket No. RCRA -09-91-0005.

# 2.0 INVESTIGATION OBJECTIVES

In order to be in compliance with the Consent Order, a RCRA Facility Investigation (RFI) is required for the Omega facility at Whittier, California. The facility located at 12504 E. Whittier Blvd., Whittier, California 90602. The objective is to determine the nature and extent of any release of hazardous waste and hazardous constitutents at or from the Omega facility. To accompolish that goal three field investigation tasks have been proposed in Section 5.

# 3. 0 PROJECT DESCRIPTION

## 3.1 Facility Background

Omega Chemical (Omega) has operated since 1976, a chemical recycling facility at 12504 E. Whittier Blvd in Whittier, Los Angeles County, California (Figure 2-1). a California corporation

Omega presently operates as a RCRA Interim Status Hazardous Waste Management Facility and has submitted a Part B Application dated October 29, 1990, and revised Part B application January 10, 1991. In addition, Omega currently operates under a Conditional Use Permit issued by the city of Whittier. The facility operates a variety of waste management units and manufacturing and operational processes including settling tanks, holding tanks, wastewater treatment tanks, processing equipment, drum storage areas, and related equipment.

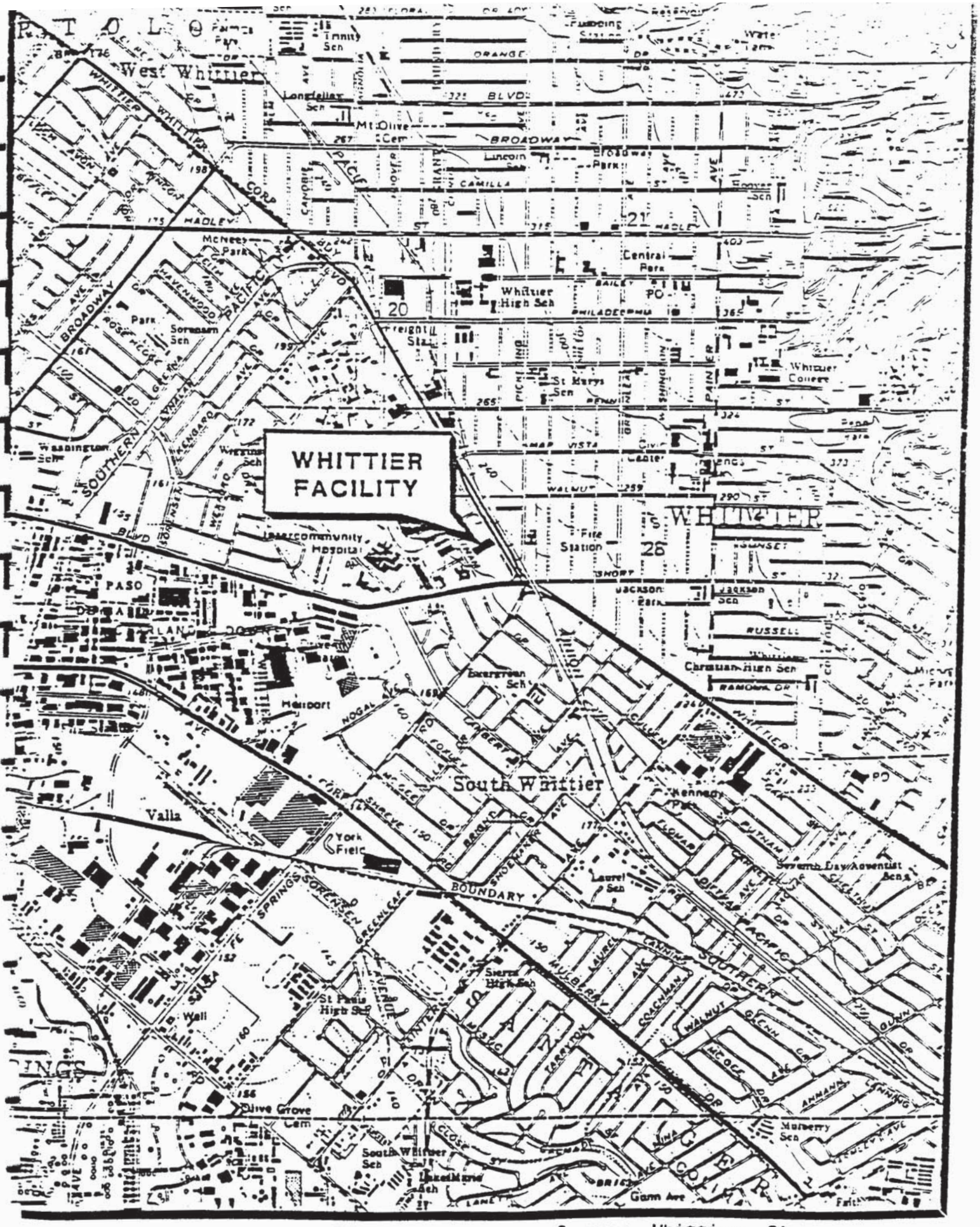
Omega receives a variety of hazardous wastes and recyclable materials from generators from a wide range of industrial classifications. These materials are treated and/or disposed through the generation of new products for sale or through treatment. Hazardous residues and sludges generated by the facility are transported to a variety of Treatment facilities for recyling/or treatment in accordance with DHS and EPA regulations.

Omega also produces chemicals from virgin materials (non-recycled). These products, some of which are patented and proprietary, are sold back to the industries that generate them and to industry at large.

Wastes presently generated by the facility contain various organic type chemicals and inorganic solids.

## 3.2 Prelimnary of Field Investigation Activities

In order to be in compliance with the Consent order, the conduct of a RCRA Facility Investigation




Site Location and Topographic Map
Omega Chemical Company
Whittier, CA

Source: Whittier, CA
USGS 7.5 Minute Quadrangles
1 inch = 2000 feet

FIGURE 3.1

(RFI) is required for the Omega Chemical Corp located at 12504 E. Whittier Blvd, Whittier, California. As stated in the Consent order, the objective of the RFI is to detemine the nature and extent of any release of hazardous waste and hazardous constituents at or from the Omega facility. Towards the accomplishment of this objective, a total of three field investigation tasks have been proposed in Section 4.0 (Sampling and Analysis Plan [SAP]) of the RFI Workplan. A brief simimary of the three tasks discussed in the SAP is provided in the following paragraphs. Section 4.0 provides a detailed discussion of the conduct of the field sampling and analysis program.

Field sampling proposed for the subject facility consists of three discrete tasks which are listed as follows:

Task 1 -Surface Soil Sampling
Task 2 -Subsurface Soil Borings/Monitor Well Installations
Task 3 -Ground Water Sampling

**Task 1,**
Surface Soil Sampling, consists of the collection of XX surface soil. At the Waste Management Units, either soil samples will be collected from subsurface soil borings during Task 2 activities. The majority of the samples will be analyzed for the key organic chemical constituents identified in the Current Situation Report to EPA.

**Task 2,**
Subsurface Soil Borings/Monitor well Installations, consists of the drilling of four background borings (three on-site, and off-site, depending on access), Subsurface soil samples will be collected from the boreholes under this task with a split spoon sampler equipped with stainless steel liners for analysis of the key organic constituents.

Omega presently anticipates that the subsurface investigations will be conducted as a phased approach. If contamination of soil or ground water media is encountered to the fullest depth investigated, a second phase of deeper borings and/or monitor wells may be required. Resolution of Phase 2 requirements, if any, will be accomplished in close coordination with the EPA and other applicable regulatory authorities.

**Task 3.**
After the newly installed wells have had time to equilibrate with their surroundings, ground water sampling activities (Task 3) will commence. Samples for laboratory analysis will be collected with a compressoractivated bladder pump from the newly installed wells at the subject facility. Two full rounds of ground water samples will be collected over a three month period to address regulatory agency concerns for complete site characterization and short-tem temporal changes thereof. Long-tem trends will be quantified from monitoring well data. During the first round of sampling wells will also be analyzed for RCRA Part 264 Appendix Ix parameters.

# 4.0 PROJECT MANAGEMENT PROGRAM

The Project Management Program for Omega's RCRA Facility Investigation consists of an overall technical approach, a specific scope of work, management information systems (which ensure adherence to project schedules and budget), and internal Quality Assurance/Quality Control (QA/QC) and Health and Safety protocols. The specific scope of work was introduced in Section 2.0 with further details provided in Section 5.0 under the Sampling and Analysis Plan. Similarly, the QA/QC and Health and Safety issues are addressed in Sections 5.0 and 7.0, respectively, of this document. The following sections, therefore, present information on the project technical approach, the management system, personnel assigned to the project, and project schedule and budget.

## 4.1 Technical Approach

The overriding objective of all technical components of the RFI is to attain full compliance with the Administrative Order on Consent (Consent order), in terms of all technical, procedural, and schedule-related requirements. In doing so, Omega will achieve completion of a thorough site characterization and facilitate clean-up in a manner which meets regulatory agency approval. Towards this overall objective, the RFI also addresses six key objectives specific to this site, namely:

- Complete the additional investigations identified in the Consent order in the most technically complete, expeditious, and cost-effective mamer possible.
- Move these investigations away from a continuing monitoring mode, towards collection of those data required for full site characterization and the design of practical site remediation.
- Conduct such investigations using methods and procedures which are consistent with, and approved by, all applicable regulatory authorities.
- Identify off-site sources, particularly related to organic contaminants.
- Ensure that all investigatory procedures are conducted in strict conformance with established guidance, and fully incorporate the comments provided in the Comprehensive Ground water Monitoring Evaluation (CME) of 1988.
- Establish and maintain a cooperative relationship with the U.S. EPA, DHS and other applicable authorities.

Fulfillment of these critical objectives will be achieved by maximizing the use of existing data. The collection of additional information will include those data required for (1) documentation of the full nature and extent of contamination, and (2) design of an efficient remediation alternative. Existing data requirements, particularly those identified in the State's Comprehensive Ground Water Monitoring Evaluation (CME) and the Administrative order on Consent, focus on four principal areas necessitating further investigation, namely:

1. The hydrogeologic characteristics of the site in terms of the existence of, or potential for, vertical migration of contaminants. Specifically, further data are needed to

demonstrate the hydraulic relationship between the upper and lower water-bearing units, and contamination (if any) thereof.

2. The lateral extent of ground water contamination if any, particularly in the areas between existing sites identified in Current Situation Report boundaries allowing full plume definition.

3. The sources and character of potential organic ground water contamination, .

In addition to these areas of emphasis, the RFI will also address other areas of concern, including characterization of soils within and adjacent to all waste management units on-site, and the location and effects of water supply wells in the vicinity. The study approach which focuses on collection of this information, coupled with a thorough understanding and documentation of existing/'past on-site processes, will result in an RFI which meets both the regulatory requirements and allows for the design and implementation of cost-effective clean-up technologies.

## 4.2 Management Information System

Management systems will ensure the Omega technical consultant, Mesa[2], has reviewed the scientific performance for all phases of the project, including planning, field investigations, remedial design, bid preparation, and construction management. Although the majority of this information is strictly for use between Omega and Mesa, pertinent data are also available for transmittal to agencies, if applicable. Key components of project management include:

- Monthly Project Status Reports (PSRS) are used to track overall project finances. When coupled with monthly progress reports, which can be provided both directly to Omega, and included as a part of the progress reports per Attachment III, Task VI of the Consent order, project technical completion is compared directly to expenditures.

- Critical Path method (CPM) scheduling which identifies all key project milestones, deliverables, and manpower requirements.

- In terms of design, a component of the formal OA/QC program will be instituted to track investigatory design progress against financial performance. This ensures that the design of field programs and site clean-up is for the most cost-effective alternative, and is implemented in the most cost-effective manner. Furthermore, a direct tie-in is established between the QA program (as described in Section 5.0) and the overall project management to ensure compliance with Section XIII of the Consent order.

Most importantly, the management information system will ensure that communication protocols are established and followed, consistent with the Consent Order, between the USEPA, Omega, Mesa, and other contractors. All technical and schedule-related issues requiring action, therefore, are addressed in an expeditious mamer, consistent with the requirements of the Consent Order.

## 4.3 Personnel

Mr. Dennis O'Meara, Omega General Manager, has been designated as the Project Coordinator per Section XII of the Consent order. In this capacity, he served as the direct liaison between Omega and USEPA. Mr. O'Meara will supervise all tasks performed by contractors under the RFI including, but not limited to, Mesa.

Mesa will be responsible technical components of the RFI. Additionally, Mesa will provide assistance to Omega in the coordination of all RFI activities. In order to ensure that adequate specialized expertise are used to meet all schedule and technical requirements, the project team includes the following:

- management and supervisory personnel with extensive experience in coordination with regulatory agency officials regarding the conduct of hydrogeologic and remediation programs.

- Geologists who specialize in ground water and soil investigations at hazardous waste sites requiring strict adherence to stringent sampling protocols.

- Soil and aqueous chemists with demonstrated expertise in the interpretation of analytical data frm sites with organic chemical contamination constituents.

- Engineers with proven experience in the identification, evaluation, selection, design and implementation of remedial systems for contaminated soils and ground water.

All technical and schedule-related issues requiring action, therefore, are addressed in an expeditious mamer, consistent with the requirements of the Consent order.

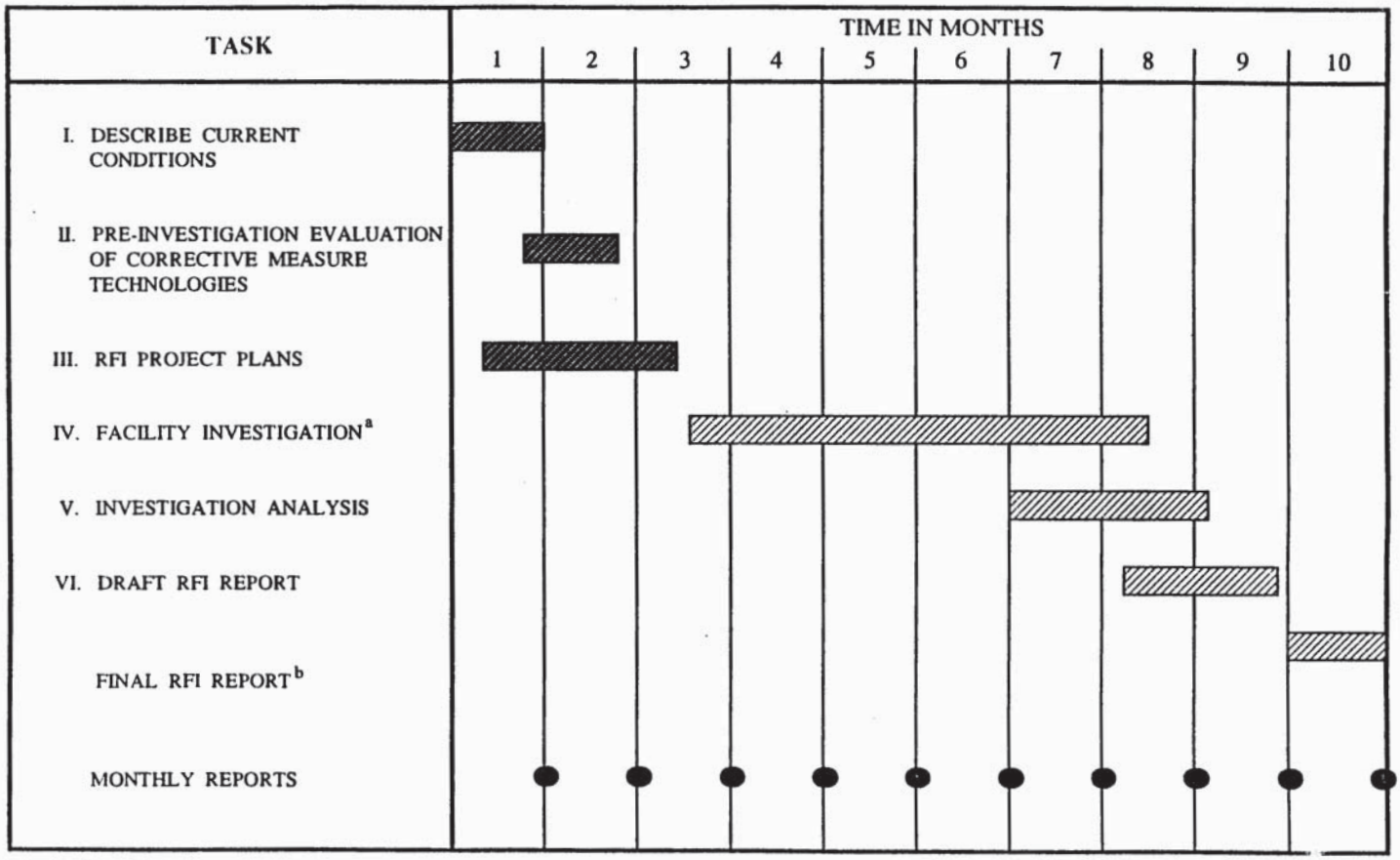
Mr. Peter Fischer will serve as Mesa's project manager. As such, he will be responsible for overall technical performance including ensuring conformance to all technical and applicable schedule criteria established in the Consent Order.

Mr. Fischer has many years experience in the envirormental engineering and analytical laboratory fields. He has been responsible for enviromental regulatory compliance at industrial facilities, conduct of feasibility studies, and management of site remediation. The majority of this work has required direct coordination and negotiation with the EPA and various state agencies. In addition, Mr. Fischer has implemented analytical laboratory protocols and data collection manipulation and evaluation procedures for chemical and envirormental testing labortories.

Additional staff resources will be utilized in the areas of field sampling of ground water and soils media, interpretation and statistical evaluation of geochemical data, and coordination of investigatory activities with plaining and preliminary design components of the Corrective Measure Study per Attachment IV of the Consent Order.

Mesa will be supported by qualified drilling subcontractor and laboratory analytical firms.

# PROJECT SCHEDULE




Note: Heavy shading represents completed tasks.

[a] Start is dependent on agency review/approval of project plans.

[b] Start is dependent on agency review/approval of draft report.

FIGURE 4-1

TABLE 4 - 1

ESTIMATED RFI COSTS

| TASK | Omega Costs | Mesa Costs | Drilling Costs | Laboratory Costs | Totals |
|---|---|---|---|---|---|
| Data Review & Inventory | | | | | |
| Project Plans (Draft & Review) | 5500 | 3500 | | | 9000 |
| Facility Investigation | 16500 | 5000 | $15,000 | $20,000 | 56500 |
| Data Analysis/ RFI Report | 12000 | 4000 | | | 16000 |
| Monthly Reports( 1992 & 1993) | 6500 | 1000 | | | 7500 |
| | | | | | 89000 |

## 4.4 Schedule and Budget

Figure 4-1 and Table 4-1 provide the estimated project schedule and budget, respectively. Actual task completion dates and associated costs are dependent upon Agency approval of project plaining documents, including the proposed scope of work herein. once the project planning documents are approved, a total cost for the RFI will be determined. Prior to commencement of field activities. .

# 5.0 SAMPLING AND ANALYSIS PLAN

This Sampling and Analysis Plan (SAP) has been prepared in accordance with United States Environmental Protection Agency (EPA) guidance documents, which are listed as follows:

- RCRA Facility Investigation (RFI) Guidance, volumes I through IV, July 1987;
- RCRA Technical Enforcement Guidance Document, September 1986;
- A Compendium of Superfund Field operations methods, December 1987; and
- Test methods for Evaluating Solid Waste (SW846), November 1986.

## 5.1 Background and objectives

Background

A complete discussion of site background has been provided in Section 3.0 of this RFI Workplan.

Objectives

The objective of this sampling effort is to be in compliance with the Administrative Order on Consent dated December , 1991, between Omega and EPA. Omega Chemical Inc. is the owner and operator of the subject facility located at 12504 E. Whittier Blvd., Whittier, CA.

As stated in the Consent order, the mutual objectives of EPA and Omega Chemical Inc. are: (1) to perfom a RCRA (Resource Conservation and Recovery Act) Facility Investigation (RFI) to determine the nature and extent of any release of hazardous waste and hazardous constituents at or from the Omega facility; (2) to perfom a Corrective Measure Study (CMS) to identify and evaluate alternatives for the corrective action necessary to prevent or mitigate any releases of hazardous wastes or hazardous constituents at or from the facility. This SAP is intended as partial fulfillment of Objective No. 11 and has been prepared as a stand alone docunx-nt to be used during the conduct of the field investigation. Subsequent field sampling in support of the SAP, and submittal and approval of the RCRA Facility Investigation Report will fulfill the requirements of the first objective. In addition, data generated from the RFI will be used during the CMS to evaluate potential corrective measure altematives for the facility.

A concern shared by both the local regulatory agencies and Omega is that an approved SAP for the conduct of on-going quarterly ground water monitoring activities has never been approved for the facility. Therefore, Section 5.3.3 of the SAP (Ground Water Sampling) will also serve as a guidance document and SAP for the conduct of subsequent ground water monitoring activities at the facility. Upon the completion of a complete statistical analysis of the ground water analytical data, revisions to this plan (change in frequency of sampling or analytical parameters) may be forthcoming. If such changes are indicated by an evaluation of the data, a revised ground water monitoring plan will be submitted to the regulatory agencies for their approval.

## 5.2 Rationale for Sampling

Field sampling at the subject facility has been divided into discrete tasks which are listed as follows:

- Task 1 - Surface Soil, Sludge/Liquid Sampling
- Task 2 - Subsurface Soil Borings/Monitor well Installations
- Task 3 - Ground Water Sampling

The following section will discuss the rationale for sample location, sample depth, and analytical parameter selection. The procedures for performance of each task will be described in detail in Section 5.3 of this SAP.

### 5.2.1 Task 1 - Surface Soil, Sludge Sampling

Surface soil sampling will be conducted at various Waste Manageraent Unit (present and former) (WMU) locations throughout the subject facility. The Current Conditions Report (CCR) illustrates the general areas of known contamination. Samples were not proposed for areas where the exact spill locations were unknown.

The purpose of Task 1 is to address the requirements of the Consent Order for the conduct of soils investigations in the vicinity of each WMU. The approximate boundaries (where known) of the individual WMUs included in the investigation, in addition to proposed sample location points, are illustrated in Figure 5-1 . It is important to note that the information contained in Table 5-1 was derived from the Consent Order, and environmental assessments performed at the site. The RFA is believed to contain numerous factual inaccuracies. CCR discusses these inaccuracies and efforts are being made at present to identify and resolve this issue.

Unit Number/Name

TABLE 5-1

WASTE MANAGEMENT UNITS

| Status | Wastes Received |
|---|---|

For the purposes of this discussion, even though the samples will be collected at some shallow depth below ground surface, they will be referred to as surface soil samples because of the collection technique. This sampling effort has been designed to provide characterization of shallow soils adjacent to each WMU and several additional areas. At the majority of the locations, samples will be analyzed for the eight key organic constituents . Analytical parameters per sample site will be

discussed in detail in Section 5.3 of this document. If the presence of contamination is confirmed at any one of the waste management units or other areas, more detailed contaminant characterization sampling (Phase II) will be proposed.

### 5.2.1.1 Drum Storage WMUS

There are several drum storage areas included in the RFI. They are located in both the Western and Eastern sections of the facility. The facility is a RCRA regulated unit which is an active unit and is presently entirely concreted and diked.

Samples at all locations will be collected in the interval from 1 to 2 feet below the top of native materials. This interval has been specified because of the possibility that the top one foot of native materials may have been mixed, moved around and possibly contaminated by other materials during grading and paving operations. Subgrade materials (gravel, sand, etc.) and fill material that visually appear to have been artificially placed at the locations will also not be sampled.

Assuming access permission can be obtained three off-site soil/sediment samples, therefore, will be collected in the drainage ditch at the locations shown on Figure 5-1. Sample locations DD-1 through DD-3. The samples will be collected in the interval from 1 to 2 feet below ground surface. The interval from 0 to 1 foot will be not be composited in order to remove soils that have been in direct contact with the elements (sun, rain, etc.), which tend to volatilize or otherwise decrease organic compound concentrations in the soils. Also, windblown surficial debris can contribute contamination from off-site areas.

Background Sampling

In order to establish background concentration levels for the various site specific contaminants, it will be necessary to obtain data from various surrounding evaluations currently being studied by other companies in the area. Because of potential access restrictions on off-site private property, it may not be feasible to mobilize a drilling rig to the preferred off-site locations . If this is the case, access will be sought for two hand auger borings per location, with samples collected at the 5, 7, and 10 foot depths.

The on-site boring has been sited, based on historical aerial photographs, for that portion of the present facility which has had the least activity. The intermediate 10, 15 and 20 foot sample depths were chosen to coincide with sample intervals in other borings and maximize the vertical distribution of the analytical data. The final sample will be collected frm the bottom of the borehole in order to document concentrations at the maximum drilled depth. According to existing data, a 20-foot thick aquitard consisting of fine-grained materials exists belaw the site at an approximate depth of 30 feet. The 30 foot sample depth was selected in order to sample the aquitard and confirm its existence, but not penetrate it. If the aquitard is deeper than 30 feet, the nominal 40-foot sample is designated as the total depth. Subsurface soil samples for lithologic analysis will be collected at five foot intervals throughout the total drilled depth of the borehole. All lithologic samples will be stored on-site in plastic, ziplock bags for possible future reference.

The on-site background boring (BG-l) will be placed as illustrated in Figure 5-1. The approximate off-site boring locations (BG-2, -3 and -4) are shown in Figure 5-3.

The shallow soil borings, designated as SB-l through SB-8 on Figure 5-1, will be installed at the

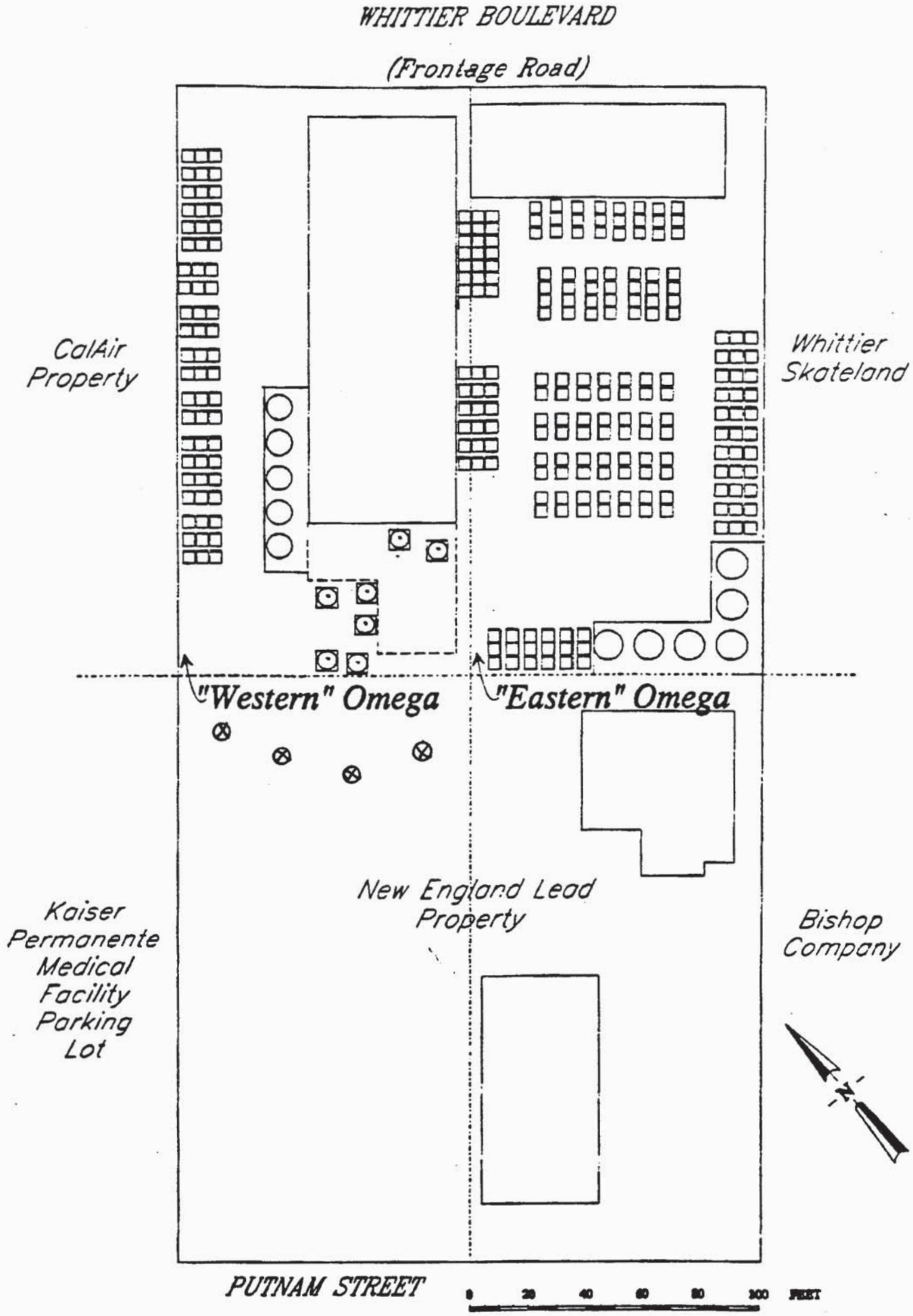



FIGURE 5-3 PROSOSED OFF-SITE BORINGS

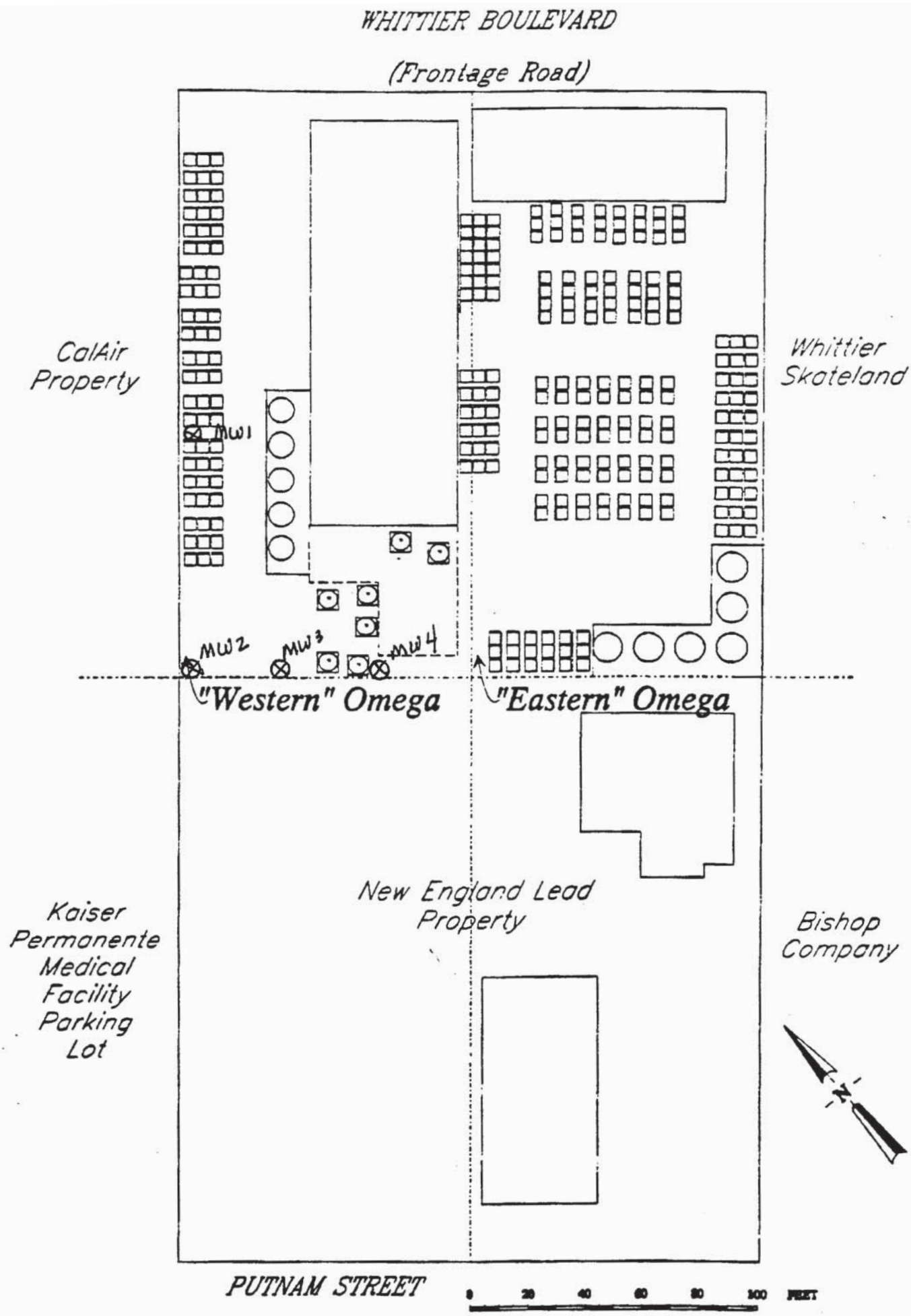



FIGURE 5-3A PROPOSED ON-SITE MONITORING WELLS

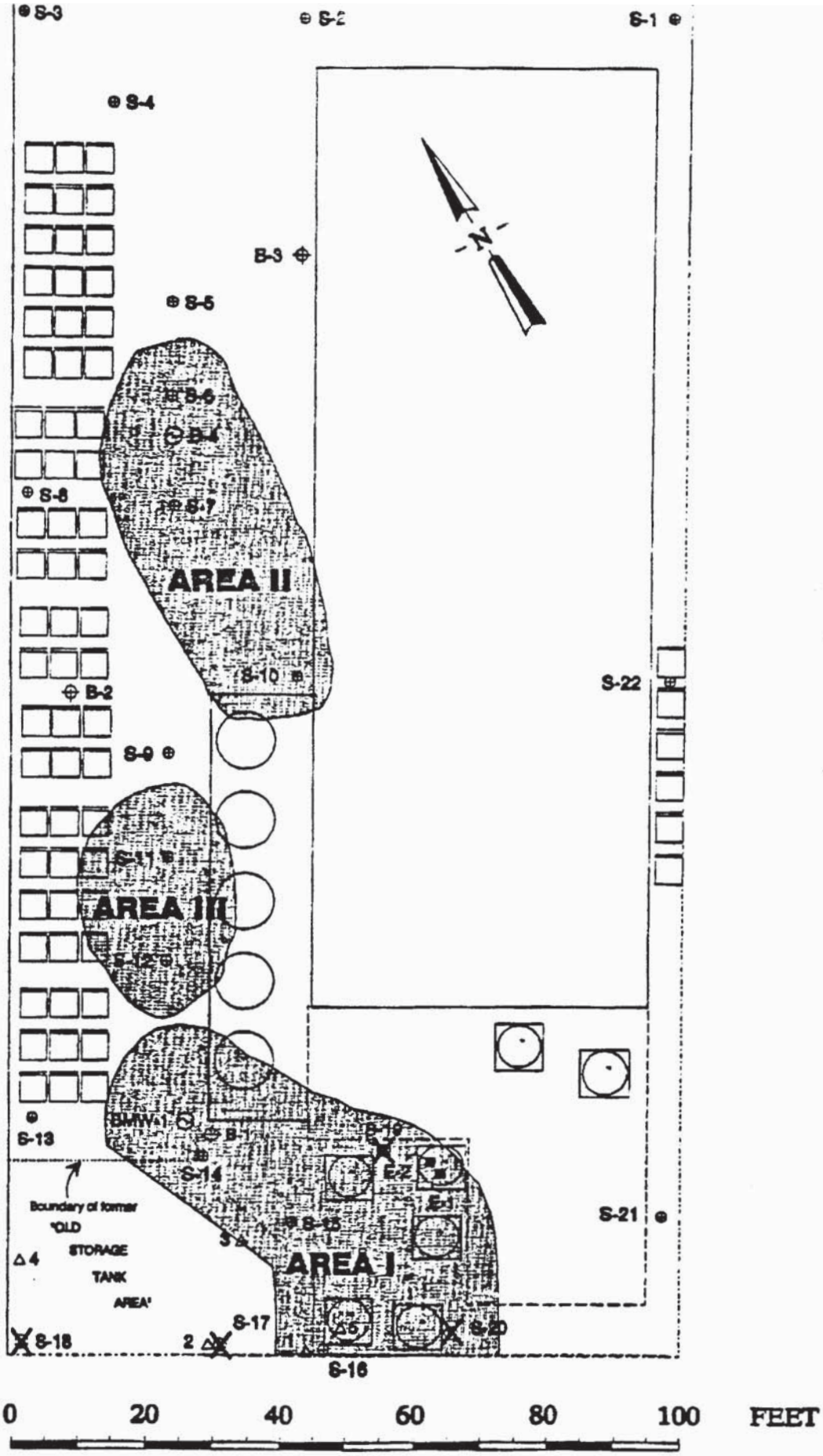

S-3
S-2
S-1
S-4
B-3
S-5
B-6
B-4
S-8
S-7
AREA II
S-10
S-22
B-2
S-9
S-11
AREA III
S-12
S-13
BMW-1
B-1
S-14
Boundary of former
'OLD
STORAGE
TANK
AREA'
S-15
AREA I
S-21
S-17
S-18
S-20
S-16
N
0
20
40
60
80
100
FEET

FIGURE 5-3B

**KEY**

| | | |
|---|---|---|
| *LRC Borings (1985)* | *1, 2, 3, 4, 5* | △ |
| *L & A Soil Samples Under UST (1987)* | *E-1, E-2* | ■ |
| *ENSR Borings (1988)* | *B-1, B-2, B-3, B-4* | ⊕ |
| *ENSR Water Wells (1988)* | *BMW-1* | ⊖ |
| *ERT Soil Vapor Points (1988)* | *S-1 to S-16, S-21, S-22* | ⊕ |
| *ERT Point not analyzed* | *S-17 to S-20* | ⊗ |

*NOTE: S-17 and B-2 overlap*

FIGURE 5-3C

locations where waste handling units apparently existed in the past but no site-specific subsurface information currently exists. In general, the majority of these borings will have samples collected for laboratory analyses at depths of 5, 10, 15, 25, and 30 feet. The analytical parameters for all soil boring samples are discussed in Section 5.3.2. During drilling and sampling, all soil samples will be screened with a portable organic vapor detector. If readings above calibrated background are observed for samples not presently scheduled for analysis, all such samples will also be submitted for 8240 and total organic carbon (TOC) analyses.

### 5.2.2.2 Ground Water Monitoring Well Installations

A total of four monitoring well pairs will be completed at the locations illustrated on Figure 5-1. As shown, the well pair locations have been selected to provide one additional well pairs which are generally upgradient of the major sources of contamination, and three additional well pairs downgradient. At each location, one shallow (approximately 75 feet in depth) and one deep (approximately 110 feet in depth) well will be installed. As discussed previously, all existing site hydrogeologic data indicate that the base of the Hollydale Aquifer occurs at a depth of approximately 110 feet. The horizontal distribution of wells is designed to document more fully off-site contamination character (well pairs MW1) and downgradient contamination extent (well pairs MW2, 3, and 4 ). The differing screened completion depth at each pair will provide information on piezometric elevations and concentration levels in the deeper interval.

Three soil samples for laboratory analysis (one in the unsaturated zone at approximately 25 feet, one in the middle of the shallow well perforated section at approximately 60 feet, and one at the top of the aquitard at the base of the Hollydale Aquifer at approximately 110 feet, if possible) will be collected during drilling at all deep well sites. Additional subsurface soil samples will be collected from MW-l at depths of 1, 5, 10, 15, 20, 30 and 40 feet. These depths are comparable to sample intervals in background borings BG-2 through BG--4. Additional soil samples will also be collected from MW-2, 3, and 4 at 5, 10, 15, and 40 feet in order to further characterize soils and possible contaminants in the . Analytical parameters are presented in Section 5.3.2. Soil sample analyses will be used to document both organic contamination at each location, and when coupled with ground water data, provide information on adsorption (and hence migration/ mobility) characteristics. It is important to emphasize that this well installation program is presented as a phased approach. If ground water contamination is detected , additional wells may be required. Such a second phase, if necessary, will be discussed in detail with the EPA and DHS once analytical results are available.

It is also important to note, that while three soil samples for laboratory analysis will be collected from each of the three deep monitor well locations, soil samples for lithologic analysis and organic vapor screening will also be collected with the split spoon at 5 foot intervals during advancement of the borehole. Previous investigations have noted the impracticality of using the hollow-stem auger technique below a depth of 45 feet. Therefore, it is possible that a combination hollow-stem auger/rotary drilling rig will be required to install the monitoring wells. Hollow-stem auger will continue to be the drilling technique of preference. If loose sands restrict the use of augers at depth, rotary drilling methods will be implemented. It is hoped that air, water, or light foam will be sufficient drilling fluids to maintain borehole integrity; light muds will be used only as a last resort. Assuming a change to rotary drilling methods below a depth of 45 feet, it may not be feasible to collect split-spoon samples at every five foot interval below that depth. Samples will continue to be collected and logged at five foot intervals, but only those which are "undisturbed" (i.e., split spoon versus cuttings) will be considered appropriate for laboratory analysis.

The shallow well of each of the four well pairs will be completed to a depth of approximately 70 feet below ground surface. Perforations, therefore, will extend from approximately 50 to 70 feet in depth, roughly equivalent to the intervals screened in the majority of the existing on-site wells. Generally, well screens in water table (unconfined) type aquifers are positioned to allow the perforated section to straddle the air-water interface in order to detect floating, imiscible layers. Care will be exercised to not extend the perforations through any confining layer, thereby creating a vertical conduit for the downward migration of possible surficial contaminants.

The four deeper wells will be completed to a depth of approximately 110 feet below ground surface. Deep monitoring wells will be screened . Completion details for the deep wells are identical to the new shallow wells, with the exception of the placement of a shorter screened section (15 versus 20 feet) in the lower portion of the deep well. Again, this is in keeping with- the desire to match the screened interval of the new deep well .

### 5.2.3 Task 3 - Ground Water Sampling

After the newly installed wells have had tine to equilibrate with their surroxmdings, ground water sampling activities will comwnce. Samples for laboratory analysis will be collected from the four newly installed wells. Two full rounds of samples will be collected over a three month period. one of the rounds will coincide with quarterly ground water sampling activities. The data from the two full rounds will be used to provide concomitant analyses of all wells across the site, to address regulatory agency concerns for complete site characterization and short-tem temporal changes thereof. Long term trends will be quantified from monitoring well data over the period of a year.

Quarterly monitoring requires analysis for the following compounds: purgeable halocarbons/aromatics by EPA Methods 601/602,. In addition, four replicate analyses for the indicator parameters TOC, TOX, (total organic halogenated compounds) pH, and specific conductance (EC) will be performed quarterly . Both rounds of samples will be analyzed for the first group of parameters noted abovel. During the first round, Wells will also be analyzed for RCRA 40 CFR Part 264 Appendix IX parameters. A survey will be conducted in order to identify ground water production wells and potential receptors within a three-mile radius of the subject facility.

The objectives of subsurface investigations during the RFI are threefold:

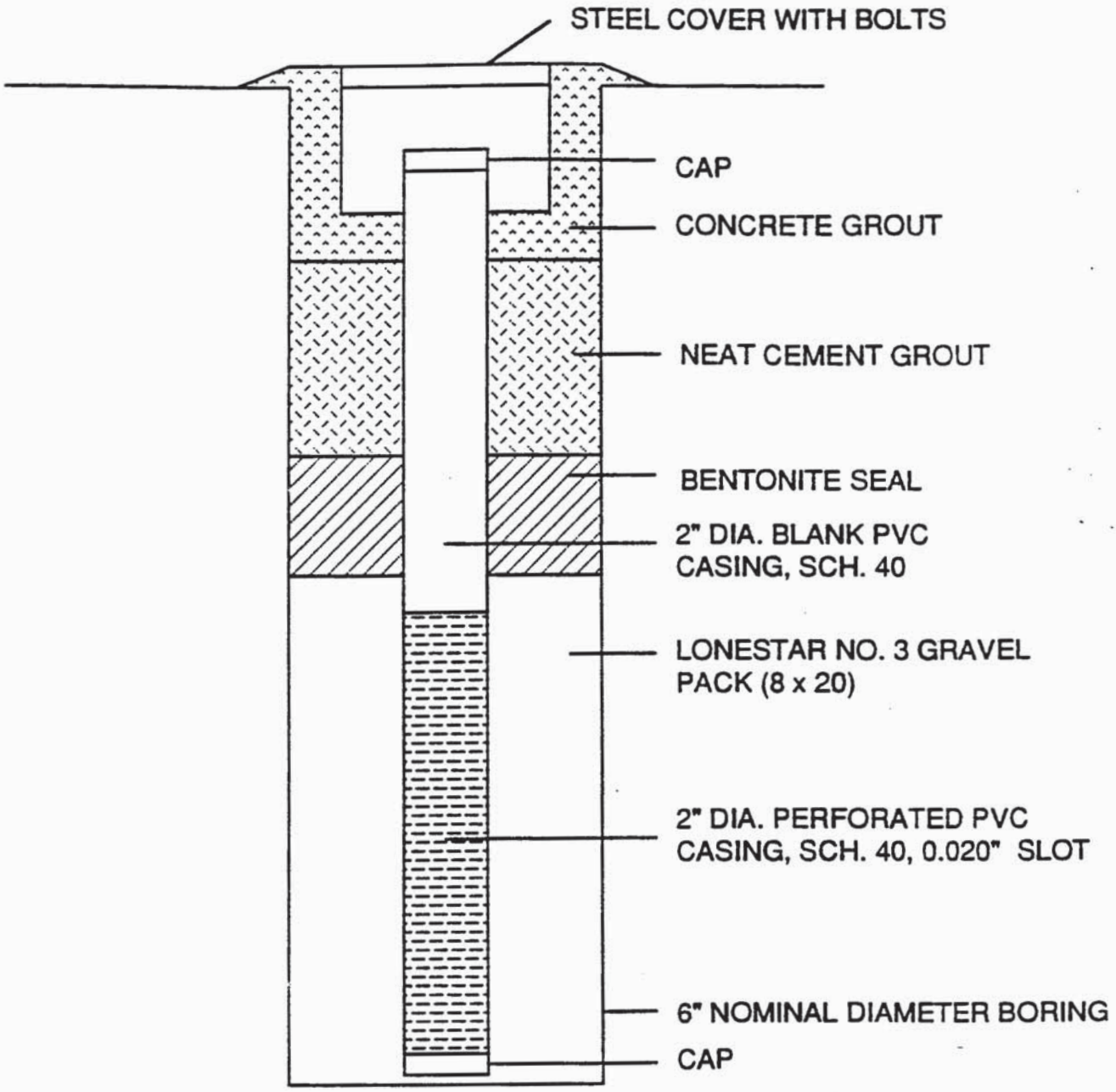
1. To collect soils chemistry data which more clearly define the distribution of specific organic contamination.

2. To define the lateral and vertical extent of contamination .

3. To collect adequate soils chemistry data to allow design of an effective Corrective Measure.

Toward these objectives, a two-phased approach is recommended.

Ground water data collected to date from downgradient wells have shown little or no detectable concentrations of organic chemical compounds. This is not surprising, given the prevalence of clay materials between 30 and 50 feet in depth across the site, and the relative immobility of the heavier petroleum fractions which appear to comprise the majority of the contamination. once the horizontal




NOT TO SCALE

MONITOR WELL CONSTRUCTION DETAILS
PROPOSED SCHEMATIC

FIGURE 5-4

extent of contamination has been defined, the placement of an additional ground water monitoring well downgradient of the area is proposed, if subsurface conditions and other factors are favorable to its placement in the proposed area. The additional monitor well will be located southwest of the area

## 5.3 Field Procedures

The site-specific procedures described in the following section are based upon sampling procedures developed for the performance of remedial response activities at hazardous waste sites . The applicable standard procedures may be found in Attachment 4-1 of this SAP. The procedures have been modified in Section 4.3, where appropriate. Prior to the initiation of intrusive sampling activities, an underground utility check of the facility and off-site boring location will be performed.

In accordance with regulatory agency concerns regarding a complete analytical characterization of surface and subsurface soils below the facility, A total of profile locations were selected, therefore, based on activities/areas of concern. The locations selected also provide for good spatial distribution across the facility.

The expanded suite of paramters at these profile locations . This will provide an in-depth screening of possible organic contamination at the site. In addition, batch leaching studies will be conducted on one sample from each profile location. Samples from each depth will be logged and preserved while the Sw 6010 analysis and pH are run. The depth showing the highest organic chemical concentration will be determined and the archived sample from that depth will then be submitted for leaching studies.

Leaching studies will be conducted according to established TCU procedures using a 0.01 molar solution of calcium chloride in deionized water as the extraction solution. The results of this study will be used to predict the mobility of the soil contaminants during the Corrective Measures Study (CMS). Batch-type tests use a larger soil to water ratio than actually exists in the field and are run under more turbulent conditions than a typical column study. The resulting contaminant concentrations in the collected leachate, therefore, may be higher than what actually occurs at the site under natural leaching conditions. Additional column studies may be appropriate during the CMS to evaluate specific in situ remediation technologies for contamination removal.

### 5.3.1 Task 1 - Surface Soil Sampling

The majority of the facility is paved with concrete. Therefore, prior to initiating sample collection activities, a concrete breaker or cutter will be used to expose the native materials at each surface soil sampling location. All sampling will then be conducted with a hand-auger. upon the completion of sampling activities, all holes will be backfilled with excavated materials, compacted, and patched with cement or asphalt, as appropriate.

At each sampling location covered by concrete, an approximate one foot square section will be cut out and removed, allowing enough space to relocate the hand boring in case refusal is met at depth and auger samples will be analyzed for the additional parameters at the depths noted on Table 4-3.

#### 5.3.1.1 Monitor Well Installations

<u>.Subsurface Soil Sampling</u>

Subsurface soil samples for laboratory analysis will be collected from the deeper well at each of the four ground water monitoring well sites at the depths noted in Table 5-5. All samples will be analyzed for organic chemical constituents. Samples collected from will also be analyzed for the expanded analytical parameters shown in Table 5-3. The first sample will be collected, via the split-spoon sampling technique, in the unsaturated zone. The second sample will be collected in the saturated zone, adjacent to the approximate middle of the shallow well perforated casing. An attempt will be made to drill all monitoring well boreholes with the hollow-stem auger technique. Because of possible adverse drilling conditions, however, it is possible that the drilling method will be converted to rotary at depths in excess of 45 feet during drilling of the ground water monitoring well boreholes. If such is the case, it may not be feasible to collect split-spoon samples for laboratory analysis for each interval below that depth. Lithologic samples will, however, continue to be collected at five foot intervals.

The rotary technique employs a rotating bit to advance the borehole, and the addition of drilling fluid additives (foam, polymer, bentonite, etc.) mixed with water to remove soil cuttings from the bottom of the borehole. During advancement of the borehole, the drilling fluid deposits a coating on the inside of the boring (referred to as wall-cake), which serves to stabilize the boring and minimize fluid infiltration into the adjacent geologic formations at depth. The use of bentonite as a drilling fluid additive will not be allowed because of associated problems with monitor well development. Lithologic samples will be collected at 5 foot intervals throughout the entire drilled depth of each monitor well borehole, and described in accordance with the procedures discussed in Section 5.3.1 of this SAP.

Well Completion Details

Each well will be completed with 2-inch diameter, schedule 40, flush joint, threaded and coupled polyvinylchloride (PVC) blank casing and screen. The bottom 20 feet of each shallow well and 15 feet of each deep well will consist of 0.020-inch (20 slot) perforated PVC casing. The annular space (annulus) between the borehole wall and the outside of the casing will be filled using a number of different materials. Lone Star No. 3 (8 x 20 blend) gravel pack will be used to fill the annulus from the bottom of each well to approximately 5 feet above the top of the perforations. This size gravel pack is selected as the most appropriate for the anticipated materials in the completion interval. Because split spoon samples will not be truly representative of all of the soil media in the completion zone, sieve analyses will not be used to precisely specify slot size. Because of time constraints and other technical considerations, sieving is generally not considered practical nor is it commonly employed in determining monitor well perforation and gravel size. A conservative 0.020-inch opening with an 8 x 20 blend gravel pack was selected for the new monitoring wells because that combination is commonly used in Southern California by Mesa and other geotechnical firms and drilling contractors.

Therefore, this combination has been proven to be effective and will be used to complete the new well installations. Sieve analyses, however, will be available for use should turbidity problems be encountered. A minimum 3-foot thick bentonite seal (pellets or volclay grout) will be placed above the top of the gravel pack. The remainder of the annulus will be filled with cement bentonite grout to within several feet of ground surface. The casing string, filter pack, and annular seal materials will be introduced through the inside of the hollow-stem augers as they are withdrawn, if possible, to ensure placement of the casing and annular fill materials at their intended depths.

The use of concrete for added strength will be allowed in the annulus above the cement to construct

the at-grade surface completion. Each well will be finished with a well head box with a moisture and tamper-resistant lid. Well head boxes will be set 1 to 2 inches above grade, with a finished, raised concrete apron surrounding them to minimize the entry of surface fluids and runoff into the well. Each well will be capped and locked after the completion of well construction activities. Proposed well design is illustrated in Figure 5-4.

Well Development

The wells will be developed by swabbing, bailing and air-lifting, as appropriate. Swabbing consists of installing a close fitting, vented surge-block in the well on a wire line and gently moving it up and dawn inside the well, adjacent to the perforated interval. The swabbing action flushes water through the perforations, resulting in compaction of the filter pack and removal of fine-grained materials. It also serves to break up and remove filter-cake built up on the inside of the borehole, if rotary drilling methods were used. These materials then settle to the bottom of the well where they are removed by bailing. Swabbing and bailing is the preferred method of well development and will be performed on all newly installed ground water monitoring wells. If swabbing and bailing do not permit adequate development, air-lifting methods may be employed. Air-lift development consists of inserting an air line inside the well and using compressed air to lift water and solids from the well. occasionally, the air supply is shut off, resulting in the column of water falling back into the well. This surging action assists in well development by moving water back and forth through the screen and flushing the gravel pack. when no appreciable amounts of solids are pulled through the screen and the discharge water is relatively clear, development is terminated. In no case will less than 50 gallons of water be evacuated from each well. Upon the completion of well development activities, the bottom of the well will be measured with a bottom sounder to determine that it is free of accumulated sediments. If more than one foot of fill material is present, the excess material will be bailed.

Containment of Soil Cuttings/Well Development Water

Because of the possibility of encountering contamination at depth, all soil cuttings generated during drilling activities will be contained in 55gallon steel ring-top drums, for temporary storage and eventual disposal by Omega. In order to minimize the amount of possibly contaminated soils which Omega will be required to dispose of at a hazardous waste landfill, soils exhibiting visible, olfactory or PID indications of contamination will be segregated in different drums from those that do not. In addition, cuttings from different borings will be contained in separate drums. Mesa field persomel will label each drum with boring/Well number, depth interval, matrix, etc., clearly identified. Analytical results obtained from the drilling and sampling program will be used to characterize the materials contained in each drum. Where available data are inadequate to characterize drxm contents, additional conffsite samples will be collected from each drum in question.

All well development water will be temporarily stored in 55-gallon plastic ring-top drums provided by Omega. The developmnt water will be treated in the facility wastewater treatment system prior to disposal by Omega into the sanitary sewer system in accordance with its permit with the Los Angeles Sanitation District Permit. It will not be necessary to characterize the well development water because it will be incorporated into the facility wastewater treatment system. The volume of well development water (estimated at approximately 50 to 100 gallons per well) is considered insignificant . In addition, the quality of the treated water discharged into the sanitary sewer system is monitored as required by the Permit.

Well Head Elevation Survey

TABLE 5 - 3

HOLLOW-STEM AND HAND AUGER PROFILE BORINGS

EXPANDED ANALYTICAL PARAMETERS

| PROFILE BORING | SAMPLE INTERVAL (feet) | | VOA 8240 | Semi VOA 8270 | pH |
|---|---|---|---|---|---|
| MW 1 | 1 to 2 | | x | x | x |
| | 5 | | x | | |
| | 10 | | x | x | x |
| | 20 | | x | | |
| | 30 | | x | x | x |
| | 40 | | x | | |
| | 50 | | x | x | x |
| | 60 | | x | | |
| | 70 | | x | x | x |
| | | | | | |
| MW 2 | 1 to 2 | | x | x | x |
| | 5 | | x | | |
| | 10 | | x | x | x |
| | 20 | | x | | |
| | 30 | | x | x | x |
| | 40 | | x | | |
| | 50 | | x | x | x |
| | 60 | | x | | |
| | 70 | | x | x | x |
| | | | | | |
| MW 3 | 1 to 2 | | x | x | x |
| | 5 | | x | | |
| | 10 | | x | x | x |
| | 20 | | x | | |
| | 30 | | x | x | x |
| | 40 | | x | | |
| | 50 | | x | x | x |
| | 60 | | x | | |
| | 70 | | x | x | x |
| | | | | | |
| MW 4 | 1 to 2 | | x | x | x |
| | 5 | | x | | |
| | 10 | | x | x | x |
| | 20 | | x | | |
| | 30 | | x | x | x |
| | 40 | | x | | |
| | 50 | | x | x | x |
| | 60 | | x | | |
| | 70 | | x | x | x |

Upon the completion of all drilling and construction activities, well-head elevation to the nearest 0.01 foot will be determined for all new wellsites. A reference point on the top of the protective steel cover will be established and marked at each location.

### 5.3.1.2 Sample Handling

Upon removal of the sample-filled rings from the split-spoon sampler, teflon sheeting will be placed over the ends of the ring selected for laboratory analysis. Plastic end caps will then be placed over the teflon sheeting and securely taped in place. All samples will be labeled with sample number, parameters of analysis, and date and time of sampling. The sample will then be placed inside a plastic zip-lock freezer bag, sealed, and immediately inserted inside an ice-filled cooler. Sample filled coolers shall be delivered to the laboratory at the end of each day's sampling by Mesa sampling team members. A Chain of Custody (COC) fom will be completed for each sample cooler delivered to the analytical laboratory.

## 5.3.2 Task 3 - Ground Water Sampling

Ground water samples for laboratory analysis will be collected from the 4 newly installed wells at the facility. Ground water sampling consists of several discrete subtasks which will be described in the following sections. Sampling will be initiated at the background well first, then downgradient wells in order to minimize the possibility of cross-contamination. Prior to the initiation of ground water sampling activities, the Los Angeles Regional Water Quality Control Board and DHS will be notified and provided an opportunity to observe the sampling activities and collect duplicate and/or split samples if they so desire.

### 5.3.2.1 Organic Vapor Check

Prior to the initiation of well evacuation procedures, the interior of each well will be checked with the PID for the presence of organic vapors. with the sampling team members standing upwind of the well, the well cap will be opened slightly, allowing for the insertion of the PID probe tip inside the well. Readings (generally in parts per million) will be monitored until they stabilize. The final reading, as well as the peak reading, will be recorded in the field log book. The cap will then be removed and the well allowed to vent for a shoi:t period of time prior to measuring static water level.

### 5.3.2.2 Static Water Level/Well Depth measurement

Prior to initiating well evacuation procedures, the static water level at each well will be measured with a decontaminated electric water level indicator (sounder). Prior to first use and then weekly thereafter, the sounder will be calibrated and the noter response checked. The measuring (reference) point used will be noted, and the depth to water below the reference point will be measured to the nearest 0.01 foot and recorded in the field log book. Well head elevation data will be used with depth to water measurements to calculate ground water elevation at each well location.

The bottom of the well will also be measured, with the sounder or a weighted fiberglass tape, to the nearest 0.1 foot. The amount of fill material in the bottom of the well will be calculated from well construction data, and will be noted in the log book. The sounder will be decontaminated after each use in accordance with the procedures described in Section 4.4.1 of this document.

### 5.3.2.3 Detection of Immiscible Layers

In order to detect the presence of any floating, immiscible layers on top of the ground water surface, a clear teflon bailer will be lowered approximately one-half its length below the surface of the water. The bailer will be removed from the well and its contents checked for immiscible layers or iridescence. The PID probe will also be inserted inside the bailer to check for volatile emissions. If immiscible fluids are detected, a sample will be collected for laboratory analysis of purgeable halocarbons and aromatics (EPA Method Nos. 601/602) and total petrolelum hydrocarbons (modified method 8015). The bailer will be decontaminated and the sampling line discarded after each use.

### 5.3.2.4 Purge Volume Determination/Well Evacuation

Saturated casing volume will be calculated at each well by using the depth to water and bottom sounding measurements obtained in the previous steps, to calculate the amount (height) of the saturated well casing. The inside diameter of the casing will then be measured, and the following formula will be applied:

Volume - n radius2 X height

A minimum of three saturated casing volumes of water will be evacuated from each well prior to collecting a ground water sample for laboratory analysis.

The decontaminated sampling apparatus (a Geoguard bladder/air lift pump) will be installed inside each well to the approximate middle of the perforated section. The Geoguard system has the option to be used as either an air lift pump for well evacuation, or a bladder pump for actual sample collection. At the shallow well sites where purge volume is minimal, the bladder pump will be used for both well evacuation and sample collection. At the deeper well sites, the air lift pump option will be used for the purposes of well evacuation. The air lift pump will be removed and the apparatus fitted with a bladder pump when the actual ground water samples will be collected. The pump body is constructed with stainless steel and teflon, with a teflon bladder and teflon lined coaxial tubing.

Prior to initiating well evacuation procedures, the red line on the conductivity meter will be checked and adjusted where necessary. Meter calibration will be checked-by inserting the probe in a known solution and comparing the result with the standard. It is not possible to field calibrate the YSI model 33 SCT Meter which will be used for the conduct of the field program. This is not considered problematic since the laboratory will be determining the actual EC of the ground water s&nple. The meter is used for field screening purposes only, and is used to determine the stability of the discharge water field parazneters prior to collection of a laboratory sample. In addition, a two point calibration (pH 7 alnd 10) will be performed on the Orion Model SA 250 pH Meter prior to actual use.

Periodically during well evacuation, the field parameters (temperature, salinity, EC, and pH) of the discharge water shall be measured and recorded in the log book. The physical appearance of the water (turbidity, color, sediment content, etc.) shall also be noted and recorded. Flow rate shall occasionally be measured using a calibrated container and stop watch. After a minirmim of three saturated casing volumes of water have been evacuated from each well and the field parameters have stabilized (change between readings of less than 5 percent), a sample for laboratory analysis will be

TABLE 5 -4 - SUMMARY OF CHEMICALS PRESENT IN BORINGS, SOIL SAMPLES AND MONITORING WELL ON OMEGA PROPERTY IN PPB (ug/kg) [[OR PPM (mg/kg)]

| | 1,1,1-Tri-chloro-ethane | Methylene chloride | Tri-chloro-ethylene | Tetra-chloro-ethylene | 1,2-Di-chloro-ethane | Ace-tone | Chlor-oform | 2-But-a-none | 4-methyl-1,2,2-penta-none | Tri-chloro-fluoro-ethane | 1,1-Di-chloro-ethylene | 1,1-Di-chloro-ethyne | 1,1,2-Tri-hloro-1,2,2-fluoro-ethane | Tol-uene | 1,1-Di-chloro-ethane | 1,1,2-Tri-chloro-ethane | Ethyl-enzene | ortho-Xylene | Total Xylene | Ben-zene | Total hydro-car-bons | Trans-1,2-Di-chloro-ethyl-ene |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Abbrev. | 1,1,1-TCA" | "MC" | TCE | PCE | "1,2-DCA" | "ACE" | "CHF" | MEK | "MP" | "TCFM" | DCE | "DCY" | TTE | "TOL" | "1,1-DCA" | 1,1,2-DCA" | EB | "O-X" | "T-X" | "BNZ" | "T-HC" | "T-DCE" |
| Density | 1.3376 | 1.3255 | 1.4649 | 1.6230 | 1.2569 | 0.788 | 1.484 | 0.81 | 0.8 | 1.494 | 1.2129 | XXX | 1.59 | 0.87 | 1.757 | 1.4416 | 0.866 | 0.88 | ~0.86 | 0.879 | n/a | ~1.28 |
| EPA No. | U226 | U080 | D040 | 210/D039 | D028 | U002 | D022 | U159 | U161 | U121 | 078/D029 | | F002 | U220 | UNC | UNC | UNC | UNC | UNC | D018 | | U079 |
| EPA 1 MCL | 200 | 5 | 5 | 5 | 5 | ? | 100 | 200 | ? | — | 7 | ? | — | 1000 | — | 5 | 700 | ? | 10000 | 5 | — | 100 |
| CA 1 MCL | 200 | — | 5 | 5 | 0.5 | ? | 100 | ? | ? | 150 | 6 | ? | 1200 | — | 5 | 32 | 680 | ? | 1750 | 1 | — | 10 |
| SAMPLE | | | | | | | | | | | | | | | | | | | | | | |
| B1 (1988) (36'TD) EPA 8240 | | | | | | | | | | | | | | | | | | | | | | |
| 10 | 12 | ND | ND | 20 | - | 56 | 7 | 12 | 11 | ND | ND | ND | ND | 10 | - | - | - | - | - | - | - | - |
| 25 | 54 | ND | 32 | 129 | - | ND | 10 | 5 | ND | ND | ND | ND | ND | 5 | - | - | - | - | - | - | - | - |
| 35 | 75 | ND | 42 | 257 | - | 112 | 9 | 6 | ND | ND | ND | ND | ND | ND | - | - | - | - | - | - | - | - |
| B2 (1988) (26'TD) | | | | | | | | | | | | | | | | | | | | | | |
| 5 | 7 | ND | 19 | 84 | - | ND | ND | 24 | ND | ND | ND | ND | ND | 24 | - | - | - | - | - | - | - | - |
| 15 | 9 | ND | 45 | 127 | - | ND | ND | 12 | ND | ND | ND | ND | ND | 8 | - | - | - | - | - | - | - | - |
| B3 (1988) (20'TD) | | | | | | | | | | | | | | | | | | | | | | |
| 20 | ND | 69 | ND | 5 | - | 35 | ND | 11 | ND | ND | ND | ND | ND | 7 | - | - | - | - | - | - | - | - |
| B4 (1988) (60'TD) | | | | | | | | | | | | | | | | | | | | | | |
| 30 | 23 | 96 | 143 | 143 | - | ND | ND | ND | ND | ND | 12 | ND | 60 | ND | - | - | - | - | - | - | - | - |
| 50 | 27 | 141 | 350 | 266 | - | ND | ND | ND | ND | ND | 32 | ND | 436 | ND | - | - | - | - | - | - | - | - |
| BMW1 (1988) (110'TD) | | | | | | | | | | | | | | | | | | | | | | |
| 55 | 874 | 2650 | 156 | 854 | - | ND | ND | ND | ND | 156 | 222 | 19 | 155 | ND | - | - | - | - | - | - | - | - |
| —WT | | | | | | | | | | | | | | | | | | | | | | |
| 75 | 74 | 80 | 23 | 98 | - | ND | ND | ND | ND | 146 | 36 | ND | 880 | ND | - | - | - | - | - | - | - | - |
| BMW1 Water Samples (1988) ---- EPA 624 | | | | | | | | | | | | | | | | | | | | | | |
| 0.00487013 | 2080 | 650 | 258 | 1030 | - | ND | ND | - | - | 1540 | 1080 | - | 5240 | - | - | - | - | - | - | - | - | ND |
| 0.004261364 | 2150 | 260 | 160 | 667 | - | ND | 24 | - | - | 1718 | 836 | - | ND | - | - | - | - | - | - | - | - | 9 |
| 0.003246753 | 2200 | 280 | 120 | 510 | - | 160 | ND | - | - | ND | 510 | - | ND | - | - | - | - | - | - | - | - | ND |

ND = NOT DETECTABLE

UNC= UNCLASSIFIED

- = NOT TESTED FOR OR NOT DETECTABLE

XXX= This material is incorrect. It is impossible to have 1,1 Dichloroethyne, Ethyne is a triple bonded C-C molecule which has only one bond on either C for attached Chlorine. It could not have two chlorines attached at the first C.

TABLE 5 -4 - SUMMARY OF CHEMICALS PRESENT IN BORINGS, SOIL SAMPLES AND MONITORING WELL ON OMEGA PROPERTY IN PPB (ug/kg) [[OR PPM (mg/kg)]

| | 1,1,1-Tri-chloro-ethane | Methylene chloride | Tri-chloro-ethylene | Tetra-chloro-ethylene | 1,2-Di-chloro-ethane | Ace-tone | Chlor-oform | 2-But-a-none | 4-methyl-1,2,2-penta-none | Tri-chloro-fluoro-ethane | 1,1-Di-chloro-ethylene | 1,1-Di-chloro-ethyne | 1,1,2-Tri-hloro-1,2,2-fluoro-ethane | Tol-uene | 1,1-Di-chloro-ethane | 1,1,2-Tri-chloro-ethane | Ethyl-enzene | ortho-Xylene | Total Xylene | Ben-zene | Total hydro-car-bons | Trans-1,2-Di-chloro-ethyl-ene |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Abbrev. | 1,1,1-TCA" | "MC" | TCE | PCE | "1,2-DCA" | "ACE" | "CHF" | MEK | "MP" | "TCFM" | DCE | "DCY" | TTE | "TOL" | "1,1-DCA" | 1,1,2-DCA" | EB | "O-X" | "T-X" | "BNZ" | "T-HC" | "T-DCE" |
| Density | 1.3376 | 1.3255 | 1.4649 | 1.6230 | 1.2569 | 0.788 | 1.484 | 0.81 | 0.8 | 1.494 | 1.2129 | XXX | 1.59 | 0.87 | 1.757 | 1.4416 | 0.866 | 0.88 | ~0.86 | 0.879 | n/a | ~1.28 |
| EPA No. | U226 | U080 | D040 | 210/D039 | D028 | U002 | D022 | U159 | U161 | U121 | 078/D029 | | F002 | U220 | UNC | UNC | UNC | UNC | UNC | D018 | | U079 |
| EPA 1 MCL | 200 | 5 | 5 | 5 | 5 | ? | 100 | 200 | ? | — | 7 | ? | — | 1000 | — | 5 | 700 | ? | 10000 | 5 | — | 100 |
| CA 1 MCL | 200 | — | 5 | 5 | 0.5 | ? | 100 | ? | ? | 150 | 6 | ? | 1200 | — | 5 | 32 | 680 | ? | 1750 | 1 | — | 10 |
| SAMPLE | | | | | | | | | | | | | | | | | | | | | | |
| B1 (1985) ===== EPA Test 8120 ========== | | | | | | | | | | | | | | | | | | | | | | |
| 1' | ND | 2.89ppm | ND | 30.1ppm | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1.25' | ND | 1000ppm | ND | 1201ppm | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 3.5' | ND | 9.73ppm | ND | 89.0ppm | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 7' | ND | ND | ND | 0.18ppm | ND | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 8.5' | ND | ND | ND | ND | ND | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| B2 (1985) ——— | | | | | | | | | | | | | | | | | | | | | | |
| 1' | 75.1ppm | 8.28ppm | 9.4ppm | 9.55ppm | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 3.5-4' | ND | ND | ND | ND | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 5.5-6' | ND | ND | ND | ND | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| B3 (1985) ——— | | | | | | | | | | | | | | | | | | | | | | |
| 1' | ND | ND | ND | ND | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 3.5' | ND | ND | ND | ND | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 5.5-6' | ND | ND | ND | ND | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| B4 (1985) ——— | | | | | | | | | | | | | | | | | | | | | | |
| 1' | ND | ND | ND | ND | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 3.5' | ND | ND | ND | ND | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 5.5-6' | ND | ND | ND | ND | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| B5 (1985) ——— | | | | | | | | | | | | | | | | | | | | | | |
| 1' | 848ppm | 4.49ppm | 58ppm | 2064ppm | 25ppm | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 3' | ND | ND | ND | 0.69ppm | ND | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 5' | ND | ND | ND | 0.29ppm | ND | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 7' | ND | ND | ND | 0.19ppm | ND | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| E-1 (1987) ====== EPA 8010 and 8240 ========== | | | | | | | | | | | | | | | | | | | | | | |
| 10'(8010) | - | - | - | 0.24ppm | - | - | - | - | - | - | - | - | - | - | - | - | ND | 9 | ND | ND | 11ppm | - |
| EPA 8240 | ND | ND | - | 200 | - | 46 | - | - | 6 | - | - | - | - | ND | ND | ND | - | - | (EPA 8010) | — | (EPA 8015) | - |
| E-2 (1987) ——— | | | | | | | | | | | | | | | | | | | | | | |

TABLE 5-4 - SUMMARY OF CHEMICALS, DENSITIES AND AGENCY ACTION LEVELS

| CHEMICAL COMPOUND (NAME) | ABBREV. | DENSITY | EPA No. | CA DEPT.HEALTH SERVI Primary MCL | Second. MC | US E P A Primary MCL | econ. MCL | MCL Goal | CA ACTION LEVELS DEPT.HEALTH SERVICES TOXICITY | TASTE & ODO | SNARLs EPA | NAS | Prop.65 LEVELS | CHEMICAL COMPOUND (NAME) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **(Chemicals less dense than water)** | | | | | | | | | | | | | | |
| Acetone | "ACE" | 0.788 | U002 | | | | | | | | | | | Acetone |
| 2-Butanone (methyl ethyl ketone) | MEK | 0.805 | U159 | - | - | - | - | - | - | - | 200 | - | - | 2-Butanone (methyl ethyl ketone) |
| Total xylenes | "T-X" | ~0.86 | | 1750 | - | 10000 | 20 | 10000 | - | - | 10000 | - | - | Total xylenes |
| Ethylbenzene | EB | 0.866 | | 680 | - | 700 | 30 | 700 | - | - | 700 | - | - | Ethylbenzene |
| Toluene | "TOL" | 0.866 | U220 | - | - | 1000 | 40 | 1000 | 100 | - | 1000 | 340 | - | Toluene |
| Benzene | "BNZ" | 0.8787 | D018 | 1 | - | 5 | - | 0 | - | - | 200 | - | 3.5 | Benzene |
| ortho-Xylene | "O-X" | 0.8801 | | | | | | | | | | | | ortho-Xylene |
| **(Chemicals more dense than water)** | | | | | | | | | | | | | | |
| 1,1-Dichloroethylene | DCE | 1.2129 | 078/D029 | 6 | - | 7 | - | 7 | - | - | 7 | 100 | - | 1,1-Dichloroethylene |
| 1,2-Dichloroethane | "1,2-DCA" | 1.2569 | D028 | 0.5 | - | 5 | - | 0 | - | - | 700 | - | 5 | 1,2-Dichloroethane |
| Trans-1,2-dichloroethylene | "T-DCE" | ~1.28 | U079 | 10 | - | 100 | - | 100 | - | - | 100 | - | - | Trans-1,2-dichloroethylene |
| Methylene chloride (dichloromethane) | "MC" | 1.3255 | U080 | - | - | 5 | - | - 0 | 40 | - | 1500 | ### | 25 | Methylene chloride (dichloromethan |
| 1,1,1-Trichloroethane | "1,1,1-TCA | 1.3376 | U226 | 200 | - | 200 | - | 200 | - | - | 200 | ### | - | 1,1,1-Trichloroethane |
| 1,1,2-trichloroethane | "1,1,2-DCA | 1.4416 | | 32 | - | 5 | - | 3 | - | - | 3 | - | - | 1,1,2-trichloroethane |
| Trichloroethylene | TCE | 1.4649 | D040 | 5 | - | 5 | - | 0 | - | - | - | - | 30 | Trichloroethylene |
| Chloroform | "CHF" | 1.484 | D022 | 100 | - | 100 | - | - | - | - | 100/500 | - | 4.5 | Chloroform |
| Trichlorofluoromethane | "TCFM" | 1.494 | U121 | 150 | - | - | - | - | - | - | 2000 | ### | - | Trichlorofluoromethane |
| Tetrachloroethylene | PCE | 1.6230 | 210/D039 | 5 | - | 5 | - | 0 | - | - | 1000/5000 | | 7 | Tetrachloroethylene |
| 1,1-dichloroethane | "1,1-DCA" | 1.757 | | 5 | - | - | - | - | - | - | - | - | - | 1,1-dichloroethane |
| 1,1-Dichloroethyne | "DCY" | | | | | | | | | | | | | 1,1-Dichloroethyne |
| 4-methyl-1,2,2-pentanone | "MP" | | | | | | | | | | | | | 4-methyl-1,2,2-pentanone |
| 1,1,2-trichloro-1,2,2-fluoroethane | TTE | | | 1200 | - | - | - | - | - | - | - | - | - | 1,1,2-trichloro-1,2,2-fluoroethane |
| Total hydrocarbons | "T-HC" | n/a | | | | | | | | | | | | Total hydrocarbons |

TABLE 5 -6

GROUND WATER SAMPLE PARAMETERS

| WELL | KEY ORGANICS | PURGEABLE * HALOCARBONS | PURGEABLE ** AROMATICS |
|---|---|---|---|
| MW-1 | | | |
| MW -2 | " | " | " |
| MW-3 | " | " | " |
| MW-4 | " | " | " |

* EPA METHOD 601

** EPA METHOD 602

Note: All samples will be measured for temperature, conductivity, slainity, and pH in the Field

collected.

### 5.3.2.5 Sample Collection and Handling

Previous versions of this section have stated that sample collection at each individual well would be performed in order of volatilization sensitivity, and included a numerical listing of the sequence with which bottles would be filled. Since RCRA Appendix IX parameters have been added to the analytical suite at the well locations and indicator parameters in quadruplicate are collected. Generally, volatilization sensitivity is an important consideration when ground water sampling is conducted with a device which agitates the water inside the well casing (e.g., bailer). Presently, bladder pumps will be used at the facility for well evacuation and sampling purposes. volatilization due to sampling methodology, therefore, is not a concern.

Standard Mesa practice is to fill all VOA vials first, followed by other bottles with no headspace requirements. other glass and poly bottles are then filled last. This practice ensures that extra care is provided to sample bottles which require no headspace. Bottles for quadruplicate analyses are grouped together and filled as sets per parameter, as are bottles for duplicate analyses.

Ground water samples collected from the 4 new wells during the two sampling rounds will be submitted to the laboratory for analysis of the eight key organics, purgeable halocarbons/aromatics (EPA Methods 601/602), . As shown in Table 5-6, the wells have been selected for additional RCRA Appendix IX parameters during the first round of sampling (Appendix IX parameters are listed in Table 5-7). After the completion of RFI ground water sampling, subsequent quarterly rounds will be analyzed for the standard parameters discussed in Section 5.2.3 of this document.

A complete ground water sample summary has been provided in Table 5-8. Sample container type and volume, analytical methods, sarople holding times, and other comments are listed in Tables 5-9 and 5-10. It is important to note, that the bottle for metals analysis shall be filtered in the field using a 0.45 micron in-line filter.

Sampling persomel shall wear clean PVC gloves during all sample collection activities. Samples shall be placed inside precleaned bottles provided by the analytical laboratory. The laboratory shall also add preservative where appropriate. Sample bottles for organics analysis (purgeable halocarbons/aromatics, Tox and TOC) shall be filled completely, allowing no headspace. Sample bottles will be labeled with sample/,Well number, parameters for analysis, date and time of sampling, preservative (if used), and filtering (if performed). Filled sample bottles will be inserted into plastic bags and placed into ice-filled coolers immediately after collection. A COC fom will be completed for each sample cooler delivered to the analytical laboratory. Sample-filled coolers will be picked up by courier or hand-delivered by Mesa sampling persomel to the laboratory at the end of each day's sampling.

## 5.4 Field Quality Control Procedures

Field quality control will be accomplished by strict adherence to the field procedures set forth in this document, including but not limited to:

- Proper equipment decontamination according to procedures established in the SAP;
- Use of clean sample containers provided by the analytical laboratory;

TABLE 5-7

APPENDIX IX - GROUND WATER PARAMETERS

| Common Name | Suggested Methods | PQL (µg/L) |
|---|---|---|
| Acenaphthene | 8100 | 200 |
| | 8270 | 10 |
| Acenaphthylene | 8100 | 200 |
| | 8270 | 10 |
| Acetone | 8240 | 100 |
| Acetophenone | 8270 | 10 |
| Acetonitrile, Methyl cyanide | 8015 | 100 |
| 2-Acetylaminofluorene; 2-AAF | 8270 | 10 |
| Acrolein | 8030 | 5 |
| | 8240 | 5 |
| Acrylonitrile | 8030 | 5 |
| | 8240 | 5 |
| Aldrin | 8080 | 0.05 |
| | 8270 | 10 |
| Allyl Chloride | 8010 | 5 |
| | 8240 | 100 |
| 4-Aminobiphenyl | 8270 | 10 |
| Aniline | 8270 | 10 |
| Anthracene | 8100 | 200 |
| | 8270 | 10 |
| Antimony | 6010 | 300 |
| | 7040 | 2,000 |
| | 7041 | 30 |
| Aramite | 8270 | 10 |
| Arsenic | 6010 | 500 |
| | 7060 | 10 |
| | 7061 | 20 |
| Barium | 6010 | 20 |
| | 7080 | 1,000 |
| Benzene | 8020 | 2 |
| | 8240 | 5 |
| Benzo[a]anthracene; Benzanthracene | 8100 | 200 |
| | 8270 | 10 |
| Benzo[b]fluoranthene | 8100 | 200 |
| | 8270 | 10 |
| Benzo[k]fluoranthene | 8100 | 200 |
| | 8270 | 10 |
| Benzo[ghi]perylene | 8100 | 200 |
| | 8270 | 10 |
| Benzo[a]pyrene | 8100 | 200 |
| | 8270 | 10 |
| Benzl alcohol | 8270 | 20 |
| Beryllium | 6010 | 3 |
| | 7090 | 50 |
| | 7091 | 2 |

TABLE 5-7

APPENDIX IX - GROUND WATER PARAMETERS

| Common Name | Suggested Methods | PQL (µg/L) |
|---|---|---|
| alpha-BHC | 8080 | 0.05 |
| | 8250 | 10 |
| beta-BHC | 8080 | 0.05 |
| | 8250 | 40 |
| delta-BHC | 8080 | 0.1 |
| | 8250 | 30 |
| gamma-BHC; Lindane | 8080 | 0.05 |
| | 8250 | 10 |
| Bis(2-chloroethoxy)methane | 8270 | 10 |
| Bis(2-chloroethyl)ether | 8270 | 10 |
| Bis(2-chloro-1-methylethyl) ether | 8010 | 100 |
| 2,2'-Di-chlorodiisopropyl ether | 8270 | 10 |
| Bis(2-ethylhexyl) phthalate | 8060 | 20 |
| | 8270 | 10 |
| Bromodichloromethane | 8010 | 1 |
| | 8240 | 5 |
| Bromoform; Tribromomethane | 8010 | 2 |
| | 8240 | 5 |
| 4-Bromophenyl phenyl ether | 8270 | 10 |
| Butyl benzyl phthalate; Benzyl butyl | 8060 | 5 |
| phthalate | 8270 | 10 |
| Cadmium | 6010 | 40 |
| | 7130 | 50 |
| | 7131 | 1 |
| Carbon disulfide | 8240 | 5 |
| Carbon tetrachloride | 8010 | 1 |
| | 8240 | 5 |
| Chlordane | 8080 | 0.1 |
| | 8250 | 10 |
| p-Chloroaniline | 8270 | 20 |
| Chlorobenzene | 8010 | 2 |
| | 8020 | 2 |
| | 8240 | 5 |
| Chlorobenzilate | 8270 | 10 |
| p-Chloro-m-cresol | 8040 | 5 |
| | 8270 | 20 |
| Chloroethane; Ethyl chloride | 8010 | 5 |
| | 8240 | 10 |
| Chloroform | 8010 | 0.5 |
| | 8240 | 5 |
| 2-Chloronaphthalene | 8120 | 10 |
| | 8270 | 10 |
| 2-Chlorophenol | 8040 | 5 |
| | 8270 | 10 |
| 4-Chlorophenyl phenyl ether | 8270 | 10 |

TABLE 5-7

APPENDIX IX - GROUND WATER PARAMETERS

| Common Name | Suggested Methods | PQL (µg/L) |
|---|---|---|
| Chloroprene | 8010 | 50 |
| | 8240 | 5 |
| Chromium | 6010 | 70 |
| | 7190 | 500 |
| | 7191 | 10 |
| Chrysene | 8100 | 200 |
| | 8270 | 10 |
| Cobalt | 6010 | 70 |
| | 7200 | 500 |
| | 7201 | 10 |
| Copper | 6010 | 60 |
| | 7210 | 200 |
| m-Cresol | 8270 | 10 |
| o-Cresol | 8270 | 10 |
| p-Cresol | 8270 | 10 |
| Cyanide | 9010 | 40 |
| 2,4-D; 2,4-Dichlorophenoxyacetic acid | 8150 | 10 |
| 4,4'-DDD | 8080 | 0.1 |
| | 8270 | 10 |
| 4,4'-DDE | 8080 | 0.05 |
| | 8270 | 10 |
| 4,4'-DDT | 8080 | 0.1 |
| | 8270 | 10 |
| Diallate | 8270 | 10 |
| Dibenz[a,h]anthracene | 8100 | 200 |
| | 8270 | 10 |
| Dibenzofuran | 8270 | 10 |
| Dibromochloromethane; Chlorodibromomethane | 8010 | 1 |
| | 8240 | 5 |
| 1,2-Dirbromo-3-chloropropane; DBCP | 8010 | 100 |
| | 8240 | 5 |
| | 8270 | 10 |
| 1,2-Dibromoethane; Ethylene dibromide | 8010 | 10 |
| | 8240 | 5 |
| Di-n-butyl phthalate | 8060 | 5 |
| | 8270 | 10 |
| o-Dichlorobenzene | 8010 | 2 |
| | 8020 | 5 |
| | 8120 | 10 |
| | 8270 | 10 |
| m-Dichlorobenzene | 8010 | 5 |
| | 8020 | 5 |
| | 8120 | 10 |
| | 8270 | 10 |

- Adherence to the sampling procedures described in this document;
- Complete documentation of all field activities in field logbooks;
- Use of duplicate samples, and equipment and trip blanks; and
- Use of COC forms as required to document sample tracking.

Field sampling procedures have been described at length in Section 5.3 of this document. The following section will describe the proper equipment decontamination procedures which will be used during the conduct of this investigation. In addition, the collection of field quality control samples for laboratory analysis, and complete documentation of all field activities will also be described at length.

### 5.4.1 Equipment Decontamination

All field equipment (hand augers, split-spoon samplers, bailers, bowls, etc.) will be decontaminated before first use and after each use in accordance with the following procedures, to minimize the chances of cross-contamination. All sampling equipment will be placed in a soapy water wash (Alconox or equivalent laboratory grade detergent) and thoroughly scrubbed with stiff brushes. Equipment will then be subjected to a tap water rinse, reethanol rinse, double tap water rinse, and final double deionized (DI) water rinse. All down-hole drilling equipment (flight augers, bits, down-hole hammer, drill stem, etc.) will be steam cleaned before drilling and after each use. All PVC well casing will be provided cleaned and boxed from the manufacturer. If, during well installation procedures, the casing comes in contact with surficial soils, it will be decontaminated as described above.

The bladder pump will be decontaminated by totally submerging the pump in a soapy water bath, and pumping the soapy solution entirely through the system. The pump will then be submerged in a tap water solution and the procedure repeated until the water runs clear. Lastly, the pump will be submerged in a DI water solution and the procedure repeated until a minimum of five gallons of DI water has been pumped through the system. The soapy and tap water solutions will be allowed to recirculate per well site, the DI water will not be allowed to recirculate. Instead, the pumped DI water will be contained in a separate 55 gallon plastic drum for temporary storage. If the well being pumped is a deep well where the air-lift pump will be used for well evacuation purposes, the pump body will be disassembled and the air-lift assembly installed. The air lift assembly will then be subjected to the procedure described above. While the deep well is being evacuated, the bladder pump will be decontaminated in the same manner as the other field sampling equipuent. The outside of the pump tubing will be decontaminated by steam cleaning. The length of tubing subjected to decontamination will be dependent upon depth to water measurements and the depth of submergence of the pump. This determination will be made in the field at each well site. The amount of tubing to be submerged, plus an additional 20 feet will be decontaminated prior to installation in the well.

All wash and rinse waters will be changed after use at each well site and temporarily stored at the location in 55-gallon plastic drums provided by Omega. Omega will be responsible for removal of all drums from the work area and disposal of the fluids contained in the drums at the facility's wastewater treatment plant.

### 5.4.2 Field Quality Control Samples

TABLE 5-10

RECOMMENDED ANALYTICAL METHODS AND HOLDING TIMES

| PARAMETER | METHOD NO. | TEST TYPE | HOLDING TIME (Prior to extraction) |
|---|---|---|---|
| SOIL SAMPLES | | | |
| Metals* | 6010 | ICP | 6 Months |
| Cr [VI] | 7196 | Colorimetric | 24 Hours |
| Hg | 7471 | CVAA | 13 Days |
| As | 7060 | ICP | 6 Months |
| Cyanide (CN) | 9010 | Colorimetric | 14 Days |
| PCBs | 8080 | GC-ECD | 14 Days |
| Semi-VOA | 8270 | GC-MS | 14 Days |
| VOA | 8240 | GC-MS | 14 Days |
| TEPH | mod. 8015 | GC-FID | 14 Days |
| Purg. Aromatics & Halocarbons | 8010/8020 | GC-ECD | 14 Days |
| Bulk Density | C559-79*** | Gravimetric | 7 Days |
| Soil Moisture | D2216-80*** | Gravimetric | 7 Days |
| Total Organic Carbon (TOC) | 9060 | UV - Persulfate | 28 Days |
| Electrical Conductivity (EC) | 9050 | Electrometric | ** |
| pH | 150.1 | Electrometric | ** |
| WATER SAMPLES | | | |
| Metals, filtered* | 6010 | ICP | 6 Months |
| Cr[VI] | 7196 | Colorimetric | 24 Hours |
| Chloride | 325.2 | Colorimetric | 28 Days |
| Purg. Aromatics & Halocarbons | 601/602 | GC-ECD | 14 Days |
| Nitrite | 353.1 | Colorimetric | 28 Days |
| Semi-VOA | 625 | GC | 7 Days |
| DBCP | 608 | GC-ECD | 7 Days |
| Clorinated Herbicides | 615 | GC-ECD | 7 Days |
| Organophosphate Pest. | 614 | GC-FPD | 7 Days |
| EDB | 504 | GC-ECD | 28 Days |
| Dioxin | 8290 | GC-ECD | 7 Days |
| Carbamate & Urea Pest. | 632 | HPLC-UV | 7 Days |
| Sulfide | 9030 | Colorimetric | 7 Days |
| Cyanide (CN) | 9010 | Colorimetric | 14 Days |
| VOA | 624 | GC-MS | 7 Days |
| TEPH | mod. 8015 | GC-FID | 14 Days |
| Total Organic Halides (TOX) | 9020 | Pyrolysis | 28 Days |
| Total Organic Carbon (TOC) | 9060 | UV - Persulfate | 28 Days |
| Electrical Conductivity (EC) | 9050 | Electrometric | ** |
| pH | 150.1 | Electrometric | ** |

*Metals include Cr [T], Cd, Cu, Fe, Pb, Ni and Zn. Appendix IX metals for water analyses are in Table 4-7.
**No holding time recommended - should be tested as soon as possible.
***ASTM method number (EPA method number unavailable)

ICP - Inductively Coupled Plasma
CVAA - Cold Vapor Atomic Absorbtion
ECD - Electron Capture
GC - Gas Chromatography
UV - Ultraviolet Spectrophotometer
GC-MS - GC with Mass Spectroscopy
FID - Flame Ionization Detector
HPLC - High Performance Liquid Chromatograph
FPD - Flame Photometric

In order to verify the quality of the sample collection and transportation techniques, several types of quality control (QC) samples will be collected during the conduct of the field program. These samples will include: duplicates, equipment blanks, and trip blanks. For the purposes of this plan, QC samples will be defined as follows:

- Duplicates - these are blind QC samples which are duplicates of field samples (soil and water) and which are submitted to the laboratory for analysis. Blind samples are labeled in such a manner that the laboratory does not know that they are analyzing QC samples. Duplicate soil samples will be collected at a frequency of 1 per 10 samples sent to the lab. Duplicate water samples will be collected at a frequency of 1 per 10 samples sent to the lab. Sample results will be compared to those of the original samples for final data validation. if possible, duplicate samples will be selected at sample locations and intervals suspected to be contaminated. Analytical parameters will be identical to those selected for the original sample. It should be noted, however, that it is not possible to collect true duplicate soil samples with the split-spoon technique. Therefore, duplicates will only be submitted for composited, hand-auger samples.

- Equipment Blanks - these are blind QC samples (water only) which will be collected at a frequency of 1 per every 10 ground water samples submitted to the laboratory. Equipment blank samples will be collected immediately after bladder pump decontamination operations are complete. Sample collection will consist of pumping deionized water through the sample pump and filling the appropriate sample containers. The sample will be analyzed for the constituents shown in Table 5-6 (with the exception of the RCRA Appendix IX parameters, which will not be analyzed). one sample of the source deionized water will also be submitted to the laboratory for analysis of organic constituents to verify the composition of the water prior to pumping through the sampling system. By analyzing the source DI water for organic constituents, the use of costly organic-free DI water is not required.

- Travel Blanks - these QC samples (water only) are shipped to the laboratory with each cooler containing water samples for volatile organics analysis (purgeable halocarbons/aromatics). The trip blanks are prepared by the laboratory and are not submitted as blind samples. Trip blanks will be submitted at a frequency of 1 per sampling day per cooler containing water samples for volatile organics analysis.

### 5.4.3 Equipment Calibration and Maintenance

Prior to use, all field equipmnt will be visually inspected to verify that it is in good working order. The calibration, maintenance, and operating procedures for all Mesa instruments, equipment, and sampling tools are based upon manufacturer's instructions and coamn industry practice, and include specifications and criteria for calibration, maintenance, and operation. The specific calibration and maintenance procedures that will be implemented during the conduct of the field program are listed in Table 5-11. operational procedures have been described in Section 5.3 of this docxment.

### 5.4.4 Documentation of Field Activities

#### 5.4.4.1 Field Log Books

TABLE 5-11

EQUIPMENT CALIBRATION AND MAINTENANCE SCHEDULE

| Instrument | Calibration Schedule | Maintenance Schedule |
|---|---|---|
| YSI Model 33 S-C-T Meter | Prior to each use. | Clean following use, replace batteries as required. |
| pH Meter | Prior to each daily use and following use. | Clean following use, replace batteries as required. |
| Thermoelectron 580A PID | Calibrate weekly, check performance before each use. | Clean window of detector if calibration performance is off, recharge batteries after each use. |
| Powers Well Sounder | Calibrate weekly, check performance before each use. | Clean following use, replace batteries as required. |

A bound field log book shall be maintained by the field sampling team to provide a daily record of events. At the beginning of each day's work, the following shall be recorded:

- Date
- Time
- Meteorological conditions
- Field persomel present
- Level of personal protection
- Signature of person making the entry

Field log books shall provide the means of recording all data regarding sample collection. As such, entries shall be described in as much detail as possible so that essential information is properly documented. All documentation in field books shall be made in permanent ink. If an error is made, corrections shall be made by crossing a line through the error and entering the correct information. Changes shall be initialed, no entries shall be obliterated or rendered unreadable.

Entries in the log book shall include at a minimum the following for each days sampling:

- Site identification
- Location of sampling points
- Description of sampling points
- Sample identification numbers
- Number of samples collected
- Time of sample collection
- Number of QC samples collected
- Sampling team members names
- Field observations
- Field parameters

### 5.4.4.2 Sample Identification Numbers

Because of the large volume of samples which will b.e collected during the RFI, a sample numbering system has been devised for use at the site which will result in data that can be readily identified as to type of sample and location, and can be easily organized into specific groups for interpretation purposes. For example, a sample labeled in the following manner:

| | | | |
|---|---|---|---|
| Omega<br>Site Name<br>and number | BGOL<br>Sample type | 10.5<br>Bottom of<br>sampled interval<br>(depth in feet) | 001<br>Sequence<br>number |

refers to a sample collected at Omega from background boring number 1, at a depth of 10.5 feet, and the first collected at that location and depth. If the location were to be resampled, the sequence number 002 would be assigned to the sample. All subsurface soil samples collected during the conduct of the RFI will be assigned sample identification numbers using the boring and well numbers listed in Tables 5-4 and 5-5. Surface soil samples will be identified by their numbers as presented in Table 5-2.

Ground water samples will be distinguished from soil samples by deleting the reference to sample

depth. Each round of ground water sampling will be assigned a different sequence number in order to easily distinguish between rounds. For example, the first round of sampling at the site (scheduled for mid-July 1992) will be assigned a 001 sequence number. When new ground water monitoring wells are installed at the facility and sampled for the first time, they will be assigned the same sequence number as the current round of sampling.

## 5.5 Health and Safety Program

In accordance with the Health and Safety Plan (HSP) contained in Section 8 of this RFI Workplan, all Mesa field persomel involved in sampling activities at the facility shall be enrolled in Mesa.'s Medical monitoring Program. All persomel shall be familiar with the contents of the HSP and shall adhere to the health and safety protocols established in the plan.

# 6.0 QUALITY ASSURANCE PROJECT PLAN

## 6.1 Introduction

This Quality Assurance Project Plan (QAPP) addresses the requirements set forth in the RCRA Sectim 3008(L) Consent Order for (OMEGA) (Administrative order on Consent, December 27, 1991) facility to ensure the precision, accuracy, completeness, and representativeness of all data collected and generated during the course of the RFI. Further, the QAPP provides the quality assurance requirements for data handling and manipulation during all phases of the RFI leading towards the determination of appropriate corrective measures for the OMEGA facility. It is intended to guide all field, laboratory, and management personnel in all relevant aspects of data collection, management and control while on- or off-site.

The QAPP addresses US. Environmental Protection Agency (EPA) policies and guidelines ("Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans" EPA 1983) and "Test methods for Evaluating Solid Waste," SW-846 that Omega will be implementing as part of this quality assurance/quality control (QA/QC) program. Quality assurance is defined as the integrated program designed for assuring reliability of monitoring and measuring data. Quality control is defined as the routine application of procedures for obtaining prescribed standards of performance in the monitoring and measuring process. Quality assurance procedures such as tracking, reviewing and auditing are implemented as necessary to ensure that all project work is performed in accordance with professional standards, EPA and other governmental regulations and guidelines, and specific project goals and requirements stated in the RFI work Plan.

## 6.2 Project Description

This QAPP has been prepared in support of a RFI Work Plan. The objective of the RFI is to determine the nature and extent of any releases of hazardous wastes and/or materials at or from the OMEGA facility. In addition, data generated from the RFI will be used during the Corrective Measures Study (CMS) to evaluate potential corrective measure alternatives for the facility.

The proposed field activities will include the collection of surface and subsurface soil samples and the collection of ground water samples. The purpose of RFI sampling activities is to provide additional information on both subsurface lithology and the extent of soil and ground water subsurface contamination.

Field sampling at the subject facility consists of five discrete tasks which are listed as follows:

- o Task 1 -Surface Soil, Sludge/Liquid and Surface water Sampling
- o Task 2 -Subsurface Soil Borings/Monitor Well Installations
- o Task 3 -Ground Water Sampling

Task 1, Surface Soil, Sludge/Liquid and Surface Water Sampling, consists of the collection of surface soil samples with a hand-auger . In addition, soil samples will be collected from locations . Task 2, Subsurface Soil Borings/Monitor Well Installations, consists of the drilling of four background

borings (three on-site and off-site if possible), and additional shallow borings to characterize the site. In addition, ground water monitoring well pairs consisting of a deep and shallow well will be installed at three locations around the facility. Task 3, Ground water Sampling, consists of the collection of two full rounds of samples from the newly installed ground water monitoring wells.

The protocols for sample collection and field measurements are developed and presented in Section 4.3 of the Sampling and Analysis Plan (SAP). Section 4.4 presents field quality control procedures to be used to assure the reliability of all data and field measurements. Analytical procedures for each sampling medium are presented in Section 5.3.3.5 of the SAP.

## 6.3 Quality Assurance Objectives

The overall quality assurance objective is to develop and implement procedures for field sampling, chain-of-custody, laboratory analysis and reporting that will provide defensible results. Objectives for measurement data are usually expressed in terms of accuracy, precision, completeness, representativeness, and comparability. Definitions of these characteristics are as follows:

• Accuracy - the degree of conformity of a measurement (or an average measurement of the same parameter), X, with an accepted reference or true value, T, usually expressed as the difference between the two values, X - T, or the difference as a percentage of the reference or true value 100 (x - T), and sometimes expressed as a ratio ' X/T. Accuracy is a measure of the bias in a system. To ensure accuracy of all field data collected, instruments used in the sampling efforts will be maintained and calibrated as specified in Section 5.4.3 of the SAP. Computer programs will be used to store and report all analytical data. Entry accuracy will be checked by proof-reading all output and comparing against the laboratory reports. All accuracy requirements of routine analytical services will be included in an addendum to this QAPP when a subcontract laboratory is selected.

Precision - a measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision is best described in terms of the standard deviation. Various measures of precision exist depending upon "prescribed similar conditions", such as agreement between duplicate measurements. Duplicates (1 in 20 soil samples, and I in 10 water samples), will be collected. to ensure precision of field collection procedures. Precision of air monitoring field instrument (e.g. PID) response can be determined by the use of certified standard gases during calibration. PID calibration has been described in Section 5.3.3 of the SAP. The precision of laboratory analytical services will be presented in an addendum to this QAPP.

Completeness - a measure of the amount of valid data expressed as a percentage obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. Field and analytical data are specified at 90% completeness.

Representativeness - the degree to which data represent a characteristic of a population. Surface and subsurface soil sampling points and monitor well locations have been determined by Mesa's professional hydrogeology staff to ensure the collection of representative data and supplement existing data. The various soil and ground water sample collection procedures have been described in Section 5.3 of the SAP and will

Table 6-1

SUMMARY OF MEASUREMENT OBJECTIVES
FOR ANALYTICAL LABORATORIES

| Parameter | Matrix | PQL (mg/kg solid) (ug/l water) | Spike Recovery Control Limits (%R) | Duplicate Control Limits RSD +/- (%) | QA Sample Frequency |
|---|---|---|---|---|---|
| Arsenic (As) | Soil | 1.00 | 46-137 | 20 | 1 / 20 |
| Cadmium (Cd) | Soil | 0.50 | 68-111 | 20 | 1 / 20 |
| | Water | 5.00 | 61-127 | 20 | 1 / 20 |
| Chromium, Tot (Cr T) | Soil | 0.50 | 61-124 | 20 | 1 / 20 |
| | Water | 10 | 61-126 | 20 | 1 / 20 |
| Chromium, Hex (Cr+6) | Soil | 0.20 | 42-110 | 20 | 1 / 20 |
| | Water | 20 | 75-124 | 20 | 1 / 20 |
| Copper (Cu) | Soil | 1.00 | 69-122 | 20 | 1 / 20 |
| | Water | 20 | 78-114 | 20 | 1 / 20 |
| Iron (Fe) | Soil | 0.50 | 45-125 | 20 | 1 / 20 |
| | Water | 10 | 67-127 | 20 | 1 / 20 |
| Lead (Pb) | Soil | 1.50 | 57-128 | 20 | 1 / 20 |
| | Water | 3.00 | 61-125 | 20 | 1 / 20 |
| Mercury (Hg) | Soil | 0.25 | 65-145 | 20 | 1 / 20 |
| Nickel (Ni) | Soil | 1.00 | 70-122 | 20 | 1 / 20 |
| | Water | 10 | 69-126 | 20 | 1 / 20 |
| Zinc (Zn) | Soil | 0.50 | 62-118 | 20 | 1 / 20 |
| | Water | 10 | 68-120 | 20 | 1 / 20 |
| Purgeable Halocarbons/ Aromatics | Soil | 0.025 | 41-140 | 20 | 1 / 20 |
| | Water | 0.50 | 77-123 | 20 | 1 / 20 |
| TEPH/BTEX | Soil | 0.025 | 41-140 | 20 | 1 / 20 |
| Cyanide, Total & Amenable (CN) | Soil | 10 | 51-132 | 20 | 1 / 20 |
| PCBs | Soil | 1.00** | 36-139 | 20 | 1 / 20 |
| VOA | Soil | 3.00** | 37-148 | 20 | 1 / 20 |
| Semi-VOA | Soil | 0.85** | PQL-176 | 20 | 1 / 20 |
| TOC | Water | 500 | 28-155 | 20 | 1 / 20 |

Table 6-1

SUMMARY OF MEASUREMENT OBJECTIVES
FOR ANALYTICAL LABORATORIES

| Parameter | Matrix | PQL (mg/kg solid) (ug/l water) | Spike Recovery Control Limits (%R) | Duplicate Control Limits RSD +/- (%) | QA Sample Frequency |
|---|---|---|---|---|---|
| TOX | Water | 0.80 | 61-124 | 20 | 1 / 20 |
| Chloride | Water | 2.00 | 91-115 | 20 | 1 / 20 |
| Nitrate | Water | 50 | 59-133 | 20 | 1 / 20 |
| pH | Water | NA | 75-125 | 20 | 1 / 20 |
| Specific Conductivity | Water | 20* | 75-125 | 20 | 1 / 20 |

* umhos/cm
**highest PQL
NA = Not Applicable
PQL = Practical Quantitation Limits

Adapted from Contract Laboratory Statement of Work- EPA, 1986 and from ATI laboratory standards, 1990.

be adhered to by the sampling team. Well evacuation and sample compositing procedures ensure the collection of representative samples for laboratory analysis. Analytical data representativeness will be presented in an addendum to the QAPP-

Comparability - the confidence with which one data set can be compared to another. Comparability may be assured by using approved SAPS, standardized analytical methods, and identical units for reportive data. Ground water sampling locations have been selected with regard to ground water flow paths, well depth, and comparability of well casing and screen materials. Field blanks collected after decontamination efforts will further ensure data comparability between sample locations. Data will be grouped and evaluated according to similar sampling methods, sampling media, and laboratory analytical methods. Quality assurance objectives for analyses performed under laboratory analytical services will be specified in an addendum to this QAPP when a laboratory is selected.

Quality assurance objectives for field measurements are listed in Table 6-1.

## 6.4 Sampling Rationale and Procedures

This section presents an overview of the sampling procedure to be conducted at the OMEGA facility and describes routine procedures to be followed by all OMEGA personnel performing field measurements, testing and collection of samples. Specific OMEGA standard operating procedures (SOPs) to be implemented at the facility are presented in Section 5, Sampling and Analysis Plan (SAP). Table 6-2 lists the procedures to be followed.

The procedures presented in this section and in Section 5.0 are designed to ensure that all samples collected are consistent with the following project objectives: (1) samples are identified, preserved, and transported in a manner such that data are representative of the actual site conditions, (2) information is not lost in sample transferal, and (3) laboratory data can be used for site assessment purposes. These data will ultimately be used to determine the nature and extent of contamination and to support the CMS.

The procedures presented in Table 6-2 are general in nature and have been developed to provide guidance in conducting field investigations. As such, these procedures may require modifications to meet site specific conditions. Modifications to the procedures are described in detail in the SAP.

General descriptions of the sampling procedures to be followed to collect ground water, surface soil, sludge/liquid, surface water and subsurface soil samples are provided in the following.

### 6.4.1 Task 1 - Surface Soil, Sludge/Liquid and Surface Water Sampling

Surface soil and sludge/liquid sampling will be conducted at various locations throughout the subject facility. A full listing of each WM requiring investigation is provided in Table 5-1 of the SAP.

In order to provide a more concise discussion of surface soil sampling rationale, the WMUs have been organized into four main categories which are: sumps, surface impoundments, drum storage areas and miscellaneous areas. The rationale for sample location, depth, and analytical parameters for each category of will then be discussed in the applicable section. In most instances, surface soil sampling will be conducted in the intervals between 1 and 4 feet below ground. However, this should

TABLE 6-2

SAMPLING PROCEDURES

| Discipline | Procedure |
|---|---|
| Soils | General Soil Sampling Procedures |
| | General Procedues for Surface and Shallow Depth Soil Sampling |
| | Subsurface Soil Sampling |
| Hydrology | General Considerations for Monitoring Well Installation |
| | Sampling Procedures for Monitoring Wells |
| | Slug Test Procedures |
| | Considerations for Sample Withdrawal from Wells |
| | Special Considerations for Sampling of Organics in Ground Water |
| | Procedure for Water Level Measurement |

be considered a first phase; should these shallow soils prove to be contaminated, additional deeper sampling will be undertaken. For the purposes of deciding whether to proceed with deeper sampling, "contaminated" will be defined as above the mean of background samples. This calculated mean, however, will not include data anomalies, i.e., constituent concentrations which are either too high to represent native soils, or too low when compared to other background data. Further information on background samples is provided in Section 5.2.2.1. All decisions regarding further samples will be made in close coordination with the EPA.

For the purposes of this discussion, even though the samples will be collected at some shallow depth below ground surface, they will be referred to as surface soil samples because of the collection technique. If the presence of contamination is confirmed at any one of the units or other areas, more detailed contaminant characterization sampling will be proposed.

### 6.4.1.1 Drum Storage unit WMU

There are drum storage areas included in the investigation , with one of the areas regulated under RCRA. one to two soil samples will be collected from either the approximate middle of each area, or from an area where fluids may potentially collect. Samples will be collected from an approximate depth of 1 to 2 feet below the top of native soils below each sampling location. Rationale for sample depth selection is based upon the possibility that the interval from 0 to 1 foot could have been disturbed during paving operations. Analytical parameters are as previously noted in the discussion on sumps.

Sampling is also proposed at off-site locations along the western edge of the property bordering New England property, if allowed.

## 6.4.2 Task 2 - Subsurface Soil Borings/,Monitor Well Installations

The task can be divided into two subtasks, the drilling of soil borings via the hollow-stem auger method solely for the collection of subsurface soil samples, and the installation of ground water monitoring wells at selected boring locations. All proposed borings and monitor well locations (existing and proposed) are illustrated in Figures 5-1 and 5-2 of the SAP.

Background Sampling

In order to establish background concentration levels for the various site specific contaminants, it will be necessary to drill and sample on-site and off-site borings. A total of six soil samples for laboratory analysis will be collected from each borehole at depths of 1, 5, 10, 15, 20, 30 and (potentially) 40 feet. The intermediate 10, 15 and 20 foot sample depths were chosen to coincide with sample intervals in other borings and maximize the vertical distribution of the analytical data. The final sample will be collected from the bottom of the borehole in order to document concentrations at the maximum drilled depth. All samples will be analyzed for the eight key organic chemical constituents.

According to existing data, a 20 foot thick aquitard consisting of fine-grained materials exists below the site at an approximate depth of 30 feet. The 40 foot total depth was selected in order to sample the aquitard and confirm its existence, but not penetrate it. Subsurface soil samples for lithologic analysis will be collected at five foot intervals throughout the total drilled depth of the borehole. All lithologic samples will be stored in plastic, zip-lock bags for possible future reference. The on-site background borings (BG--l) will be placed as illustrated in Figure 5-1. The approximate off-site

boring locations (BG-2, -3 and -4) are shown in Figure 5-3.

### 6.4.2.1 Ground Water Monitoring Well Installations

A total of three monitoring well pairs will be completed at the locations illustrated on Figure 5-1 of the SAP. As shown, the well pair locations have been selected to provide one additional upgradient, and two additional downgradient wells. At each location, one shallow (approximately 75 feet in depth) and one deep (approximately 110 feet in depth) well will be installed. The horizontal distribution of wells is designed to document more fully off-site contamination character and downgradient contamination extent. Additionally, deeper (110 feet) wells will be installed. The differing screened completion depth at each pair will provide information on piezometric elevations and concentration levels in the deeper interval.

Three soil samples for laboratory analysis (one in the unsaturated zone at approximately 25 feet, one in the middle of the shallow well perforated section at approximately 60 feet, will be collected during drilling at all deep well locations. Because the locations of well MW-1 and background boring BG,-l coincide, additional subsurface soil samples will be collected from MW-l at depths of 1, 5, 10, 15, 20, 30 and 40 feet. These depths are comparable to sample intervals in background borings BG-2 through BG--4. Additional soil samples will also be collected from MW-2,3, and 4 at 5, 10, 15, and 40 feet in order to further characterize soils and possible contaminants in the vicinity. Analytical parameters are presented in Section 5.3.2. Soil sample analyses will be used to document organic contamination at each location, and when coupled with ground water data, provide information on adsorption (and hence migration/ mobility) characteristics. It is important to emphasize that this well installation program is presented as a phased approach. If ground water contamination is detected in the Lower Hollydale Aquifer, additional wells may be required, completed in the underlying Jefferson aquifer. Such a second phase, if necessary, will be discussed in detail with the EPA and DHS once analytical results are available.

It is also important to note, that while three soil samples for laboratory analysis will be collected from each of the three deep monitor well locations, soil samples for lithologic analysis and organic vapor screening will also be collected with the split spoon at 5 foot intervals during advancement of the borehole. Previous investigations have noted the impracticality of using the hollow-stem auger technique below a depth of 45 feet. Therefore, it is possible that a combination hollow-stem auger/ rotary drilling rig will be required to install the monitoring wells. Hollow-stem auger will continue to be the drilling technique of preference. If artesian pressures and/or loose sands restrict the use of augers at depth, rotary drilling methods will be implemented. It is hoped that air, water, or light foam will be sufficient drilling fluids to maintain borehole integrity; light muds will be used only as a last resort. Assuming a change to rotary drilling methods below a depth of 45 feet, it may not be feasible to collect split-spoon samples at every five foot interval below that depth. Samples will continue to be collected and logged at five foot intervals, but only those which are "undisturbed" (i.e., split spoon versus cuttings) will be considered appropriate for laboratory analysis.

The shallow well of each of the four well pairs will be completed to a depth of approximately 70 feet below ground surface. Perforations, therefore, will extend from approximately 50 to 70 feet in depth, roughly equivalent to the intervals screened in the majority of the existing on-site wells. Generally, well screens in water table (unconfined) type aquifers are positioned to allow the perforated section to straddle the air water interface in order to detect floating, immiscible layers. Because the aquifers immediately below the site are believed to be under slight artesian (confined) conditions, the screened sections will instead be placed just below the aquitard. Care will be exercised to not extend

the perforations through any confining layer, thereby creating a vertical conduit for the downward migration of possible surficial contaminants.

The deeper wells will be completed to a depth of approximately 110 feet below ground surface. Deep monitoring wells will be screened at the base of the Hollydale Aquifer and directly above the underlying aquitard. Completion details for the deep wells are identical to the new shallow wells, with the exception of the placement of a shorter screened section (15 versus 20 feet) in the lower portion of the deep well. Again, this is in keeping with the desire to match the screened interval of the new deep well.

### 5.4.3 Task 3 - Ground Water Sampling

After the newly installed wells have had time to equilibrate with their surroundings, ground water sampling activities will commence. Samples for laboratory analysis will be collected from the newly installed wells. Two full rounds of samples will be collected over a three month period. one of the rounds will coincide with on-going quarterly ground water sampling activities. The data from the two full rounds will be used to provide concomitant analyses of all wells across the site, to address regulatory agency concerns for complete site characterization and short-term temporal changes thereof. Long term trends will be quantified from existing monitoring well data.

At the present time, on-going quarterly monitoring requires analysis for the following compounds: purgeable halocarbons/aromatics by EPA Methods 601/602. In addition, four replicate analyses for the indicator parameters TOC, TOX, pH, and specific conductance (EC) are performed semi-annually during the January and July sampling events. Both rounds of samples will be analyzed for the first group of parameters noted above. During the first round, wells will also be analyzed for RCRA 40 CFR Part 264 Appendix IX parameters. If sampling takes place during either January or July, one round will also be analyzed for the four indicator parameters in quadruplicate.

## 5.5 Sample Handling and Custody Procedures

Standard procedures for sample handling and custody procedures are listed in Table 5-1. A brief description of field sampling and handling techniques follows:

Samples will be collected and handled in accordance with accepted practices and the procedures described in the SAP. The relevant handling and custody procedures have been summarized in the following paragraphs.

Surface soil sampling will be accomplished with the use of a hand-operated auger. Upon reaching the depth at which sample collection will be initiated, a clean auger will be inserted into the hole and the next one foot interval will be extracted and placed into a clean stainless steel mixing bowl for compositing. Care will be exercised to accomplish compositing as quickly as possible, minimizing agitation and aeration of the sample. Clean, 4- and 16-ounce wide-mouth glass jars provided by the analytical laboratory will be used as the sample containers.

At the majority of the locations, one 4-ounce sample jar will be filled for analysis of the eight key organics constituents.

In order to prevent volatilization, a sample will be collected with a drive sampler fitted with a 2-inch by 6-inch stainless steel ring in the interval from 1 to 1.5 feet. A second hand boring will be placed immediately adjacent to the first boring, and a composite sample collected in the interval from 1-2 feet. The material contained in the ring will be analyzed for volatile and semi-volatile organics (EPA methods 8240 and 8270) and PCBs (EPA method 8080). The composite sample will be analyzed for key organic contaminants. The pair of borings are considered to be one location and will be identified by the same location number on the samples.

Subsurface soil sampling will be collected using a split-spoon sampler and hollow-stem auger drilling rig. upon removal of the sample-filled rings from the split-spoon sampler, teflon sheeting will be placed over the ends of the ring selected for laboratory analysis. Plastic end caps will then be placed over the teflon sheeting and securely taped in place. All samples will be labeled with sample number, parameters of analysis, and date and time of sampling. The sample will then be placed inside a plastic zip-lock freezer bag, sealed, and immediately inserted inside an ice-filled cooler. Sample-filled coolers shall be delivered to the laboratory at the end of each days sampling by OMEGA sampling team members. A Chain of Custody (COC) form will be completed for each sample cooler delivered to the analytical laboratory.

Ground water samples for laboratory analysis will be collected from the newly installed wells at the facility. Previous versions of this section have stated that sample collection at each individual well would be performed in order of volatilization sensitivity, and included a numerical listing of the sequence with which bottles would be filled. Since RCRA Appendix IX parameters have been added to the analytical suite at the well locations and indicator parameters in quadruplicate are collected semi-annually, it is no longer practical to include such a list. The procedure was a relic of previous Kleinfelder QA/QC protocols and is not considered necessary. Generally, volatilization sensitivity is an important consideration when ground water sampling is conducted with a device which agitates the water inside the well casing (e.g., bailer). Volatilization due to sampling methodology, therefore, is not a concern.

Standard OMEGA practice is to fill all VOA vials first, followed by other bottles with no headspace requirements. Other glass and poly bottles are then filled last. This practice ensures that extra care is provided to sample bottles which require no headspace. Bottles for quadruplicate analyses are grouped together and filled as sets per parameter, as are bottles for duplicate analyses.

Ground water samples collected from the new wells during the two sampling rounds will be submitted to the laboratory for analysis of the eight key organic, purgeable halocarbons/aromatics (EPA Methods 601/602). After the completion of RFI ground water sampling, subsequent quarterly rounds will be analyzed for the standard parameters discussed in Section 4.2.3 of this document.

A complete ground water sample summary has been provided in Table 4-8. Sample container type and volume, analytical methods, sample holding times, and other comments are listed in Tables 4-9 and 4-10. It is important to note, that the bottle for organic analysis shall be filtered in the field using a 0.45 micron in-line filter.

Sampling personnel shall wear clean PVC gloves during all sample collection activities. Samples shall be placed inside precleaned bottles provided by the analytical laboratory. The laboratory shall also add preservative where appropriate. Sample bottles for organics analysis (purgeable halocarbons/aromatics, TOX and TOC) shall be filled completely, allowing no headspace. Sample bottles will be labeled with sample/,well number, parameters for analysis, date and time of sampling, preservative (if used), and filtering (if performed). Filled sample bottles will be inserted into plastic

bags and placed into ice-filled coolers immediately after collection. A COC form will be completed for each sample cooler delivered to the analytical laboratory. Sample-filled coolers will be picked up by courier or hand-delivered by OMEGA sampling personnel to the laboratory at the end of each day's sampling.

## 6.6 Field Quality Control Procedures

Field quality control will be accomplished by strict adherence to the field procedures set forth in the SAP, including but not limited to:

Proper equipment decontamination according to established procedures, as discussed in Section 5.4.1 of the SAP;
Use of clean sample containers provided by the analytical laboratory;
Adherence to the sampling procedures described in the SAP;
Complete documentation of all field activities in field logbooks;
Use of duplicate samples, and equipment and trip blanks; and
Use of COC forms as required to document sample tracking.

The following section will describe the proper equipment decontamination procedures which will be used during the conduct of this investigation. In addition, the collection of field quality control samples for laboratory analysis, and complete documentation of all field activities will also be briefly described.

### 6.6.1 Field Quality Control Samples

In order to verify the quality of the sample collection and transportation techniques, several types of quality control (QC) samples will be collected during the conduct of the field program. These samples will include: duplicates, equipment blanks, and trip blanks as illustrated in Table 4-8 of the SAP.

### 6.6.2 Documentation of Field Activities

A bound field log book shall be maintained by the field sampling team to provide a daily record of events. At the beginning of each day's work, the following shall be recorded:

Date
Time
Meteorological conditions
Field personnel present
Level of personal protection
Signature of person making the entry

Field log books shall provide the means of recording all data regarding sample collection. As such, entries shall be described in as much detail as possible so that essential information is properly documented. All documentation in field books shall be made in permanent ink. If an error is made, corrections shall be made by crossing a line through the error and entering the correct information. Changes shall be initialed, no entries shall be obliterated or rendered unreadable.

Entries in the log book shall include at a minimum the following for each days sampling:

Site identification
Location of sampling points
Description of sampling points
Sample identification numbers
Number of samples collected
Time of sample collection
Number of QC samples collected
Sampling team members names
Field observations
Field parameters

### 6.6.3 Equipment Decontamination

All field equipment (hand augers, split-spoon samplers, bailers, bowls, etc.) will be decontaminated before first use and after each use in accordance with the procedures described in Section 5.4.1 of the SAP, to minimize the chances of cross-contamination. All sampling equipment will be placed in a soapy water wash (Alconox or equivalent laboratory grade detergent) and thoroughly scrubbed with stiff brushes. Equipment will then be subjected to a tap water rinse, methanol rinse, double tap water rinse, and final double deionized (DI) water rinse. All down-hole drilling equipment (flight augers, bits, down-hole hammer, drill stem, etc.) will be steam cleaned before drilling and after each use. All PVC well casing will be provided cleaned and boxed from the manufacturer.

The bladder/air lift pump will be decontaminated by totally submerging the pump in a soapy water bath, and first pumping the soapy water solution entirely through the system, then tap water, and finally DI water. The soapy and tap water solutions will be allowed to recirculate per well site, the DI water will not be allowed to recirculate. Instead, the pumped DI water will be contained in a separate 55 gallon plastic drum for temporary storage. The outside of the pump tubing will be decontaminated by steam cleaning. The amount of tubing to be submerged, plus an additional 20 feet will be decontaminated prior to installation in the well. This procedure is described at length in Section 5.4.1 of the SAP.

All wash and rinse waters will be changed after use at each well site and temporarily stored at the location in 55-gallon plastic drums provided by OMEGA. OMEGA will be responsible for removal of all drums from the work area and disposal of the fluids contained in the drums at the facility's waste water treatment plant.

## 6.7 Calibration Procedures and Frequency

Prior to use, all field equipment will be visually inspected to verify that it is in good working order. The calibration, maintenance, and operating procedures for all OMEGA instruments, equipment, and sampling tools are based upon manufacturer's instructions and common practice, and include specifications and criteria for calibration, maintenance, and operation.

The specific calibration and maintenance procedures that will be implemented during the conduct of the field program are listed in Table 5-11 of the SAP. Operational procedures have been described in Section 5.3 of the SAP and are s ummarized below.

Prior to initiating well evacuation procedures, the red line on the conductivity meter will be checked

and adjusted where necessary. meter calibration will be checked by inserting the probe in a known solution and comparing the result with the standard. It is not possible to field calibrate the YSI Model 33 SCT Meter which will be used for the conduct of the field program. This is not considered problematic since the laboratory will be determining the actual EC of the ground water sample. The meter is used for field screening purposes only, and is used to determine the stability of the discharge water field parameters prior to collection of a laboratory sample. in addition, a two point calibration (pH 7 and 10) will be performed on the Orion Model SA 250 pH Meter prior to actual use.

The PID will be calibrated prior to first use at the site and weekly thereafter. Calibration will be performed in accordance with the instruments operation and maintenance manual. Calibration will consist of analyzing a gas of known concentration, generally isobutylene because of the instrument's relatively high sensitivity to it and the non-toxic nature of the gas, and adjusting the span potentiometer so that the instrument is reading the exact value of the calibration gas. The battery will be periodically checked and charged as needed.

Prior to first use and then weekly thereafter, the electric water level indicator will be calibrated using a 100 foot fiberglass tape, and the meter response checked.

## 6.8 Analytical Procedures

The various analytical procedures that will be performed on the soil and ground water samples collected during the conduct of the RFI have been described in Sections 4.2 and 4.3 of the SAP. A summary table is presented as Table 4-8 of the SAP. Analytical test type, container types, and analytical holding times for both soil and ground water samples have been compiled in Table 4-10 of the SAP.

## 6.9 Data Reduction, validation and Reporting

### 6.9.1 Field measurement Data

Reduction and validation of data obtained from field measurements will be performed by the project hydrogeologist. Validity of all data will be determined by checking calibration procedures utilized in the field, and by comparing the data to previous measurements obtained at the specific location. Large variations (greater than 10%) will be examined in association with changes in local conditions and general trends. Variations in data which can not be explained by local changes will be assigned a lower level of validity and will be used for limited purposes. Relevant field measurement data will be summarized and included in the report of findings.

### 6.9.2 Historical Analytical Data

Historical site data will be reviewed and incorporated into the overall study. Since those data have been collected by a variety of methods using different procedures, an evaluation of the quality of the data must be made before the data are incorporated into the investigation. The previous data to be examined and evaluated consists of ground water and soil sample data. Unless information is available on the sample collection and handling methods and QA/QC procedures in effect at the time of sampling, these data points will be assigned a low level of confidence.

### 6.9.3 Newly Acquired Analytical Data

Analytical data generated during the conduct of the RFI shall be evaluated by the project quality assurance coordinator to ensure that the data meets the requirements of the project. The laboratory shall be required to follow the protocols established in EPA guidance document SW-846 (Test Methods for Evaluating Solid Waste, November 1986). Key laboratory QC elements include:

Method blanks
Laboratory control samples
Calibration check samples
Replicate samples
Matrix-spiked samples
Control charts
Surrogate samples
Zero and span gases
Reagent quality control checks

At the present time, an analytical laboratory has not been selected for the project. Laboratory selection will be based upon several factors, one of which is an acceptable laboratory QA/QC Plan. A copy of the laboratory Analytical QC/QC Plan will be incorporated into this QAPP upon selection of an analytical laboratory.

## 6.10 Internal Quality Control Checks and Frequency

Quality control of field data obtained from measurement equipment will be accomplished by following the procedures specified in Section 5.3 of the SAP, and by performing proper calibration procedures at the frequencies established in Section 5.4.3 of the SAP. In addition, quality control samples as listed in Table 5-8 of the SAP shall be collected. Quality control checks and technical review of all deliverables will be performed by qualified OMEGA personnel and Mesa personnel.

Quality control of all deliverables will be assured through checking all data and data calculation printouts against original records and verification of analytical results prior to the release of draft documents. These checks will occur for all project deliverables. In addition, all deliverables will be reviewed by the project manager and others familiar with the project.

## 6.11 Corrective Action

All nonconformance with the established quality control procedures will be identified and brought into conformance. Additional work which is dependent on the nonconforming activity will not be performed until the nonconformance is corrected. Corrective actions will be defined by the project quality assurance coordinator and implemented to the satisfaction of the project manager.

# 7. DATA MANAGEMENT PLAN

## 7.1 Introduction

Data management requirements are essential as part of the development and completion of the RFI Program. The data management requirements as listed herein provide procedures necessary to properly document, track and manage all field and laboratory data generated during the course of each site specific investigation. The purpose of the RFI Program Data Management Plan is to:

- Identify Omega data management personnel and responsibilities
- Identify all field, laboratory and development data to be recorded and maintained
- Identify data coding requirements
- Identify data to be included on progress and site investigation reports to OMEGA

This Data management Plan shall provide format requirements for presenting raw data, tabulated data, and summary data of the field investigations and laboratory analyses. Deviations of data formats and required information will not be permitted unless written approval for such is obtained from the Project Manager.

## 7.2 OMEGA Personnel Data Management Responsibilities

### 7.2.1 RFI Project Manager

The OMEGA Project Manager shall be responsible for ensuring that all field and laboratory information collected and/or managed by OMEGA or submitted to OMEGA is recorded accurately and completely. The Project manager shall be responsible for approving any changes or deviations to the reporting of data as required under this Data management Plan. Furthermore, the RFI Project Manager shall be responsible for performing inspections related to the generation, collection and storage of data under the scope of work required of OMEGA.

### 7.2.2 RFI Field Manager

The RFI Field Manager shall be responsible for maintaining and recording all information and data required in the field logbook as discussed in Section 5.4.4. In addition, the RFI Field Manager shall be responsible for ensuring that all laboratory data are accountable and accurately reflect field sampling and chain-of-custody information.

### 7.2.3 RFI Health and Safety Officer

The RFI Health and Safety Officer shall be responsible for maintaining and recording all information and data required by Section 7 of this document.

### 7.2.4 RFI Contract Laboratory Project Managers

An independent laboratory will be contacted to analyze all environmental samples collected during the RFI. The laboratory will provide a Laboratory manager who shall be responsible for ensuring

that all laboratory data submitted to OMEGA is recorded, documented and presented in the proper formats.

## 7.3 Recording of Field Data

OMEGA shall be responsible for recording all data from the start of site investigation through the completion of the investigation.

All data, checklists, photographs, calibration logs, etc., generated during the course of the investigation shall be included as part of the RFI project file arid/or logbooks. After completion of the investigation, data and reports shall be maintained by OMEGA.

In all cases, the field logbook, calibration logs, and all laboratory log books shall always be maintained by OMEGA until the completion of the investigation. OMEGA shall label each of the logbooks on the front cover with the information specified below:

- Person or organization to whom the book is assigned
- Book number
- Project name, number
- Start date
- End date

It shall be the responsibility of OMEGA to ensure that all data recorded in the field logbook are printed in a legible manner using water proof ink. All logbook entries shall contain accurate and inclusive documentation of project activities, specifically daily activities. Because the information contained in these logbooks forms a basis for the later written reports, such information and data must contain only facts and observations. Language shall be objective, factual, and free of personal feelings or any other terminology that may prove to be inappropriate or irrelevant. The field logbook shall denote that information, at a minimum, specified below:

- Site identification
- Location of sampling points
- Description of sampling points
- References to photographs of the RFI site and brief sketch of sampling points
- Sample identification number
- Number of samples taken
- Time of sample collection
- Reference to sample location map
- Number of QA samples taken (e.g., duplicates)
- Collector's name
- Field observations
- Sample distribution (e.g., QA laboratory, agency split)
- All field measurements made (e.g., PH, temperature, specific conductance)

The field logbook shall be maintained at the OMEGA site during all times.

### 7.3.1 Photographs

Photographs may be taken by OMEGA as a means of providing visual evidence of unusual items and

TABLE 7-1

PRELIMINARY DATABASE SET-UP

| Column Name | Example Entry | Record Description |
|---|---|---|
| RECORD ID | #00001 | assigned No. |
| WELL ID | MW- | Well No. |
| SLBR ID | BG,RS,PI | Soil Boring No. (Background, Relocation Siting, Pond Investigation) |
| SFSMP ID | WMU,RR,DD | Surface Sample No. (Waste Management Unit, Railroad, Drainage Ditch) |
| LAB ID | 12-333-01 | Lab No. Assigned to Sample |
| ID | -BG-01-001 | Field Assigned No. to Sample |
| LABCODE | ATI | Lab where sample was analyzed |
| SAMPDATE | 1/30/89 | Date sampled |
| ANALDATE | 2/4/89 | Date analyzed |
| EXTRDATE | 2/3/89 | Date extracted |
| METHOD | 664 | EPA Test Method No. |
| PARMCODE* | 79-01-6 | Cas No. for constituent |
| PARMRPT | Trichloroethylene | Constituent |
| STDRPT | Vols263 | Category of constituent |
| VALFLAG | < | Below detection limit |
| VALUE | 10 | Concentration |
| UNITS | MG/L | Units of concentration |
| VALMOD | DF | "Value Modifier": see list |
| QACODE | ORG | Quality Assurance Code: see list |
| DILUTION | 1 | Sample dilution factor |

Keys to Certain Fields:

VALMOD
- SQ: Semiquantified Analysis
- SD: Sample Destroyed
- PE: Past Expiration Date
- DF: Data Failed Validity Criteria

QACODE

| | | | |
|---|---|---|---|
| CHK: | Check | PE: | Performance Evaluation |
| FB: | Field Check | R1: | R1-RN=Repeat Analysis 1-N |
| FD: | Field Duplicate | REF: | Reference Standard |
| LB: | Lab Blank | REP: | Replicate |
| LD: | Lab Duplicate | SPK: | Spike |
| MB: | Method Blank | TB: | Trip Blank |
| ORG: | Original | BD: | Blind Duplicate |
| | | EB: | Equipment Blank |

* See constituent parameter codes, Attachment G-I.

anomalies discovered during the course of the RFI. OMEGA will be responsible for references to these photographs as part of the field log book.

## 7.4 Recording of Laboratory Data

This Data Management Plan does not require recording of particular procedures related to the management of data delivered to the laboratory from OMEGA (except for sample labels, chain-of-custody forms, and analysis request forms). These forms shall not be included as part of the field logbook but shall be part of the data received from the laboratory by OMEGA to be maintained as part of the project files. OMEGA shall be responsible for storing all information and data received from the laboratory and related to the RFI site investigation as specified in the contract with OMEGA. This information and data shall include, but not be limited to:

- Chain-of Custody Forms
- Analysis Request Forms
- Laboratory Notes
- Internal Laboratory Performance Audits
- Chromatograms
- Raw Data Printouts
- Tabulated Data Printouts
- Laboratory QA/QC Data

These data shall be maintained in a manner that provides the above information concerning each site investigation. The data shall be available within 48 hours, upon request by OMEGA. These data shall be stored in an environmentally sound manner that would protect their integrity as long as required.

### 7.4.1 Field Laboratory Data Requirements

A laboratory logbook shall be utilized by the analysts who conduct analyses on all media samples received from OMEGA. This logbook shall not only document the analyses performed but shall also document the dates and results of equipment calibrations, incidents that occur during analyses and visitors to the laboratory. Laboratory performance audits shall be recorded in this logbook as well as other requirements set forth under the work contract. OMEGA shall be responsible for ensuring the proper recording of laboratory data generated for the analyses of media samples.

### 7.4.2 Analytical Database

The primary objective of developing an analytical database is to ensure that a detailed record of data collection, analysis, verification and reporting is maintained. In particular, environmental sampling data need to be stored within a medium which allows for accurate and appropriate manipulation for the purposes of validation, evaluation, statistical analyses and reporting.

OMEGA will manage all field sampling and laboratory analytical data with its in-house computer capabilities including dbase IV, Microsoft Excel and other software programs. Microsoft Excel will be used for short-term reporting and simple data evaluation and organization. Each of these programs can download data to dbase IV in order to maintain a total project database within a singular, manipulative format.

Each environmental sample will have a documentation sheet (file) consisting of all of the elements shown in Table 7-1. Within this format, all pertinent sample information will be readily accessible and capable of being validated, evaluated, transferred, manipulated, graphically displayed, etc.

Statistical Analysis

Statistical analysis will be performed on environmental samples to provide a means of quantifying the confidence level of data. Statistical analysis of ground water samples has been performed to date by previous consultants, and will continue to be performed by OMEGA, per RCRA 40 CFR 265 regulations. The purpose of this analysis is to determine whether there is a statistically significant exceedance of background levels, or other allowable levels of specified chemical parameters and hazardous waste constituents in ground water.

Final regulations for statistical methods for evaluating ground water monitoring data from hazardous waste facilities became effective April 11, 1989. OMEGA has used a variety of statistical analyses programs . With the advent of these new regulations and the requirements thereof, OMEGA is in the process of evaluating its present use of certain statistical analysis programs for reliability and compliance.

OMEGA will ensure that the selected statistical analysis method is compliant with the new regulations. In addition, OMEGA will employ a systems approach, to ensure an adequate and appropriate statistical analysis. This approach will include adequate characterization of hydrogeology and contaminant fate and transport, proper location of monitoring wells, appropriate sample sizing and reduction of measurement variability, through stringent application of procedures.

## 7.5 Recording of Development Data

Development Data is identified as that information or data, (such as isopleths, geological cross sections, potentiometric diagrams, well logs, etc.), developed as a result of data and information gathered from fieldor-laboratory based activities. OMEGA shall be responsible for generating development data as necessary. These data shall be included in progress reports and in the final report. These data shall be prepared in a clear, concise manner using graphical displays and standard symbols or, where necessary, those symbols approved by OMEGA. It shall be the responsibility of OMEGA to store and maintain these data in an environmentally sound manner to prevent any degradation thereof.

## 7.6 Recording of Health and Safety Program Data

HSP data is identified as that information or data (such as training records, medical surveillance files, safety and emergency procedures, etc.), required by Section 8 Health and Safety Program (HSP). OMEGA shall be responsible for generating these data as necessary. These data shall be prepared in a clear, concise manner. It shall be the responsibility of the Health and Safety officer to store and maintain these data in an environmentally sound manner and prevent any degradation thereof. All or any part of these data records shall be produced within 48 hours if so requested by the OMEGA RFI Program Team, OMEGA or the EPA.

## 7.7 Procedure for Data Validation

Data are used for preparing sampling plans, assessing historical trends, or evaluating potential risks to human health and the environment and ultimately for developing design alternatives for site remediation. Data quality and utility depends on many factors, including sampling methods, sample preparation, analytical methods, quality control, and documentation. The following criteria (EPA, January 1, 1985) divide physical and chemical data into three categories for the purposes of screening data for acceptability:

1. Unusable

2. Level A: sufficiently reliable for development of study plans, evaluating sampling techniques, and identifying gaps in a data base.

3. Level B: meet all criteria and can therefore be used to evaluate potential risks and solutions.

All data collected during the RFI are anticipated to qualify as Level B (i.e., they must satisfy all criteria). The following procedures for data validation will be carefully reviewed before data collection begins, to ensure adequate documentation and acceptable methodologies. Subcontracting laboratories and sampling personnel will be advised of all applicable documentation and procedural requirements.

Once the data are assembled, satisfaction of all criteria will be documented as listed below. Chemical data must meet criteria of (1) quantitative statistical significance, (2) custody and document control, and (3) sample representativeness. Physical data include (1) sampling location, time and personnel, (2) documentation, and (3) methodologies.

### 7.7.1 Chemical Data

Quantitative Statistical Significance

The following items will be documented:

1. Laboratory/field instrumentation, including calibration data, standard methods and references;
2. Proper sample bottle preparation;
3. Laboratory analysis methods including reference method;
4. Laboratory analysis detection limits;
5. Verification of standards using EPA or similar reference materials not less than once each three months;
6. Analysis of laboratory (reagent) blanks at a frequency of at least one per 20 samples;
7. Analysis of laboratory spikes at a frequency of at least 1 per 20 samples if the analyte is amenable to spiking (e.g., there is no method for spiking pH);
8. Analysis of field replicates (duplicates or splits) at a frequency of at least 1 per 10 samples for soils and 1 per 10 for ground water;
9. Analysis of laboratory replicates (duplicates or splits) at a frequency of at least 1 per 20 samples;
10. Presentation of tabulated QC data or QC charts/acceptance criteria;
11. certification of the laboratory and/or participation in round-robin testing by and/or

with EPA-accredited agencies;

12. QC limits shall be consistent with the limits established for EPA's contract laboratory program or as necessary to guarantee appropriateness of data for remedial alternative testing and design;
13. Companion sampling efforts such as crops or livestock, which do not appear to be necessary at this point.

Custody and Document Control

The following items will be documented:

1. Field custody noted in field logbook or transfer of custody documentation available;
2. Samples hand delivered to laboratory or transfer-of-custody documentation available;
3. Laboratory custody documented by transfer-of-custody documentation from either field personnel or shipper;
4. Laboratory custody documented through designated laboratory sample custodian with secured sample storage area;
5. Sample designation number(s) traceable through entire monitoring system;
6. Field notebooks and all custody documents stored in secure repository or under the control of a document custodian;
7. All forms filled out completely in indelible ink without alternations except as initialed;
8. Identity of sample taker;
9. Date of sample collection, shipping, and laboratory analysis.

In some cases, the handling of a sample while in the custody of one individual may not be properly documented. In addition, written documentation of transfers of custody between two individuals may be lost. In such cases, it may be necessary to rely on the custodian's verbal testimony that the sample remained secure or that a transfer was made to another individual. If there is any chance that the custodian's testimony will be seen as unreliable, the data produced as a result of that sample will be considered for rejection, or at minimum, assigned a low level of confidence.

Sample Representativeness

1. Compatibility between field and laboratory measurements or suitable explanation of discrepancy;

2. Analysis within time limits suitable for the preservation and analysis methods used;

3. Sample storage within suitable temperature, light, and moisture conditions;

4. Proper sample containers used (i.e., inert);

5. Proper sample collection equipment used (i.e., inert); properly decontaminated; not biased;

6. Proper sample preservation techniques used;

7. Proper laboratory preparation techniques used (e.g., grinding, sieving, drying, digestion);

8. A comprehensive evaluation of all factors indicates data was not prescreened by any party using different criteria than that contained herein (bias screening);

9. Sample site selection criteria provide representativeness.

### 7.7.2 Physical Data

1. Sampling date and tire;

2. Sampling team; observation taker and recorder, team leader;

3. Sampling location;

4. Physical description of sampling location (e.g., portion of plant sampled, etc.);

5. Sampling depth increment for soils (if applicable);

6. Sample collection technique;

7. Field preparation techniques (e.g., filtering, sieving, compositing, etc.);

8. Visual classification of sample using an accepted classification system (for soils, ground water, if applicable);

9. A thorough description of the methodology used, and a rationale for the use of that methodology;

10. Complete documentation of record-keeping practices;

11. Field notebooks and all custody documents stored in a secure repository or under the control of a document custodian;

12. All forms filled out in indelible ink without alterations except as initialed.

## 7.8 RFI Data Reporting Requirements

### 7.8.1 Progress Reports

OMEGA will be responsible for developing progress reports at the end of each month while the RFI is in progress. The progress reports will contain descriptions and estimates of work completed to date and work projected for the following reporting period; summaries of investigative findings; modifications to the initial RFI scope and/or schedule; problems, potential problems and solutions implemented or anticipated; and personnel substitutes anticipated for the following reporting period. In addition, copies of all daily reports, inspection reports, laboratory and/or field screening data and contact reports with regulatory agencies, public interest groups and other third party groups will be submitted.

### 7.8.2 RFI Final Report Requirements

OMEGA shall be responsible for preparing a final report upon completion of the site-specific RFI. A draft of this report shall be to EPA for appropriate distribution and review prior to submittal of a final report.

This final report shall detail all RFI activities that have been completed. The final report shall include a discussion about key decision points encountered and resolved during the course of the investigation. This report shall contain all data necessary to understand the project in its entirety including all investigative methods and procedures.

At a minimum, the following information shall be included in this report:

- Conclusions related to the Preliminary Site Evaluation
- Data and results generated from the Site Screening

Analytical data generated from the soil sampling

Analytical data generated from the ground water sampling

Analytical data generated from the surface water/sediment sampling

Analytical data generated from the ambient air sampling

Factors considered as part of the Receptor Analysis and the completed Receptor Analysis

Topographic map of site denoting all sample locations

In addition to these data and information it will be necessary to discuss any upset conditions that occurred during any sampling events or laboratory analyses that may influence the results. It will also be necessary to enter into the text of the final report "development data," (i.e., well drilling logs, stratigraphic cross-sections, etc.), that provide additional support to the data and interpretations discussed. It may be necessary to introduce key elements of the development data into the text of the final report using graphical displays (isopleths, potentiometric, ecological, cross-sections, etc.).

Overall data presentation will conform to the requirements of Attachment II of the Consent Order. Specifically, raw laboratory and field data will be provided as Appendices to the final report. Media specific soil and water chemistry data will be tabulated in the report text, accompanied by applicable statistical analyses. It is anticipated that data will be sorted by the following categories: ground water, surficial soils, and subsurface soils. Summary tables of these data will be provided.

Graphical presentation of the data will also be presented using the media-specific categories noted above. Maps showing concentration levels, and appropriate isoconcentration contouring, will be provided as indicators for plume delineation. Where applicable, RFI ground water data will be coupled with previous information to illustrate temporal changes for both water chemistry and piezometric data. This information will be present relative to potential on-site and upgradient sources areas as well as downgradient receptors.

The objective of the final report is to describe the whole site investigation and present the basic results. The final report shall not detail any further recommendations for additional site work or

remediation efforts.

### 7.8.3 Quality of Reports

All reports shall be prepared on classic crest grade paper or better. Only black ink will be used in conjunction with standard type at 1 1/2 spacing. The front and back of each page shall be securely bound and clearly identified for each specific site. It will be the responsibility of OMEGA to supply the required number of copies of all reports prepared in accordance with instructions from the OMEGA RFI Program Team. All reports shall be presented by the RFI Program Team upon completion.

## 7.9 Directives

At all times during the RFI, OMEGA shall be prepared to submit unsorted raw data, chain-of-custody forms, chromatograms, etc., as requested by OMEGA. This type of information shall not be included as part of the final report unless requested.

# 8.0 HEALTH AND SAFETY PLAN

## 8.1 Objectives, Site Description and History, Waste disposal methods

Objectives

The purpose of this Health and Safety Plan (HSP) is to provide field personnel with the proper health and safety procedures for use during the conduct of the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) at the OMEGA facility located in Whittier, California. The plan is intended for the exclusive use of OMEGA and OMEGA FPC personnel and their subcontractors.

Site Description and history

The Omega site lies within the boundaries of the City of Whittier. The entire treatment site (the site) consists of approximately 1.0 acre which is permitted on interim status permit to receive various types of Hazardous waste for treatment.

The site was has been recycling and treating various forms of industrial and commercial types of chemicals since the mid 1960's and was permitted under RCRA as an interim status facility in 1980. It received and processed both non-hazardous and hazardous materials as classified by RCRA and California state codes. During the early years of its operation, the major type of processing was halogenated industrial solvents and refrigerants.

Prior to August, 1976 the facility operated as Bachelor Chemical Processing. Bachelor Chemical was operated as a sole proprietary ship by Jim Bachelor. After that date it was acquired by Omega Chemical Corp. Omega made several improvements to the facility to enhance the facility in regards to safety and environmental conditions. Omega purchased the property at the site in 1987 from the Rippy Estate. Omega continued to make improvements to the physical structure of the site which included concreteing the entire site. Omega continued to operate the facility as Treatment, Storage Facility under the RCRA and California Codes.

In 1991 Omega entered into separate Consent Agreements with the EPA and Department of Health Services (DHS). The consent agreement with EPA required investigation of the site for possible contamination.

The EPA issued an Administrative Order on Consent pursuant to Section 3008(h) of RCRA for the Omega site in 1991. This Current Conditions Report is submitted in response to the order.

Leaks and spills of one or more of the compounds described above have occurred at the facility, resulting in documented contamination of soil and ground water media. Existing data indicate that the above media have been contaminated with organic (e.g. petroleum hydrocarbons, chlorinated solvents) constituents.

Adjacent properties consist of Cal Air Co. to the north (Air conditioning and mechanical contractor), New England Lead Co. to the west, and Skating rink to the south.

Waste Disposal Method

Between 1975 and present, waste generated by the processing and recycling of chemicals was sent to Class One land fill facilities or to other permitted treatment facilities.

## 8.2 Field Activities

RFI field activities have been divided into four subtasks consisting of hand-auger soil sampling at various locations, the installation of monitoring well pairs, the collection of two complete rounds of ground water samples, and the performance of single well slug-type tests on selected ground water monitoring wells. The following sections provide a brief description of each field task.

### 8.2.1 Task One - Surface Soil, Sludge/Liquid and Surface Water Sampling

At the present time, the majority of the property is covered with concrete. A concrete cutting contractor will be hired to core or saw through the concrete at each location, allowing for the collection of shallow soil samples with a hand-auger. .

### 8.2.2 Task Two - Subsurface Soil Borings/monitor Well Installation

Shallow borings will be drilled and sampled during the conduct of the field investigation. In addition,, a total of three ground water monitoring well pairs will be installed at the locations illustrated in Figure 4-1. At each location, one shallow (approximately 75 feet in depth) and one deep (approximately 110 feet in depth) well will be installed by the hollow-stem auger technique. Two additional deep wells will also be installed .

### 8.2.3 Task Three - Ground Water Sampling

OMEGA field personnel will collect two complete rounds of ground water samples over a three month period. A bladder pump will be used to collect samples from the newly installed wells.

## 8.3 Hazard Assessment

### 8.3.1 Chemical Hazards

Potentially hazardous chemical substances that could be encountered by field personnel during the performance of field activities are:

toluene
ethylbenzene
xylenes
trichloroethylene

Photoionization potentials (PP), threshold limit values (TLV) developed by the American Conference of Governmental Industrial Hygienists (ACGIH), and concentrations considered by NIOSH (National Institute for Occupational Health and Safety) to be immediately dangerous to life and health (IDLH) for some of the substances that might be encountered by field personnel are presented

TABLE 8-1

WASTE MANAGEMENT UNITS

| NAME |
|---|
| Drum Storage Areas |
| Waste Blending Tanks (1 to 5) |
| Distillation Unit #1 ( Paul) |
| Distillation Unit # 2 (Craig) |
| Distillation Unit #3 (Kirk) |
| Wiped Film Unit #1 (Jake) |
| Wiped Film Unit #2 (Fat Jack) |

in Table 8-2.

Ground water underlying the facility reportedly contains organic compounds. According to tabulated data contained in the Consent order, the maximum concentrations of cadmium (0.92 mg/1) and hexavalent chromium (500 mg/1) were detected in ground water samples collected in August 1985 from monitoring well MW-4. A maximum concentration of 3700 uVl Toluene was detected in Well MW-4 in July 1987, 550 ug/l Trichloroethylene was detected in Well MW -4 in August 1985, and 95000 ug/l Ethylbenzene was detected in well MW-3 in march 1986. Lesser concentrations of Dichloroethane, Dichloroethene, Benzene, Carbon Tetrachloride and Chloroform have been detected in several other on-site wells during previous ground water monitoring.

An examination of available data indicates that on-site workers could possibly be exposed to predominately organic contaminated soils during soil sampling activities, organic compounds in the ground water during monitor well sampling.

### 8.3.2 Inhalation Hazard

The predominant inhalation hazard at the site is from occasionally organic vapors from several of the process areas.

There is, therefore, the possibility of exposure to VOCs during drilling, ground water sampling and testing activities. Prior to the initiation of sampling or testing activities at each well, the well cap will be opened slightly and the PID probe will be inserted inside the well casing. The maximum PID reading will be recorded in the field notebook.

The well will then be allowed to vent until the readings decline, before sampling or testing is initiated. Periodically, the interior of the well will be checked with the PID to ensure that vapor levels have not increased. Sampling personnel will place themselves upwind of the well if possible during interior checking and well venting operations. According to available data (dated 1964) from a wind rose located in the nearby city of Whittier, the predominant wind direction is towards the southwest.

Except during concrete coring operations, airborne dusts should not be a hazard because for the most part, the facility is paved. Hollow-stem auger drilling also does not usually generate much dust. Concrete breaking or coring operations will likely generate dusts, however, concrete breaking operations will be stopped as soon as native materials are encountered, minimizing possible exposure.

### 8.3.3 Dermal Exposure

Because of the intrusive nature of soil sampling and drilling activities, direct contact is inevitable. Contact will be minimized by the use of proper protective clothing. It appears that the main contaminants of concern in the site soils are the various chemicals listed in Section 8.3.1 of this document. In addition, as previously discussed in Section 8.3.2, there is also the potential for exposure to organic vapors during the conduct of the field investigation.

### 8.3.4 Ingestion Hazard

Exposure can occur if food or drink is taken in and consumed in contaminated areas of the site or if contaminated items (gloves, pencils, etc.) are placed in the mouth. Exposure to chemicals via this method is considered insignificant as long as field personnel wash their hands and remove

TABLE 8-2 - SUMMARY OF CHEMICALS, DENSITIES AND AGENCY ACTION LEVELS

| CHEMICAL COMPOUND (NAME) | ABBREV. | DENSITY | EPA No. | CA DEPT.HEALTH SERVI Primary MCL | Second. MC | US E P A Primary MCL | econ. MCL | MCL Goal | CA ACTION LEVELS DEPT.HEALTH SERVICES TOXICITY | TASTE & ODO | SNARLs EPA | NAS | Prop.65 LEVELS | CHEMICAL COMPOUND (NAME) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **(Chemicals less dense than water)** | | | | | | | | | | | | | | |
| Acetone | "ACE" | 0.788 | U002 | | | | | | | | | | | Acetone |
| 2-Butanone (methyl ethyl ketone) | MEK | 0.805 | U159 | - | - | - | - | - | - | - | 200 | - | - | 2-Butanone (methyl ethyl ketone) |
| Total xylenes | "T-X" | ~0.86 | | 1750 | - | 10000 | 20 | 10000 | - | - | 10000 | - | - | Total xylenes |
| Ethylbenzene | EB | 0.866 | | 680 | - | 700 | 30 | 700 | - | - | 700 | - | - | Ethylbenzene |
| Toluene | "TOL" | 0.866 | U220 | - | - | 1000 | 40 | 1000 | 100 | - | 1000 | 340 | - | Toluene |
| Benzene | "BNZ" | 0.8787 | D018 | 1 | - | 5 | - | 0 | - | - | 200 | - | 3.5 | Benzene |
| ortho-Xylene | "O-X" | 0.8801 | | | | | | | | | | | | ortho-Xylene |
| **(Chemicals more dense than water)** | | | | | | | | | | | | | | |
| 1,1-Dichloroethylene | DCE | 1.2129 | 078/D029 | 6 | - | 7 | - | 7 | - | - | 7 | 100 | - | 1,1-Dichloroethylene |
| 1,2-Dichloroethane | "1,2-DCA" | 1.2569 | D028 | 0.5 | - | 5 | - | 0 | - | - | 700 | - | 5 | 1,2-Dichloroethane |
| Trans-1,2-dichloroethylene | "T-DCE" | ~1.28 | U079 | 10 | - | 100 | - | 100 | - | - | 100 | - | - | Trans-1,2-dichloroethylene |
| Methylene chloride (dichloromethane) | "MC" | 1.3255 | U080 | - | - | 5 | - | 0 | 40 | - | 1500 | ### | 25 | Methylene chloride (dichloromethan |
| 1,1,1-Trichloroethane | "1,1,1-TCA | 1.3376 | U226 | 200 | - | 200 | - | 200 | - | - | 200 | ### | - | 1,1,1-Trichloroethane |
| 1,1,2-trichloroethane | "1,1,2-DCA | 1.4416 | | 32 | - | 5 | - | 3 | - | - | 3 | - | - | 1,1,2-trichloroethane |
| Trichloroethylene | TCE | 1.4649 | D040 | 5 | - | 5 | - | 0 | - | - | - | - | 30 | Trichloroethylene |
| Chloroform | "CHF" | 1.484 | D022 | 160 | - | 100 | - | - | - | - | 100/500 | - | 4.5 | Chloroform |
| Trichlorofluoromethane | "TCFM" | 1.494 | U121 | 150 | - | - | - | - | - | - | 2000 | ### | - | Trichlorofluoromethane |
| Tetrachloroethylene | PCE | 1.6230 | 210/D039 | 5 | - | 5 | - | 0 | - | - | 1000/5000 | | 7 | Tetrachloroethylene |
| 1,1-dichloroethane | "1,1-DCA" | 1.757 | | 5 | - | - | - | - | - | - | - | - | - | 1,1-dichloroethane |
| 1,1-Dichloroethyne | "DCY" | | | | | | | | | | | | | 1,1-Dichloroethyne |
| 4-methyl-1,2,2-pentanone | "MP" | | | | | | | | | | | | | 4-methyl-1,2,2-pentanone |
| 1,1,2-trichloro-1,2,2-fluoroethane | TTE | | | 1200 | - | - | - | - | - | - | - | - | - | 1,1,2-trichloro-1,2,2-fluoroethane |
| Total hydrocarbons | "T-HC" | n/a | | | | | | | | | | | | Total hydrocarbons |

contaminated protective clothing prior to ingesting foods or drinks, and are not allowed to eat, drink or smoke in the work area.

### 8.3.5 Physical Hazards

All activities will take place in an active chemical recycling facility. There is an abundance of trucks and forklifts moving around the site at all times, an assortment of chemical tanks and various process areas, utilities, etc. All personnel should be extremely cautious walking and driving around the facility. Prior to the initiation of soil sampling and drilling activities, each sampling location will be checked with the OMEGA plant manger to determine whether underground utilities exist at the location. Exclusion zones will be posted to keep plant workers out of the work zone.

The possibility of site workers experiencing heat stress should also be considered. Heat stress usually is a result of protective clothing decreasing natural body ventilation, although it may occur at any time work is being performed at elevated temperatures. If the body's physiological processes fail to maintain a normal body temperature because of excessive heat, a number of physical reactions can occur, ranging from mild (such as fatigue, irritability, anxiety, and decreased concentration, dexterity, or movement) to fatal. Because heat stress is one of the most common and potentially serious illnesses at hazardous waste sites, regular monitoring and other preventative measures are vital.

When the air temperature exceeds 80*F, the following heat stress management plan will be implemented:

- Have workers drink 16 ounces of water before beginning work, such as in the morning or after lunch. Provide disposable 4-ounce cups, and water that is maintained at 50 - 60 $^{o}$F. Urge workers to drink 1 - 2 of these cups of water every 20 minutes, for a total of 1-2 gallons per day. Provide a cool, preferably air conditioned area for rest breaks. Discourage the use of alcohol in non-working hours, and discourage the intake of coffee during working hours. monitor for signs of heat stress.

- Acclimate workers to site work conditions by slowly increasing workloads, i.e., do not begin site work activities with extremely demanding activities.

- In hot weather, conduct field activities in the early morning or evening.

### 8.3.6 Overall Hazard Rating

The site is for the most part covered with concrete, therefore, during soil sampling activities, contact with contaminated soils will be limited if standard sampling practices are adhered to. Except during concrete coring operations, airborne dusts should not be a problem since the site is mostly paved. Elevated concentrations of organic compounds in the ground water below the site are thought to be more pronounced during periods of actual ground water pumping and extraction from the facility's extraction well. Therefore, organic concentrations in the ground water are expected to be much reduced. The overall hazard rating for the site is therefore determined to be low.

## 8.4 Personal Protective/Monitoring Equipment

## 8.4.1 Personal Protective Equipment

Personal protective equipment (PPE) will- consist of tyveks, full-face air -purifying respirators, inner and outer gloves, boots, hardhats and goggles. Activities will be carried out under level D (modified) personal protection. PPE requirements per each individual task are listed below. Contingencies for an increase in personal protection to a qualified Level C have also been included.

Task 1 - Soil, Sludge/Liquid and Surface Water Sampling

- Tyvek coveralls
- PVC inner gloves
- Latex outer gloves
- Boots
- Rubber overboots
- Hardhat

Level C Contingency

Respirators for dust while cutting pavement by dry methods

Task 2 - Subsurface Soil Borings/Monitor well Installations o Tyvek coveralls

PVC inner gloves
Latex outer gloves
- Boots
- Rubber overboots
- Hardhat
- Hearing protection
- Goggles or eyeglasses

Level C Contingency
Respirators will be worn if visible concentrations of dust in air are observed

Task 3 - Ground Water Sampling
Tyvek coveralls
PVC inner gloves
Latex outer gloves
Boots
Rubber overboots
Hardhat
Goggles or eyeglasses

Level C Contingency
Respirators fitted with organic vapor cartridges will be worn when opening wells

## 8.4.2 Monitoring Equipment

The use of a photoionization detector (PID) with a 10.2 ev probe will be required for all field activities. The PID will be used to monitor emissions from all hand-auger holes, drilled boreholes,

and cuttings piles. In addition, prior to sampling and testing of all monitor wells, the PID will be used to check the interior of the well for accumulated vapors. Experience has shown that the best response is to be prepared for rapid donning of a full-face, airpurifying respirator (APR) upon the detection of strong odors. It is recommended, therefore, that each sampling team member store their individual respirator (fitted with the appropriate cartridges) in close proximity to the actual work zone.

### 8.4.3 Contingency Upgrade

In the event that significant VOCs are detected during well sampling or testing activities, the respirators will also be fitted with organic vapor high efficiency particulate filters. While on site, team members will record PID readings at 15 minute intervals and when entering new work areas. The level of protection and upgrade contingencies have been established as follows:

PID Readings

Background to 1 ppm 1 ppm to 25 ppm 25 ppm to 200 ppm >200 ppm

Benzene Readings
0-1 ppm > 1 ppm

PPE/Convents

Level D (modified)

Level D, take Draeger tube for benzene Level C, take Draeger tube for benzene

Leave site

PPE/Comments

Level D

Level B, leave site

If team members notice eye or throat irritation, they will leave the site or don respirators. In addition, each sampling team member may wear an APR any time they choose. Doming a respirator constitutes an increase in the level of protection to a modified C.

### 8.4.4 Decontamination

Field personnel will dispose of used tyveks, gloves, overboots, respirator cartridges, etc. in approved trash cans located at the facility. All decontamination fluids will be collected in 55-gallon drums for processing in the OMEGA treatment system. A hand-wash station will be located at each drilling and sampling location. All personnel should bathe/shower thoroughly after returning to their lodging at the end of each work day.

Sampling equipment will be decontaminated at a central area located by the auxiliary office trailer during the completion of Tasks 1, 3 and 4. Equipment will be decontaminated by a soapy (Alconox)

water wash, water rinse, methanol rinse, and During the completion of Task 2, set up at each location to clean samplers, bailers, etc.). Heavy cleaning prior to the initiation tap a final double deionized water rinse. a portable decontamination area will be all downhole equipment (split-spoon equipment will be decontaminated by steam of drilling activities and after each use.

As shown on Figure 8-2, a contamination reduction zone and personnel decontamination station will be established adjacent to the auxiliary office trailer. During the conduct of the field investigation, the entire facility west of the warehouse will be considered an exclusion zone. Prior to departing the site at the end of each day's sampling, personnel will discard all used PPE and utilize the hand and boot wash stations which will be established in the personnel decontamination area. Site ingress and egress will be controlled by Omega at the location noted on Figure 8-2, as the access control point.

## 8.5 Site Organization and Emergency Contacts

The facility is completely fenced and access is controlled by a Omega, visitors must sign in. Sampling equipment decontamination will take place in the extreme northeast corner of the facility, in the vicinity of the plant office . Because OMEGA is an active chemical reclaiming facility, the entirety of the subject property (with the exception of the extreme northeast corner) will be considered the work zone. Emergency station locations are illustrated in Figure 8-2.

### 8.5.1 Site Safety organization

The Site Health and Safety Coordinator (SHSC) will be responsible for implementing the HSP. The SHSC is responsible for day to-day heath and safety activities. These activities include: ensuring that PPE is available at the site for field personnel use, maintaining safety supplies, supervising decontamination procedures, performing air monitoring, determining when site conditions require increasing the level of protection, distributing and making sure that field personnel complete the monthly Incident/Status Reports, and reporting safety violations and problems to Omega,s Project manager (PM) and Regional Health and Safety Supervisor (RHSS). OMEGA's Environmental and Safety manger has been designated the alternative site health and safety coordinator.

All personnel assigned to work at the site must have current health and safety clearances before beginning work. To obtain clearance, an individual must (1) be certified by a physician as being physically fit to work with potentially toxic materials and wear respiratory devices, (2) attend an approved basic health and safety training course in compliance with OSHA Safety and Health Standards (29 CFR 1910), and (3) pass a respirator fit test. All personnel will be assigned a copy of the HSP, will become familiar with its contents, and will sign the signature page. Prior to the initiation of site activities, the SHSC will convene a site safety orientation briefing to ensure that the provisions of the plan are understood by all personnel. No one will be permitted to work at the site alone. At the present time, it is anticipated that the following individuals will be involed in field sampling activities at the Omega facility:

The nearest emergency medical facility is located less than 1/2 miles from the site. Presbyterian Intercommunity Hospital, located at 12401 East Washington Boulevard, in the city of Whittier (northeast comer of the intersection of Lambert Road and Washington Boulevard), provides 24-hour emergency services. Figure 8-3 illustrates the location of the hospital, with the suggested route from the site highlighted. In the event of personal exposure, all contaminated PPE or clothing will be removed and the individuals affected areas cleaned. In the event of injury, the individual will be treated at an on-site first aid station. If, as determined by the SRSC, the exposure or injury is of a

serious nature, the individual will be transported to Presbyterian Intercommunity Hospital for treatment.

To get to the hospital from the site, turn right (south) onto Whittier Blvd. from the facility main entrance and proceed approximately 100 yards to the intersection of Washington Blvd. turn right (west) and proceed approximately one quarter mile to the intersection Lambert Road, turn right (north) onto the hospital grounds.

### 8.5.2 First Aid

First aid station is available at the facility for treatment of minor injuries. It is located inside the rest room inside the main warehouse.

In addition, permanent eyewash stations are available at various locations throughout the facility.

### 8.5.3 Recordkeeping

Health and safety records will be maintained to monitor the program and document compliance with regulatory requirements. Records defining work activities and documenting compliance include training, daily logs, medical, and instrument calibration records and accident report data.

### 8.5.4 HSP Acknowledgment

It is essential that all site personnel, including subcontractors, receive a copy of the HSP, and read, understand, and agree to its provisions. The On-Site Coordinator will distribute the HSP to personnel as they are assigned to the project. The attached signature sheet is used to document that these provisions have been met. Contractors using their own HSP should have a means of documenting distribution of the HSP.

HEALTH AND SAFETY PROGRAM

INSTRUCTIONS: Field personnel are required to receive a copy of the Health and Safety Plan (HSP), and to read, understand, and agree to the provisions of the plan. The Site Health and Safety Coordinator (SHSC) is responsible to distribute the HSP to personnel as they are assigned to the project.

Personnel are required to sign this form indicating receipt of the HSP. The original of this form is maintained by the PM, and becomes part of the permanent project files. Copies of this form are to be sent to the Health and Safety Director (HSD). Updated copies of this form are sent to the HSD as additional personnel are assigned to the site.

SITE NAME / NUMBER

REGION / LOCATION

I have received a copy, read, understood, and agree to comply with the provisions of the above referenced HSP for work activities on this project.

| PRINTED NAME | SIGNATURE | DATE |
|---|---|---|

OMEGA
HEALTH AND SAFETY PLAN SIGNATURE FORM

# 9.0 PUBLIC INVOLVEMENT PLAN

## 9.1 Introduction

This Public Involvement Plan (PIP) describes a conceptual program for public involvement during the RCRA Facility Investigation (RFI) of the Southern California Chemical (OMEGA) facility located in the community of Whittier, Los Angeles County, California. The purpose of this Public Involvement Plan is to involve the community and other interested persons in the cleanup process by establishing procedures for the accurate and timely release of information to interested citizens and public officials, and to encourage communication between the community, OMEGA and the Agencies (EPA Region 9, California Department of Health Services and the California Regional water Quality Control Board). This PIP summarizes what is known of past city concerns and discusses assessing current and potential issues in the city related to this RCRA facility. This PIP is divided into the following four sections:

City Relations Background

Goals of the City Relations Program

Techniques to Reach City Relations Goals

Community Relations Activities and Timing

## 9.2 Community Relations Background

Based on available information, there has been limited city involvement in association with the OMEGA facility.

The Whittier News published a public notice on regarding the CEQA process for Omega's proposed expansion in 1988. The purpose was to notify the public that both DHS and EPA were accepting comments on the CEQA and permit process. No letters on behalf of Omega's position were received in response from members of the industrial community.

No environmental groups or organized community groups have been actively involved in the affairs of OMEGA.

Issues and Community Concerns

Community and local officials have not been interviewed, therefore, the issues of greatest concern to some of the affected parties cannot be identified at this time. Interviews with local (City of Whittier) and County officials will be an integral component of the Public Involvement Plan, as described below.

## 9.3 Goals of the Public Involvement Plan

The facility specific objectives for the Public Involvement Plan for the investigation and cleanup at

the OMEGA facility are presented in the following paragraphs. The lead community relations responsibilities will be borne by OMEGA, with active participation and guidance by the U.S. EPA. As available, DHS personnel will also be encouraged to participate in the city involvement activities.

Provide the Community with Information and Respond to Inquiries

Information will be disseminated to interested elected and agency officials through fact sheets and informal phone calls made by OMEGA and the EPA's Community Relations Coordinator(s) for the facility. OMEGA and the EPA will, when possible, notify officials in advance of news releases so they are able to respond to citizen inquiries when the information is made public.

Based upon a schedule devised by mutual consent, OMEGA and the EPA will inform interested residents in the Whittier area about cleanup activities at the facility. Because of the large Spanish-American population in the area, OMEGA and the EPA will provide some information to the community in Spanish as well as English. Information may be disseminated through fact sheets, press releases, information repositories, and informal public meetings.

Establish Communication Between the Agencies Responsible for Facility Work and the Community

Communication with the community during the RFI will help OMEGA and the EPA understand the community's perspective on facility issues, Comunication will also foster the development of cleanup alternatives that are responsive to the community concerns. In addition to public meetings, the Community Relations Coordinator may schedule informal discussions with residents and interest groups. Interviews with representatives of the Whittier City Government and Chamber of Commerce will facilitate the communication network.

Provide for Citizen Input and Involvement

A public cement period (duration to be determined) may be required on the draft RFI and CMS reports to receive public comments on the proposed remedial alternatives. Such comment period will be announced through notices inserted into public notices in the Whittier Daily News, Whittier News, and La Opinion newspapers. The community will be informed about the procedures for submitting comments on the report, the availability of the report in the community, and the date and place for response deliveries or any community meetings to receive public cements. The schedule for the comment period response deadlines and any community meetings will be annouced through fact sheets, public notices, or press releases at least two weeks in advance.

## 9.4 Techniques to Reach Public Involvement Goals

Another element in the Public Involvement program for the OMEGA facility is the provision of information to city and county officials, and interested and affected community members. This section presents the community relations techniques that may be employed during the Omega RFI to ensure that the community is included in the process. The following techniques are organized according to the goals of the Public Involvement program to which each technique best applies.

1. Goal: Provide the Community With Information and Respond to Inquiries

a. Establish Information Repositories

Purpose: To provide all members of the community with access to facility specific information.

Procedure: Information repositories should be located at local libraries (to be determined). The Whittier Public Library has been used in the past. The repositories may contain bilingual versions of selected documents. materials in the repositories are likely to include current and updated facility fact sheets, an explanation of RCRA, and all available public documents relating to the facility, including the Public Involvement Plan, and the draft RFI and CMS reports. The repositories will be updated as needed during the RFI/CMS.

b. Create mailing List

Purpose: To establish a mailing list of all local officials, interested and affected private citizens, and news media representatives who should receive fact sheets regarding the investigation and clean up.

Procedure: This plan includes a partial mailing list in Attachment A. Additional contacts and interested parties should be added to the list. one means of adding to the list is to distribute mail-in address forms to allow all interested individuals an opportunity to be included on the mailing list. In addition, persons making written or telephone inquiries to OMEGA or the EPA should be added to the mailing list.

c. Provide Public Service Announcements

Purpose: To reach members of the community regarding information, facility activities and public meetings.

Procedure: Local English and Spanish radio stations and newspapers are the primary news media available for the local population. To communicate information about the facility to this community group, the Agencies may make periodic public announcements through these media, in addition to submitting pertinent news releases.

d. Prepare Fact Sheets

Purpose: To provide more detailed information to local officials, interested and affected members of the community, and the news media about the progress of the RFI and CMS Schedules and sampling results.

Procedure: Fact sheets will be prepared for the community at large. At this time the number of fact sheets to be developed has yet to be determined; however, it is anticipated that fact sheets will be distributed at the early stages of the investigation, at the completion of field activities (fact sheet update), at the conclusion of the RFI, and concurrently with the release of the draft CMS report. Each of these fact sheets will summarize completed and on-going activities (and results thereof), and provide a synopsis of upcoming tasks.

e. Prepare Press Releases

Purpose: To inform the news media, and thereby the general community, about facility events.

Procedure: News releases will be prepared and distributed during the RFI and CMS to inform the community of the purpose and procedures of major RCRA actions, and to explain the kinds of activities that may be conducted at the facility.

2. Goal: Establish C ommunication Between OMEGA and EPA for Facility Work and the Community

a. Arrange Informal Discussions

Purpose: To respond to community concerns about activities at the facility in an informal setting.

Procedure:

It will be the responsibility of OMEGA to establish communication with the community. As an alternative, or in addition to public meetings, OMEGA, with the assistance of the EPA may conduct small meetings with community groups to enable residents to discuss facility issues with OMEGA and the EPA representatives and to provide the OMEGA and the EPA an opportunity to explain the goals, constraints, and progress of the cleanup.

Topics that would be particularly relevant to the community include such items as: scope of ground water sampling plans, results of ground water sampling, and an assessment of air quality near the plant, etc. The following segments of the community may be interested in such informal discussions: immediate neighbors of OMEGA facility, members of the Spanish-speaking community who are interested in the cleanup but who may feel excluded because of language differences, and members of the Whittier business community.

b. Hold Community Meetings

Purpose:To provide an opportunity at the start of the RFI and during the public comment period on the draft RFI report for the community to affect decisions made regarding RCRA action at the OMEGA facility.

Procedure: If sufficient interest is shown, OMEGA and EPA may conduct community meetings, as needed. The meetings should explain upcoming activities and introduce the key personnel responsible for the facility. At this time the OMEGA and EPA may ask those attending the meeting if they would like to be on the facility's mailing list. In addition, comments received in regards to the RFI and CMS reports may be discussed.

3. Goal: Provide for Citizen Input and Involvement

a. Hold a cement period.

Purpose: To ensure community input on the proposed cleanup alternatives for the OMEGA facility.

Procedure: A comment period (the actual period will be determined at a later date) will be scheduled when the draft RFI report is released to the community. The comment period should be announced two weeks in advance through a public notice and a fact sheet.

b. Prepare Responsiveness Summary.

Purpose: To describe community questions and comments received during the RFI and CMS, including the comment period.

Procedure: The summary will include community comments and concerns the proposed cleanup alternatives and how OMEGA and the EPA responded to these concerns.

c. Revise Community Relations Plan.

Purpose: To reflect changing community concerns and opinions as a result of the selected cleanup actions.

Procedure: This plan will be revised by OMEGA and EPA, following approval of the selected corrective measures, to incorporate city relations activities to be conducted during the final design and construction phase of the selected cleanup alternative.

## 9.5 Schedule

A schedule for the Public Involvement Program has not been developed at this time. However, it is presumed the Public Involvement Program milestones will follow the RFI schedule.

TABLE 9-1

LIST OF CONTACTS AND INTERESTED PARTIES

A. FEDERAL ELECTED OFFICIALS

Senator Alan Cranston

Washington D.C. office
Hart Senate Office Bldg., Suite 112
Washington, DC 20510 (202) 224-3553

District office
5757 W. Century Blvd., Room 515
Los Angeles, CA 90045 (213) 215-2186

Senator John Seymour

Washington D.C. office
Hart Senate Office Bldg., Suite 720
Washington, DC 20510 (202) 224-3841

District Office
11111 Santa Monica Blvd., Suite 915
Los Angeles, CA 90025 (213) 209-6765

TABLE 9-1
(CONTINUED)
LIST OF CONTACTS AND INTERESTED PARTIES

Representative Esteban Torres

Washington D.C. Office
1740 Longworth Hou Office Bldg.
Washington, DC 20515 (202) 225-5256

District office
8819 Whittier Blvd., Suite 101
Pico Riviera, CA (213) 695-0702

B. STATE ELECTED OFFICIALS

Senator Cecil Green

Sacramento, CA Office
State Capitol, 081
Sacramento, CA 95814 (916) 445-5581

District Office
12631 E. Imperial Hwy., Suite 12A
Santa Fe Springs, CA 90670 (213) 929-0016

Assemblyman Robert Epple

Sacramento, CA Office
State Capitol, Room 128
Sacramento, CA 95814 (916) 445-6047

District office
13710 St e er, Suite 202
Norwalk, CA 90650 (213) 929-1796

C. LOCAL ELECTED OFFICIALS

Los Angeles County Board of Supervisors
500 W. Temple St., Suite 383
Los Angeles, CA 90012 (213) 974-1411

Gloria Molina, Supervisor
Field Rep. Veronica Guiterrez (213) 923-1271

TABLE 9-1
(CONTINUED)

LIST OF CONTACTS AND INTERESTED PARTIES

F. COMMUNITY ORGANIZATICNS

Community Organizations

Whittier Chamber of Commerce (310) 698-9554
P.O. Box 4188
8158 S. Painter Ave.
Whittier, CA 90602
Diane Acosta, President

G. MEDIA

Newspapers:

Whittier Daily News (213) 698-0955
7612 Greenleaf Ave.
Whittier, CA 90602

La Opinion (213) 748-1191
1436 S. Main
Los Angeles, CA 90015

Television Stations:

American Cable Systems of California (213) 869-5301
10839 La Reina
Downey, CA 90241
Adam Bell

Radio Stations to be determined

H. INFORMATION REPOSITIORIES

WhittierPublic Library
7344 S. Washington Ave.
Whittier, CA 90602 (310) 698 8949

Department of Health Services
Toxic Substance Control Division
1405 N. San Fernando Blvd., Suite 300
Burbank, CA 91504 (818) 567-3021

TABLE 9-1
(CONTINUED)

LIST OF CONTACTS AND INTERESTED PARTIES

I. PUBLIC MEETING LOCATIONS

To be determined

# APPENDIX

# GENERAL SOIL SAMPLING PROCEDURES

## 1.0 INTRODUCTION

Soil sampling is undertaken at uncontrolled hazardous waste sites and controlled substances work areas to determine the type, degree and extent of contamination resulting from previous disposal practices.

For the purposes of this document, soil is considered to be all unconsolidated materials above bedrock. Consolidated materials such as bedrock or rock outcrops are not considered soil, but may be encountered in soil borings.

Soils may have variable characteristics depending upon their texture, structure and moisture content. The selection of optimum sampling techniques and equipment to be used for soils will be dependent on the condition of the soil and the amount of material required for analysis. A major differentiating factor in the selection of techniques and equipment is whether surface or subsurface sample will be obtained. Surface samples are generally easy to obtain using hand equipment, as described in "General Procedures for surface and shallow depth soil sampling". Subsurface-samples are obtained by advancing borings as described in " Subsurface Soil Sampling".

## 2.0 SOIL SAMPLE TYPES

Because it is generally difficult to interpret data obtained from composite soil samples, all samples obtained are discrete grab samples which are representative of the material under consideration. Composite samples are only obtained when it has been demonstrated in a formal sampling plan that the data generated will provide useful information on site conditions.

Grab samples are composed of material sufficient to fill two 1 pint containers, approximately 600 to 800 grams of material. Each container is filled to 75 to 90 percent by volume. Samples obtained from boreholes are placed into 1 quart wide-mouth jars.

Subsamples may be required when separate analytical tests will be performed on the same sample obtained, or duplicates will be sent to various labs. Subsampling is accomplished by dividing the initial grab sample into separate samples.

If subsampling is required, the sample is split in the field by using clean sampling canvas cloth or other appropriate material. For saturated samples, the sample is split using techniques to ensure that each subsample is representative of the material being sampled. Upon laboratory receipt of the samples, they may be further subdivided to allow for separate analytical determination.

## 3.0 SOIL SAMPLING LOG

A descriptive log of visual soil characteristics must be maintained for all soil sampling operations. The log is completed by a soil scientist or geologist supervising the soil sampling operations.

The log must be completed as a supplement to the data to be recorded in site field notebooks. In addition, the log shall contain a detailed description of the soil encountered at the site during the sampling events. This detailed description includes:

It is important to note that water levels obtained in this situation are not suitable without further interpretation for determining hydraulic gradients. To use those data for determining hydraulic gradients, the differences in density between the light immiscible and water have to be accounted for. measuring fluid levels in wells screened @.n lenses of dense immiscibles resting on a low permeability formation is somewhat easier, provided the immiscible fluid is nonconducting. The top of the dense layer can be identified by simply using an electric sounder. As an electric sounder passes from groundwater into the immiscible phase, the detection unit will deactivate because the fluid will no longer conduct electricity. Special pastes or gels may also be available for this purpose. An additional method for determining the interface of a denser-than-water fluid may be appropriate. An hydrometer having a density greater than water but less than the immiscible fluid may be used. Although it is a delicate procedure, the hydrometer should sink through the water but float on the immiscible fluid. Water levels in such wells can be measured by using normal procedures.

## 4.0 REFERENCES

USGS. 1984. National Handbook of Recommended Methods for Water-Data Acquisition.

IJSGS. 1983. RCRA Permit writer's Manual: Ground Water Protection (40 CFR Part 264 Subpart F). Geotrans Inc., prepared EPA.

# GENERAL PROCEDURES FOR SURFACE AND SHALLOW DEPTH SOIL SAMPLING

## 1.0 INTRODUCTION

This procedure presents the equipment and techniques used to collect surface and shallow depth soil samples. General procedures for the collection and handling of soil samples, as well as the equipment cleaning are given in "General Soil Sampling Procedures".

## 2.0 TROWEL

Trowels are implements consisting of scooped blades 4 to 8 inches long and 2 to 3 inches wide, attached to a handle. Trowels may be used for obtaining surface soil or sediment samples which do not require excavation beyond the depth of a few inches. Trowels may also be used to obtain subsoil samples from profiles exposed in test pits. Trowels are generally only practical when sample volumes of 1 pint or less will be obtained.

Trowels should be fabricated from stainless steel or galvanized steel. Samples which will be analyzed for organics content should only be obtained with a stainless steel implement; no plastic materials should be permitted to come in contact with these samples.

## 3.0 SHOVELS

Shovels are used when larger quantities of materials than those practically attainable using trowels are required. Shovels are also used when subsurface samples at depths of up to 6 feet are to be obtained by hand excavation. Tiling spades ("sharpshooters") are recommended for excavation and sampling.

Standard steel shovels may be used for excavation when stainless steel or polypropylene implements will be used for sampling.

## 4.0 TRIER

Triers are tubes 1 to 2 inches in diameter and generally 24 to 36 inches long, which have been cut lengthwise to form a trough. The edges of the tip of the trier are ground to form a sharp tip for ease of insertion into sediment or soil. The trier is equipped with a handle for insertion. Samples are obtained by inserting the trier at angles of up to 45 degrees from horizontal into sediment or soil. The trier is rotated to cut a core and then pulled from the material being sampled. The sample is then transferred to the appropriate container. Triers are used to s @ ample materials to depths of 1 foot or less.

Triers shall be made of stainless steel or polypropylene. Chrome plated steel may be suitable when samples are to be analyzed for organics and heavy metal content is not of concern.

## 5.0 CORE SAMPLER

Core samplers are cylindrical metal implements with diameters of 1/2 to 3 inches. Hand operated core samplers are used in a manner similar to triers but can be used to obtain samples at depths of up to 4 feet in non-compacted materials. The core itself is generally 12 to 18 inches in length, and extension rods are used to reach depths of greater than 1 foot. The sampler is pushed into the soil

- Horizonation
- Color utilizing Munsell Color Notation
- Texture using USDA or unified classification system*
- Density (standard penetration) or consistency
- odor**
- Relative moisture content

## 4.0 Equipment cleaning

In order to minimize the chances of cross contamination of samples, all sampling equipment must be carefully cleaned after obtaining each sampling. Sample containers shall also be cleaned prior to use as described in Procedure 5622006.

Equipment cleaning is undertaken in a manner which minimizes contamination of sampling sites, boreholes or monitoring wells. All wash waters and waste products generated during cleaning operations are placed in a 55-gallon drum for final disposal.

Sampling equipment is brushed with a wire brush to remove soil particles. Samplers which have been in contact with oily samples shall be wiped with absorbent cloth and then with reagent grade methanol. Samplers which have not come in contact with oily substances shall be wiped with a dry cloth. The samplers are then washed with a warm detergent solution (Liquinox, Alconox), rinsed with tap water and distilled water, wiped dry or allowed to air dry.

Thin tube samplers, split spoons and other boring rig equipment which will enter the borehole are steam cleaned with approved water, rinsed with reagent-grade methanol, and allowed to air dry prior to use.

Samplers shall be covered with plastic bags and placed into their appropriate storage containers after use.

*Field texturing shall only be undertaken when soils are known to be non-contaminated

**Odor to be determined only when respirators are determined to be unnecessary for site work.

## 5.0 GENERAL SAMPLING EQUIPMENT AND TECHNIQUES

Surface soil samples may be obtained using a number of manual devices such as shovels and trowels. These instruments may also be used to obtain subsurface samples at depths of up to 6 feet or in road cuts or backhoe pits. when subsurface soil samples are required at depths of greater than 6 feet, soil boring equipment is generally required.

Sampling equipment to be used for obtaining soil samples at

uncontrolled hazardous waste sites must be relatively inert so as not to contaminate samples, and must be easily cleaned. The equipment must also be uncomplicated and easily operated under any level of personal protection.

Sample containers must be made of material which is compatible with the material to be sampled, resistant to breakage and of adequate size to allow for collection of at least pint (500 ml) of

material. The sample containers must have wide mouth openings to allow for placing of larger pieces of consolidated materials and for ease of operation. Wide mouth, amber glass bottles (500 ml capacity) with teflon-lined caps are preferred.

Collected samples are transferred to the containers with a minimum of handling. Glass containers with plastic outer sleeves shall be used for sampling material to be analyzed for organic content, or those materials which contain petroleum distillates. Caps for glass containers must be teflon lined.

Plastic containers made of high density linear polyethylene (LPE), PVC or teflon are to be used when materials will not be analyzed for organics content. Plastic containers are only used when the material to be sampled is known to be non-reactive with the sample container screw caps of the same material from which the containers are fabricated are used.

at 45 degrees to 60 degrees from the horizontal and rotated when desired depth is reached. The core is then removed and the sample placed into an appropriate container.

Core samplers shall be stainless steel when analyzing for low concentrations of metals or organics. Plastic or polypropylene core samples are generally not suitable for obtaining dense soil samples or samples at any appreciable depth

## 6.0 HAND AUGER

Auger samplers are constructed of sharpened spiral blades attached to a hardened metal central shaft. The diameters of hand augers are generally in the range of 1 to 1-1/2 inches and are used to obtain samples in materials through which hand core samplers cannot be used. Hand augers are generally more appropriate for sampling in soils with greater stone or gravel content or higher bulk densities. Hand augers can be used to obtain samples at depths of up to 3 feet. If necessary, topsoil may be excavated with a shovel to below the existing subsoil levels, with the thickness of topsoil noted.

The hand auger is screwed into the soil at an angle between 45 degrees to 90 degrees from the horizontal. The auger is pulled from the material being sampled when the entire auger blade has penetrated soil. The sample is removed by forcing or knocking it out of the auger. This procedure is repeated until the desired depth is reached. The auger is removed:) by lifting straight up without turning (if possible).

Large diameter augers (greater than 3 inches) used in conjunction with portable gasoline powered engines can be used to obtain samples at-depths of up to about 6 feet.

The samples obtained using augers are disturbed in nature and it is difficult to determine the exact depth at which samples were obtained.

## 7.0 BUCKET AUGERS

Bucket augers are generally made of two cutting blades attached to a 3-to 4-inch diameter core 4 to 6 inches long. The bucket is attached to a hard metal shaft generally 4 to 5 -feet in length with a perpendicular handle attached for rotating the bucket.

Bucket augers are used to obtain disturbed samples at depths of up to 4 feet. Bucket augers should be utilized in stony or dense materials in which use of hand operated core or screw augers is not practical. Bucket augers with closed blades are utilized in single grain materials or saturated materials which cannot generally be retrieved in core samplers.

The bucket auger is rotated while exerting downward pressure until the bucket is full. The bucket is then removed from the boring and the sample is transferred to the appropriate container. This procedure is repeated until the appropriate depth is attained.

# SUBSURFACE SOIL SAMPLING

## 1.0 INTRODUCTION

The objective of subsurface sampling is to obtain soil from known depths in order to evaluate site characteristics, detect the presence of any contaminants and to evaluate the potential for pollutant migration. In the following sections, the equipment and techniques used to collect subsurface soil samples are described. General procedures which shall be followed during soil sample collection, including the cleaning of sampling equipment, are presented in "General Soil Sampling Procedures".

## 2.0 BOREHOLE DRILLING

subsurface soil samples from boreholes can be obtained at specified depths or continuously. Several techniques can be utilized for advancing borings including jetting, wash boring, auger boring, or rotary drilling. These techniques are briefly described in " General Considerations for Monitoring Well Installation". Jetting is not appropriate where soil samples are of concern.

In some instances-borehole advancement, in connection with soil sampling, is accomplished by continuous sampling.

## 3.0 SOIL SAMPLING

The boring techniques utilized to excavate a borehole result in considerable disturbance of soil and do not allow for accurate determination of the depth from which soil materials have been excavated. Therefore split spoon, thin wall tubes or other sampling techniques must be used in conjunction with boring operations to obtain soil samples.

Subsurface samples may be obtained at predetermined depths, at every change in lithology or continuously. Continuous sampling provides the most accurate record of subsurface conditions for interpretive purposes.

### 3.1 Split Spoons

Split spoons are devices used to obtain subsurface samples of up to 2.5 feet in length within hollow stem auger flights, cased borings, and mudded holes. The 1.75 to 2.5 in ID split spoon samplers are advanced into the undisturbed material beneath the bottom of the casing or borehole by use of weighted hammer and drill rod. The relationship between hammer weight, drop and blows required to advance the split spoon in 6-inch increments is an indication of density or consistency of subsurface soils. After the split spoon has been driven the prescribed depth, it is removed carefully to avoid loss of soil materials. In non-cohesive or saturated soils a nest shall be used to help retain the sample.

Following removal of the split spoon from the casing, it shall be detached from the drill rod and opened to allow for visual classification of the sample. when less than a 10-inch sample has been obtained, a second cleaned sampler shall be lowered into the hole and a second sample shall be obtained. The first sample collected, if any, shall be retained unless greater sample recovery is obtained during the subsequent sampling attempts. The entire sample (except the top several inches of possibly "disturbed" material) shall be retained.

Samples of cohesive clays or silts shall be wrapped in aluminum foil prior to storage in jars, to preserve as undisturbed a sample as possible.

Once an adequate sample is collected, the sample shall be inspected, described, placed in wide mouth jars, labeled, and stored for transportation to the laboratory.

If volatile organic analyses are to be performed, VOA vials shall be filled immediately from the split spoon before jarring.

Subsamples for other specific chemical analyses shall be taken as soon as possible, as required.

### 3.2 Thin Wall Tubes

Thin wall tubes are hollow pipes which are pressed or driven into the soil without rotation to obtain core samples of relatively undisturbed soils.

Thin wall tube samplers are generally 1.875 in ID, 2 in OD, and 2 to 3 feet long, but may be of any size convenient for sampling. The thin wall tube has a sharp cutting edge and a positive inside clearance.

Thin wall tube samplers may be pushed or driven into soils inside hollow stem auger flights, wash bore casings or uncased boreholes. The tubes are pushed into the soil without rotation until the desired depth is attained, or to refusal. If the sample tubes cannot be advanced by pushing, it may be necessary to drive the tube into the soil, without rotation, using hammers and drill rods. The tubes are generally allowed to remain in the boring for 10 to 15 minutes to allow buildup of skin friction prior to removal. The sampler is then rotated to shear the sample from the soil below and carefully removed from the borehole.

Following removal of the tube sampler from the drilling equipment, the sampler is inspected to ensure that an adequate length of sample as been obtained. This sampling procedure shall be repeated until an adequate soil core is obtained provided that the material being sampled is of a nature which would permit retention in the sampler.

Upon successful retrieval of a sail core it shall be described and recorded in the log book and any disturbed soil shall be removed from each end of the tube. Samples for volatile organic analysis must be extracted from the solids sample as soon after the sampler is withdrawn as possible. During transport to the sampling station, the tube should be capped with a non-reactive material. For other parameter, the shelby tube shall be sealed by pouring three 1/4 inch layers of liquid wax such as Socony Vacuum Product 2300 in each end allowing the wax to solidify between each layer. The remaining space shall be filled to the end of the cylinder with Ottawa sand or other similar sand and allowed to settle and compact. Plastic caps shall be taped over the ends of the cylinder and then sealed by successively dipping the ends into liquid wax. The tube shall then be labeled. Care should be taken in handling to label the top and bottom of the tube.

# GENERAL CONSIDERATIONS FOR MONITORING WELL INSTALLATION

## 1.0 INTRODUCTION

Monitoring wells are installed at or adjacent to hazardous waste sites in order to provide an understanding of the overall groundwater regime, to evaluate flow patterns and hydraulic head fluctuations of the groundwater immediately surrounding the site and for the collection of groundwater samples to determine the extent of contamination in instances where the site in question has affected the quality of the groundwater. It is essential that samples be collected from sources in a manner that will accurately assess the concentrations of constituents present. This may include the collection of groundwater samples from existing monitoring wells and large diameter production wells and possibly other sources under certain circumstances (i.e., springs, etc.), in addition to samples collected from monitoring wells installed for this purpose. Generally, the installation of monitoring wells includes soil sampling-the collection of which is described in "Subsurface Soil Sampling". In the following sections, techniques are generally described for the installation and sampling of monitoring wells.

In instances where new monitoring wells are necessary, a review of all prior data pertaining to the groundwater regime and the quality of the groundwater in the area is a necessary part of the decision-making process involved with siting the new wells. well installations may be accomplished through a contract based on a rigid set of specifications and unit price payments, or by a time and materials contract. While the former is normally considered preferable, the number of unknowns (both in location and subsurface conditions) may dictate that the latter course be followed.

## 2.0 MONITORING WELL INSTALLATION

### 2.1 Installation - General

Monitoring wells or permanent sampling devices placed in unconsolidated materials above bedrock are generally installed in boreholes constructed using wash boring or augering techniques. In some instances, it may be appropriate to use jetting, rotary drilling or other boring techniques where local practice or subsurface conditions dictate such a consideration.

The general description for monitoring well and permanent sampling device installation which follows is provided as an overview. Specific materials to be used and methods for the construction of monitoring wells shall be developed based on the particular needs at each site and described in the site specific sampling and analytical plans and/or the specifications developed for the boring contractor.

Where well drilling techniques, or where the purpose of the well, requires that the well be developed and/or purged of induced waters, a period of ten days shall be provided after development for stabilization prior to sampling. The requirement for developing or purging of wells shall be specified in the site specific plan.

Additional information on monitoring well installation may be found in the manual for Groundwater Sampling (Scalf et al., 1981)

### 2.2 Monitor well Drilling Techniques

Several techniques can be utilized for drilling in connection with the installation of monitoring wells. These techniques include wash borings, auger borings, rotary drillings, or jetting as briefly described below.

### 2.2.1 Wash Boring

This method involves advancing steel casing by driving and washing out the material to the bottom of the casing with chopping bits. The excavated materials are removed f rom the borehole by the return flow of water. This drilling technique employs a casing to stabilize the borehole walls. Telescoping of the casing is desirable in some instances to prevent cross contamination between specified layers. Samplers, such as the split spoon or solid tube type, can be driven or pushed into the undisturbed material at the bottom of the borehole to extract subsurface soil samples. The wash boring method is commonly used in soils which do not contain large cobbles and boulders or cemented horizons.

### 2.2.2 Auger Borings

This method involves advancing helical augers, either solid flight or hollow stem to the required sampling depth. This is a fast method for advancing the borehole, without the use of fluids, in partially saturated or unsaturated materials above the groundwater table. Conventional soil sampling procedures are employed.

Hollow stem augers are advanced hydraulically into the overburden to the top depth of the sample required, the auger acting as a casing. A removable center plug allows passage of the sampling equipment to the required depth. Augers are usually in five-foot sections. Some disturbance of the sampling zone may be created during the augering. Auger borings are not desirable where cross contamination can occur unless a large-diameter hollow stem is used, into which a casing can then be telescoped.

### 2.2.3 Hydraulic Rotary Drilling

This method of drilling boreholes consists of the rotation of a drill bit to excavate the borehole and the continuous circulation of a drill fluid to the bottom of the borehole to retrieve drill cuttings and maintain the borehole. The drill bit is attached to the drill pipe (called the drill stem) and rotated from the ground surface by the drill rig. water and drilling fluid (usually mud) are circulated down the drill stem, out the bit and up the annular space between the borehole and drill stem. Generally, a mud pit or tank at ground surface receives the drilling fluid and allows the subsurface drill cutting to settle out.

Well casing is generally not employed during drilling except to maintain an open borehole above the water table or where especially loose formation materials are encountered. Below the water table, in most normal circumstances, the thick drilling muds "pack" open the borehole, permitting placement of well screens and casing after the drill bit and stem are removed from the borehole.

Two common variations of hydraulic rotary drilling are air rotary and reverse circulation rotary. Air rotary is commonly employed in consolidated rock drilling where compressed air of high volume and pressure removes drill cuttings and the borehole remains open due to its consolidated nature. Reverse circulation rotary is a method which uses water alone as the drilling fluid.

The water flows up the drill stem and down the annular space between the borehole and drill stem ( in the opposite direction from hydraulic or straight rotary drilling). In reverse circulation drilling, the hydrostatic pressure of continuous water circulation maintains the borehole prior to screen and casing placement..

Rotary drilling is most similar to another drilling method known as jet drilling or jetting.

2.2.4 Jetting

Jetting involves the use of water or drilling muds under pressure to advance the casing. Cuttings are removed in advance of the borehole by the return flow of the drilling fluid. The-borehole is stabilized by the drilling fluid and casing.

Accurate and precise groundwater quality monitoring requires sophisticated well installations. Several basic design criteria must be followed to insure quality installations in the highly variable geologic conditions encountered.

Well drilling methods and equipment are highly specialized, and therefore, well drilling crew qualifications, equipment and experience are important to the successful completion of the work. However, well drillers typically only provide operational capabilities; they require the guidance and assistance of the certified geologist or engineer to interpret the application o.' the basic criteria to the changing geologic at a given site. In addition, onsite observation of the well driller's operations by an independent party provides a check of specific product details, which are most important to the interpretation of the water quality results obtained. The certified geologist or engineer would provide services including, but not limited to the following:

- All matters pertaining to pay estimates, contractor claims, progress of work, deficiencies.
- Reviewing the contractor's proposed plans, schedule, program, and other data to be submitted in compliance with requirements of a purchase order or specifications, such as any plans for special testing work, soils sampling, developing, grouting, and locking cap devices.
- Reviewing and approving all equipment and methods the contractor proposes to use.
- Records of operation, such as: procurement, storage and installation of all materials and equipment; all well logs, special testing reports, progress reports, equipment reports, safety reports.
- observing, measuring, and recording all operational tests such as soil or core sampling, special testing-, logging and water sampling.
- Satisfying that information on screen settings and other decisions dependent upon field conditions encountered during the progress of the work are handled expeditiously and promptly and properly transmitted to the Contractor.

3.0 REFERENCE

Scalf, M.R.; et al., 1981. Manual for ground water sampling techniques- NWWA-

# SAMPLING PROCEDURES FOR MONITORING WELLS

## 1.0 INTRODUCTION

General procedures for sampling monitoring wells include presampling procedures, well-evacuation, sample withdrawal, field testing of parameters, and sample preparation and preservation. Certain special considerations for organic samples exist and are described as well.

Sampling protocol must be adhered to strictly to insure the collection of ground water samples representative of actual subsurface conditions. Correct procedures are particularly important at hazardous materials sites, where in addition to sample integrity, other considerations such as cross-contamination, safety, and legal responsibility are of concern.

The following general procedures are followed during sampling of monitoring wells.

## 2.0 PRESAMPLING PROCEDURES

Presampling procedures include records, equipment, cleaning, and water level measurement. In addition, the well should be checked for above-ground or below ground damage.

### 2.1 Records

Prior to sampling, general information concerning the site, well and sampling technique should be recorded on the field record sheet or log.

Obtain and record data in as complete a manner as possible and in a manner suitable to the study. Items to consider include:

1. Site name and number.
2. Exact location of well or source of sample and well or source number.
3. Weather conditions.
4. Point and method of collection.
5. Depth and diameter of well.
6. Casing record.
7. Screened, slotted, perforated, or louvered intervals.
8. Types of screens, slots, perforations, or louvers.
9. Water-bearing formations(s)
10. Water level.
11. Rate of discharge.
12. Duration of pumping prior to sampling.
13. Water temperature.
14. Other field measurements (including pH, conductivity, DO, etc.).
15. Date.
16. Time of collection.
17. Sample number
18. Type of sample
19. Preservative type and amount.
20. Appearance and any other relevant data
21. Filter size used and on which samples.
22. Use of water (if any).

23. Purpose of sampling.
24. Sampler's initials.

In addition, each sample should be labeled separately with site number, well, and sample identification, sampler's initials, time and date of collection, type of sample, and preservative type and amount.

After sampling is completed, correct labeling and shipping procedures and sample chain of custody must be adhered to.

## 2.2 Equipment

All equipment should be assembled, calibrated, and tested before arriving at the site. All items which potentially come in contact with the ground water samples should be precleaned. Between sampling locations, all items which come in contact with sample water should be either disposed of or thoroughly cleaned.

All apparatus, buffers, and samples should be kept cut of direct sunlight to avoid temperature fluctuations, particularly pit buffers.

Lay out all equipment on the plastic drop cloth adjacent to the sampling location, to prevent contamination of or from the outside environment. A truck tailgate provides an excellent equipment bench, if the site is accessible to vehicles.

A list of equipment necessary for sampling of monitoring wells at hazardous waste sites is given below.

### 2.2.1 Well Evacuation and Sample withdrawal

- Disposable chemically inert gloves (separate pair for each sampling location).

-A sampler apparatus (e.g., Kenmrer, Bailer) with a capacity to collect 750 to 1000 ml of sample per trip, including sample transfer tubing.

-A 500 foot or more length of nylon cord or cable marked in 5, 25, and 100 foot increments on a retrieval system for use with the Kemmerer or Bailer.

-Pump and Power supply (if needed).

### 2.2.2 Field Measurements

- Tape measure marked in tenths and hundredths of feel-@.

- Calibrated M-scope or similar water level recording device.

- Dissolved oxygen meter with an accuracy of $\pm 0.1$ mg/l, if needed.

- Thermometer or temperature measuring device calibrated in C (degrees centigrade) with an accuracy of +1,C.

- pH meter with an accuracy of $\pm 0.1$ pH units.

- At least pH buffer standards with pH value below and pH value above the limits anticipated for the samples.

- Conductivity (specific conductance) meter preferably with the capacity to report conductivity (micromhos/cm) correct to 25°C. Functional range of 0 to 50,000 umhos/cm.

- Beaker for field measurement of pH, conductivity, etc.

- Any additional project-specific sampling equipment as required.

2.2.3 Sample Preparation

Field filter apparatus 0.45 micron membrane filters, and prefilters when dissolved constituents are to be analyzed.

A pressure-suction filtration apparatus capable of at least 250 ml volume filtration at any one time.

Precleaned, capped sample containers containing the appropriate sample preservations, if necessary.

Tightly capped, securely stored containers holding appropriate preservatives, if necessary.

Pipet or "squeeze" bottle for preservative additions if such additions are needed.

2.2.4 Sample Containers

- Precleaned, capped sample containers.

- Ice chest(s) to hold collected water samples, and ice or "blue ice".

- Leak-proof liners for ice-chest(s).

2.2.5 Labeling and Shipping

- Water resistant sample bottle labeling materials. - Laboratory instructions.

- Shipping labels, including DOT labels, waste identification, and "This end up" labels, as appropriate.

-Shipping papers, as provided by carrier or regulatory agency.

-Packing tape.

2.2.6 Cleaning between Sampling Locations

- Laboratory (phosphate-free) detergent.

- Reagent-grade methanol (one to several gallons, depending on amount of equipment to be cleaned, n . r of sampling locations, and levels of contamination).

- Distilled water, generally about 2 gallons per sampling location.

- Buckets (sufficient for each cleaning liquid and for size of equipment to cleaned).

- Brushes for cleaning inside of bailer, beakers, etc.

- Handiwipes, disposable after each use.

- Plastic sheeting at least one large sheet for each sampling location, for clean layout of equipment.

2.2.7 Record-keeping

- Prepared field record-sheets for entering data collected in the field.

-Photographic record, if appropriate.

-Chain of custody.

2.3 Equipment Cleaning

All items which potentially come in contact with ground water at the sampling location should be precleaned.

Between sites, sampler cleaning is to be performed immediately prior to sampling from any well. Any portion of the sampling device which contacts contaminated water shall be cleaned or disposed of between wells. For example, the cable used for bailing shall be subjected to the same cleaning requirement for a length at least equal to twice the depth to the water surface. Where pumps are used, short sections of sample tubing may be disposed of rather than cleaning. The other items which must be cleaned or disposed of between sampling locations include bailers, pumps, probes, beakers and gloves.

The following procedure is followed for cleaning samplers and equipment:

- Before first equipment cleaning, clean the buckets and rinse with methanol and distilled water.

- Fill first bucket with laboratory (phosphate-free) detergent and tap water.

- Fill second bucket with reagent grade methanol-

- Fill third bucket with distilled water.

- Clean equipment thoroughly in lab detergent, using brushes and disposable handiwipes as necessary.

  Rinse thoroughly in distilled water.

Lay out cleaned equipment on plastic drop-cloth adjacent to sampling location.

## 3.0 SAMPLING SCOPE AND CONSIDERATION

1. Prepare field record sheet and record all relevant data.

2. Check the well for above ground damage.

3. Remove the well cap (a wrench may be needed).

4. Lay out equipment on the plastic drop-cloth adjacent to the sampling location, to prevent contamination of or from the outside environment.

5. Measure and record the depth to water and the tine of measurement.

6. Measure the total depth of the well.

7. Remeasure and record the depth of water after a lapse of 4 to 8 minutes following initial measurement and record the depth to water and time of measurement.

8. if successive measurements show essentially no difference, continue the sampling procedure. Where the level change is greater than 1/100th ft, delay the remaining procedures until the change observed and recorded is less than that figure.

9. Determine the amount of water in the well (depth of water x cross sectional area).

10. Purge the well.

11. If soundings show sufficient level of recovery, prepare sampling system. If insufficient recovery is noted, allow additional time to collect samples on a periodic schedule which will allow recovery between samplings.

12. Collect volatile organic analysis samples if required.

13. Perform any appropriate field testing of ground-water parameters.

14. Withdraw sample(s) according to correct procedures.

15. Fill necessary sample bottles completely by allowing sampler discharge to flow gently down the side of bottle with minimal entry turbulence. Cap each bottle as filled.

16. Preserve and/or filter the sample if necessary as per guidelines.

17. Check that a Teflon-liner is present in cap if required. Secure the cap tightly.

18. Label the sample bottle with in appropriate tag. Be sure to complete the tag with all necessary information. Complete chain-of-custody documents and field log book.

19. Place the properly labeled sample bottle in an appropriate carrying container maintained at 4'C throughout the sampling and transportation period.

20. Between sampling locations, all items which come in contact with ground water such as bailers, pumps, cables, tubing, probes, gloves, and beakers must be either disposed of or thoroughly cleaned.

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SLUG TEST PROCEDURE

## 1.0 INTRODUCTION

Slug tests, or response tests, are used to obtain approximate values of transmissivity in small, properly developed wells. Slug tests are simple, inexpensive, and rapidly performed, and may be used when pump tests are not possible or economic. However, slug tests only measure aquifer properties in the immediate vicinity of the well bore. Test results may be unreliable in the presence of a water table, leakage from a confining bed, or partial- penetration of the aquifer. If the well is not completely developed, transmissivity will be underestimated. Gravel pack, if present, must be carefully corrected for. Finally, reliable storage coefficients cannot be obtained from slug test results. Storage coefficients should be estimated by some other means (e.g., geologic estimation) in order to approximate aquifer transmissivity with any accuracy.

## 2.0 EQUIPMENT

a. Transducer
b. "Slug" or suspended weight
c. Wire line probe or steel tape

## 3.0 PREPARATION

Determine the inside diameter of the well casing. Measure the static water level in the hole with a transducer. The transducer may be calibrated while being lowered into the hole . Calculate the volume of the slug and determine the instantaneous head change in the well that will result from introduction or withdrawal of the slug. The slug should d-'isplace sufficient water to cause an easily measurable change in head, but it should not change the head more than 20% of the total saturated thickness of the aquifer. Also, introduction of the slug should not cause water to overflow the well casing.

## 4.0 PROCEDURE

The equations used to analyze a slug test assume an instantaneous recharge or discharge from the piezometer. Therefore, the slug should be introduced or withdrawn from the casing as rapidly as possible without causing undue splashing or turbulence. When the slug is in place, t (time) = o. water level readings should be taken in intervals as short as possible (no more than 5 second intervals at the beginning) and gradually increased as the rate of drop decreases. Monitoring should continue until the water level has stabilized. Values for H (where H equals the head inside the well at time, t, after injection or removal of the "slug", above or below initial head) are calculated by subtracting each water level reading from the initial (Ho) reading.

## 5.0 CALCULATIONS

Using the values of H, recorded at repeated intervals, values for H/Ho are computed and plotted on semilogarithmic paper. H/Ho is plotted on the linear axis of the paper and time, t, in seconds, on the logarithmic scale. Any convenient scale is acceptable for plotting H/Ho since this number is dimensionless. Plot the values and then curve match, superimposing the field value plot on plate 2 (see2 Lohman, 1972), to define a match line for a value of t at Tt/rc2= 1.0 (match point values of H,/Ho are not needed). Determine transmissivity, T, using:

$$T = 1.0 r 2 / t c$$

## 6.0 REFERENCES


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CONSIDERATIONS FOR SAMPLE WITHDRAWAL FROM WELLS

## 1.0 INTRODUCTION

Once the well has been sufficiently purged the actual sampling should begin as soon as the water level begins to approach its prepurged level. Sampling for volatile organics may begin even sooner, before substantial volatilization begins. if recovery is very slow, it may be necessary to wait several hours or even until the following day before sufficient volume is available for all the necessary analyses. In this instance a volatile organics sample set may be collected soon after completion of the purging process and a second set collected with the remaining samples. 'When a pump is used for sample collection, its rate should be controlled to closely match the transmissivity of the formation. Excessive draw down of the well during sampling may result in non representative samples due to changes in groundwater flow.

The major consideration for sample withdrawal is ensuring that the sample is not altered or contaminated during withdrawal from the well. The sampling equipment must use materials compatible with the goals of the particular monitoring program. These materials must neither leach nor adsorb constituents of interest at levels that might be considered significant. Similarly, sampling equipment must be dedicated to individual wells or be capable of being fully disassembled and fully cleaned between sampling events.

Care should be taken to ensure that sampling equipment is lowered into the well with a proper cord. Sampling equipment should be lowered into the well by using single strand (non-plaited) wire of a material that does not conflict with the constituents of interest. Stranded or plaited wire is extremely difficult to decontaminate as pollutants may remain between strands after cleaning and could cause cross contamination. Plastic-coated wire is often used, except where certain organics are being considered. Teflon-coated wire is the best, although most expensive, choice.

It is also important not to allow the use of methods that allow excessive exposure to the atmosphere or other gases when they might influence the measurement of specific constituents. Exposure of the sample to the atmosphere or other gases may result in changes in the concentration of dissolved gases in the sample. These changes can alter the pH of the sample, which in turn may precipitate the dissolution of specific constituents, particularly metals, and influence water quality measurements. Similarly, changes in the redox potential and, consequently, in the chemical species present may result. Exposure of the sample to the atmosphere or reduced pressures may also result in the degassing and loss of volatile organics from the sample.

When specifying methods for removal of water from monitoring wells, the sampler should examine the proposed methods to ensure that they are suitable both for sample collection and for well evacuation prior to sampling. In general, evacuation methods require greater pumping rates while sample collection methods emphasize to a greater extent the preservation of sample integrity. in many instances, one method will be suitable for both purposes. However, in some cases the use of different methods for well evacuation and sample collection may be appropriate. when examining methods used solely for well evacuation, the sampler should not allow the use of any method that might contaminate or otherwise alter the quality of water remaining in the well. Such an alteration would prevent-the subsequent removal of samples representative of ground-water quality.

## 2.0 SAMPLING STEPS

When sampling a monitoring well-, the following procedure should be followed:

1. Check the well for above ground damage.

2. Remove the well cap (a wrench may be needed).

3. measure and record the depth to water and the time of measurement.

4. Measure the total depth of the well.

5. Remeasure and record the depth of water after a lapse of 4 to 8 minutes following initial measurement and record the depth to water and time of measurement.

6. If successive measurements show essentially no difference, continue the sampling procedure. where the level change is greater than 1/100th ft, delay the remaining procedures until the change observed and recorded is less than that figure.

7. Determine the amount of water in the well (depth of water x cross sectional area).

8. Clean the sampler as described in the following Section (3.0) immediately prior to inserting it into a well.

9. Collect samples using a bailer, @, or positive pressure sampler dependent upon the general nature of the contaminants of concern. Sampler materials of construction shall be specifically selected for each contaminant.

## 3.0 SAMPLER CLEANING

Sampler cleaning is to be performed immediately prior to sampling from any well. Any portion of the sampling device which contacts contaminated water shall be cleaned or disposed of between wells. For example, the cable used for bailing shall be subjected to the same cleaning requirement for a length equal to at least twice the depth to tubing may be disposed of rather than cleaned. The following procedure is followed for cleaning samplers and equipment:

- Rinse with clean tap water.
- Rinse with reagent grade methanol and allow to air dry.
- Rinse at east once with clean tap water.

If appropriate the above procedure can be preceded with a wash with soap (Alconox or Liqinox). Line and cables used to lower samplers into monitoring wells will be disposed of in an appropriate manner dictated by the On-site Coordinator or cleaned and rinsed using the procedures outlined above for cleaning sampling devices. Persons obtaining groundwater samples will wear

chemically inert protective gloves to prevent skin contact with sampling devices, lines and cables and potentially contaminated groundwater.

## 4.0 IMMISCIBLE FLUIDS SAMPLE WITHDRAWAL

Recovery of ground water and immiscible fluid samples requires special procedures. Unlike in normal wells, evacuation immediately prior to sampling is not appropriate. Evacuation will normally result in mixing of the two phases, and several days may be required before the two fluids separate and water and immiscible fluid levels stabilize. If evacuation is desired, a few days or possibly a week or more, may be needed for the well to stabilize before sampling.

A sample of the floating immiscible may then be taken by using a bailer that fills from the bottom. Care should be taken to lower the bailer just through the petrochemical layer but not significantly down into the underlying ground water. Samples of the ground water at the bottom of the screen and at some intermediate location, such as the mid-point of the screen, may also be obtained with a bailer. However, in order to avoid mixing the waters, a separate casing can be temporarily lowered inside the permanent well casing. This casing can be equipped with an easily removed cap on the bottom so that no fluid enters the casing until it has reached the desired depth for sampling. The cap is then knocked free of the bottom of the casing, allowing water entering from that specific-depth to be sampled by bailer. At significant depths below the petrochemicals, several full bailers of water may be withdrawn and discarded before the sample is taken to obtain a fresh formation sample. However, it may be impractical to continually knock free caps from the bottom of the insert casing. In some cases, the existing well may no longer be screened in portions of the aquifer containing only water.

Consequently, in cases where a large layer of immiscibles develops on top of the water table, it may be best to install a second well screened only in that portion of formation below the lens of floating immiscibles.

Sampling of dense immiscible may be accomplished by using a grab sampler. Pumps with intakes located in immiscible fluid may also be used. If a pump is used, it must be operated at a sufficiently low rate to ensure that no mixing occurs.

## 5.0 PROCEDURES

A variety of methods are available for sampling and well evacuation, including bailers, suction lift pumps such as the centrifugal and peristaltic pumps, and gas lift methods. Positive displacement or submersible pumps such as centrifugal, piston, gas squeeze, or jet pumps are also available. These methods use differing principles for operation and have distinct and frequently different advantages and disadvantages when applied to sampling and well evacuation. Each is discussed individually below and a s eries of their advantages and disadvantages is provided in Table 1. Frequently, several methods will be available that can provide a suitable means for well evacuation and sample collection in a particular monitoring program. in such cases, the sampler will want to base the choice of method partly on such factors as monitoring well diameter, water level, pumping volume and rate requirements, accessibility of the site, ease of use, and cost. All of these factors are legitimate and should be considered as long as they do not unduly compromise the goals of the sampling program.

### 5.1 Bailers

The bailer is one of the oldest and simplest methods available. Bailers consist of a container attached to a cable that is lowered into the well to retrieve a sample. They can be of various designs. The simplest is a weighted bottle or basally capped length of pipe that fills from the top as it is lowered into the well. more sophisticated bailers have a check valve located at the base that allows water to enter from the bottom as it is lowered into the well (see Figure 1). When the bailer is lifted, the check valve closes, allowing water in the bailer to be brought to the surface. more sophisticated bailers are available that remain open at both ends while lowered into the well but can be sealed at both -"op and bottom by activall--ing a triagering mechanism from the surface. This allows more reliable sampling at discrete depths within a well. Perhaps the best known bailer of this design is the Kernerer sampler, shown in Figure 2.

Bailers generally provide an excellent means for collecting samples from monitoring wells. They can be constructed from a wide variety of materials compatible with the parameter of interest. Since they are relatively inexpensive, bailers can be easily dedicated to an individual well to minimize cross contamination during sampling. If not dedicated to a well, thev can be easily cleaned to prevent cross contamination. Unfortunately, bailers are frequently not suited for well evacuation because of their small volume.

This device is particularly useful when samples must be recovered from depths greater than the range (or capability) of suction lift pumps, when volatile stripping is of concern, or when well casing diameters are too narrow to accept submersible pumps. This is the method of choice for the collection of samples which are susceptible to volatile component stripping or degradation due to the aeration associated with most other recovery systems. Samples can be recovered with a minimum of aeration if care is taken to gradually lower the bailer until it contacts the water surface and is then allowed to sink as it fills. The primary disadvantages of bailers are their limited sample volume and inability to collect discrete samples from a depth below the water surface.

The following general procedures should be adhered to for sample withdrawal using a bailer.

1. Lower bailer slowly until it contacts the water surface, then allow it to sink and fill with a minimum of surface disturbance.

2. The cable supporting the sampler should be prevented from coming in contact with the water in the well. The bailer should not come in contact with any materials outside of the well casing. Do not allow the bailer line to contact ground.

## 5.2 Suction Pumps

As their name implies, suction pumps operate by creating a partial vacuum in a sampling tube. This allows the pressure exerted by the atmosphere on the water in --he well to force water up the tube to the surface. Accordingly, these pumps are located at the surface and require only, that a transmission tube belowered into the well. Unfortunately, their use is limited by their reliance on suction to depths of 20 to 25 ft, depending on the pump. In addition, their use may result in out-gassing of dissolved gases or volatile organics and is therefore limited in many sampling applications. In spite of this, suction methods may provide a suitable means for well evacuation since the water remaining in the well is left reasonably undisturbed.

A variety of pumps are available that operate on this principle, but the most commonly suggested pumps for monitoring purposes are the centrifugal and peristaltic pumps. In the centrifugal pump,

the fluid is displaced by the action of an impeller rotating inside the pump chamber. This discharges water by centrifugal force. The resulting pressure drop in the chamber creates a suction and causes water to enter the intake pipe in the well. These pumps can provide substantial yields and are readily available and inexpensive. The disadvantages are that they require an external power source and may be difficult to clean between sampling events. in addition, the materials with which these pumps are constructed may frequently be incompatible with sampling certain constituents. However, their substantial pumping rates make them suitable for well evacuation.

Peristaltic pumps operate in a similar manner to centrifugal pumps but displace the fluid by mechanical peristalsis. A flexible transmission line is mounted around the perimeter of the pump chamber and rotating rollers compress the tubing, forcing fluid movement ahead (the peristaltic effect) and inducing suction behind each roller. This design isolates the sample from the moving parts of the pump and allows for easy cleaning by removal and replacement of the flexible tubing. Unfortunately, peristaltic pumps are generally capable of only providing .relatively low yields. They are, therefore, not well suited for well evacuation in large diameter wells with high yields. However, they may be well suited for well evacuation in small diameter wells with low yields.

In the procedure for peristaltic pumps, ground water is withdrawn through a precleaned 6 mm. I.D. teflon tube and discharged into a clean, calibrated one-liter heavy-wall erlenmeyer flask with a peristalic pump on the outlet side of the sampling flask. Tubing includes 6 mm. I.D. teflon, 6 mm. I.D. tygon, and 6 mm O.D. glass.

The sampled water only contacts teflon and precleaned glass, and is then carefully transferred to appropriate glass sample containers for shipment to the laboratory. This system shall not be used for samples to be analyzed for volatile organics, because of the possibility of stripping volatile constituents from the sample under the reduced pressure occurring in these systems. It may, however, be used for non-volatile constituents such as metals or other organics.

5.3 Gas Lift Pumps

Gas lift pumps operate by releasing compressed gas through an pipe inside a larger diameter discharge or eductor pipe. Mixing gas bubbles with the water results in a lower water density inside the discharge pipe, allowing the water to be blown to the surface. Numerous adaptations to the basic method of applying gas pressure to a water well and forcing a water sample out the discharge tube are available for use in monitoring applications. These include the use of a high-pressure hand pump and any reasonably flexible tubing. This provides a highly portable sampling unit. Similarly, a small air compressor or tank of compressed gas and the appropriate piping or flexible tubing car. be used. Unfortunately, gas lift methods aerate samples and water in the well, greatly limiting their suitability for both sample collection and well evacuation.

In general, gas pressure lift systems should not be used for sample collection as they have been shown to cause considerable changes in the groundwater character.

In gas lift pumps, compressed nitrogen is regulated into an approximate 1/2-inch diameter nylon tube connected to the sampler in the well. Groundwater that has permeated the sampler is forced up through an approximate 1/4-inch concentric nylon tube and sampled. The pressure and flow of nitrogen will be controlled with the regulator in order that the groundwater sample exits slowly and with a minimum of "spurting" at the end. one volume of groundwater will be flushed out and

TABLE 1 Advantages and Disadvantages of Monitoring Well Sampling Equipment (adopted from Larson (1981a)

| Type | Advantages | Disadvantages |
|---|---|---|
| A. Bailer | Can be constructed in a wide variety of diameters<br><br>Can be constructed from a wide variety of materials<br><br>No external power source required<br><br>Extremely portable<br><br>Low surface area to volume ratio, resulting in a very small amount of outgassing of volatile organics while sample is contained in bailer<br><br>Easy to clean<br><br>Readily available<br><br>Inexpensive | Time consuming sampling; sometimes impractical to properly evacuate casing before taking actual samples<br><br>Transfer of water to sample bottle may result in aeration |
| B. Suction lift Pump(Centrifuged, Peristaltic) | Relatively portable<br><br>Readily available<br><br>Inexpensive | Sampling is limited to situations where water levels are within about 20 ft. from ground surface<br><br>Vacuum effect can cause the water to lose some dissolved gas and volatile organics<br><br>In some cases not constructed with materials compatible with sampling certain constituents |

Table I (Continued)

| Type | Advantages | Disadvantages |
|---|---|---|
| C. Gas lift samplers | Relatively portable<br><br>Readily available<br><br>Inexpensive<br><br>Very suitable for well development | Generally not considered appropriate method for acquisition of water samples for detailed chemical studies owing to degassing<br><br>Regardless of the gas utilized, changes in $CO_2$ concentrations make this method unsuitable for sampling for pH sensitive parameters<br><br>Aeration of water remaining in well frequently makes method unsuitable for well evacuation<br><br>If air is used, oxygenation is impossible to avoid unless elaborate precautions are taken (only a very small amount of oxygen is required to cause a water sample to attain saturation with respect to oxygen) |
| D. Submersible pumps | Wide range in diameters<br><br>Various materials are available<br><br>Fairly portable<br><br>Depending upon size of pump and pumping depths, relatively large pumping rates are possible<br><br>Positive displacement minimizes loss of volatiles during pumping<br><br>Readily available | Conventional units are unable to pump sediment-laden water without incurring damage to the pump<br><br>Relatively expensive |

Table 1 (Continued)

| Type | Advantages | Disadvantages |
|---|---|---|
| E. Gas-Operated squeeze pump (Middelburg type) | Can be constructed in diameters as small as one inch<br><br>Can be constructed from a wide variety of materials<br><br>Relatively portable<br><br>Fair range in pumping rates is possible<br><br>Driving gas does not contact water sample, eliminating possible contamination or gas stripping<br><br>Positive displacement minimizes loss of volatiles | Gas source required<br><br>Large gas volumes and long cycles are necessary for deep operation<br><br>Pumping rates are not as great as with suction or jet pumps<br><br>Commercial units are relatively expensive, - pumps cost around $300.00, while central gas unit cost around $15.0 |
| F. Gas driven piston pump | Isolates the sample from the operating gas<br><br>Requires no electrical power source<br><br>Operates continuously and reliably over extended periods of time<br><br>Uses compressed gas economically<br><br>Can be operated at pumping heads in excess of 500 m<br><br>Positive displacement minimizes loss of volatiles | Relatively expensive; in excess of $3,000 for the continuously operating unit<br><br>Particulate material may damage or inactivate pump unless the suction line is filtered<br><br>Low pumping rates |
| G. Jet pumps | Capable of producing high yields<br><br>Commonly used in shallow domestic wells<br><br>Available for relatively small diameter wells | Requires priming and mixing sample with water circulating in pump, greatly limiting any use in monitor well applications<br><br>Use of venturi may result in stripping of volatiles |

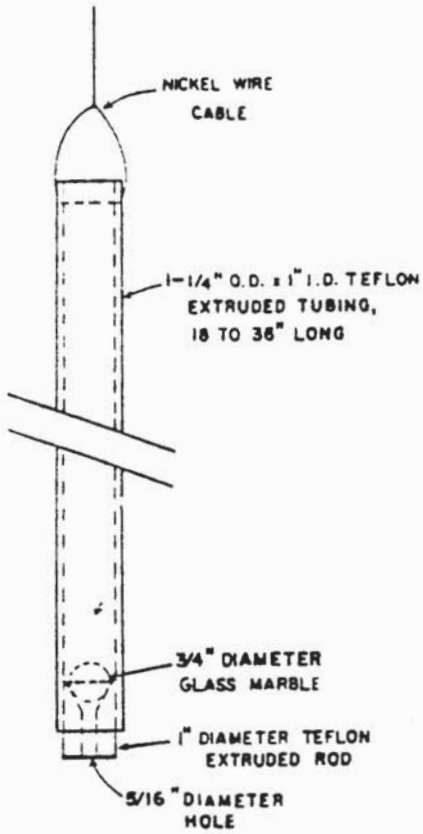



Figure 1 - Teflon Bailer

Figure 2 - Modified Kemmerer Sampler

discarded to clean the tubes and obtain newly permeated groundwater. All sample bottles will be filled directly from the 1/4-inch tubing.

## 5.4 Submersible Pumps

A variety of positive displacement pumps are available for use in withdrawing water from wells. These methods use some pumping mechanism placed in the well- that forces water from the bottom the well to the surface by some means of positive displacement. This minimizes the potential for aerating or stripping volatile organics from the sample during removal from the well.

The submersible centrifugal pump is one common example of a positive displacement pump. It works in a manner similar as the centrifugal suction lift pump previously described except at the pump and electric motor are lowered into the well. As the impeller rotates and fluid is brought into the pump, fluid is displaced up the transmission line and out of the well. These pumps are capable of providing a high yield. However, they require an external source of power and are frequently constructed with materials and contain lubricants incompatible with sampling certain constituents, particularly organics. They require considerable equipment and effort to move from well to well. The chief drawback, however, is the difficulty of avoiding cross contamination between wells. These systems are generally too expensive to allow for several separate units and field decontamination is very difficult. Decontamination should properly require solvents, which may lead to sample contamination. Use of submersible pumps, therefore, in multiple well programs, should be carefully considered against bailers.

## 5.5 Piston Pumps

Piston-driven or reciprocating piston pumps are another example of common positive displacement pumps (see Figure 3). These pumps consist of a piston in a submerged cylinder operated by a rod connected to the drive mechanism at the surface. A flap valve or ball-check valve is located immediately above or below the piston cylinder. As the piston is lowered in the cylinder, the check valve opens, and water fills the chamber. On the upstroke, the check valve closes, and water is forced out of the cylinder up into the transmission l- and to the surface. -.he transmission line or piston contains a second check valve that closes on the down stroke, preventing water from re-entering the cylinder. These pumps are capable of providing high yields. However, moving these pumps from well to well is difficult, and their use in monitoring programs may require that a pump be dedicated to each well. Many of these pumps are not constructed with materials compatible with monitoring certain constituents.

A special adaptation of this pump has recently become available for use in ground-water monitoring. These piston pumps use compressed gas rather than a rod connected to a driving mechanism at the surface to drive the pistons. This provides a much more convenient and portable means for collecting samples from Figures 3/4 monitoring wells. They provide good yields and can be constructed with materials compatible to many sampling programs. This pump is especially useful for sampling water with trace and volatile organic constituents.

## 5.6 Gas Operated Squeeze Pumps

Another positive displacement pump applicable for monitoring purposes is the gas-operated squeeze pump (see Figure 4). This pump was originally developed by R. F. middelburg of the U.S. Geological Survey and consequently is referred to as the Middelburg pump. It consists principally of a collapsible membrane inside a long rigid housing, a compressed gas supply, and appropriate

Figure 4 - Gas-Operated Squeeze Pump

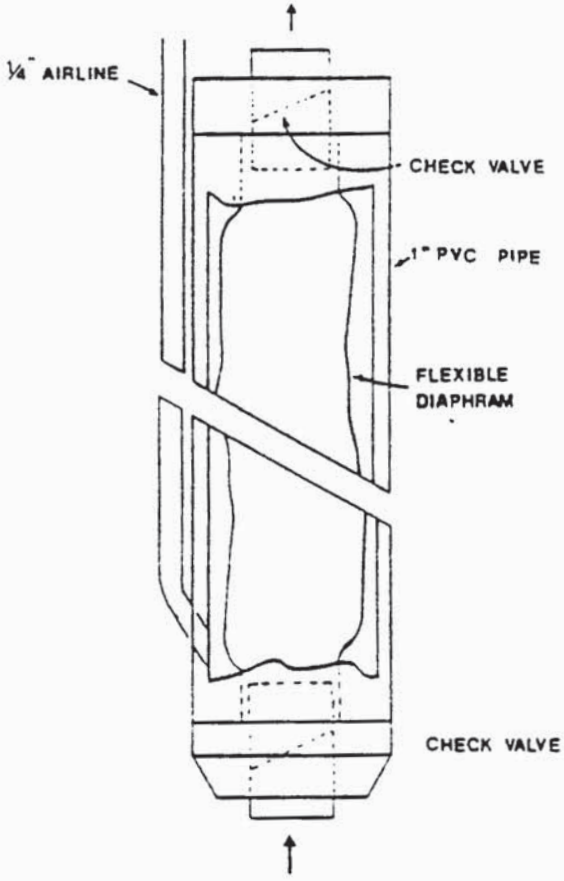
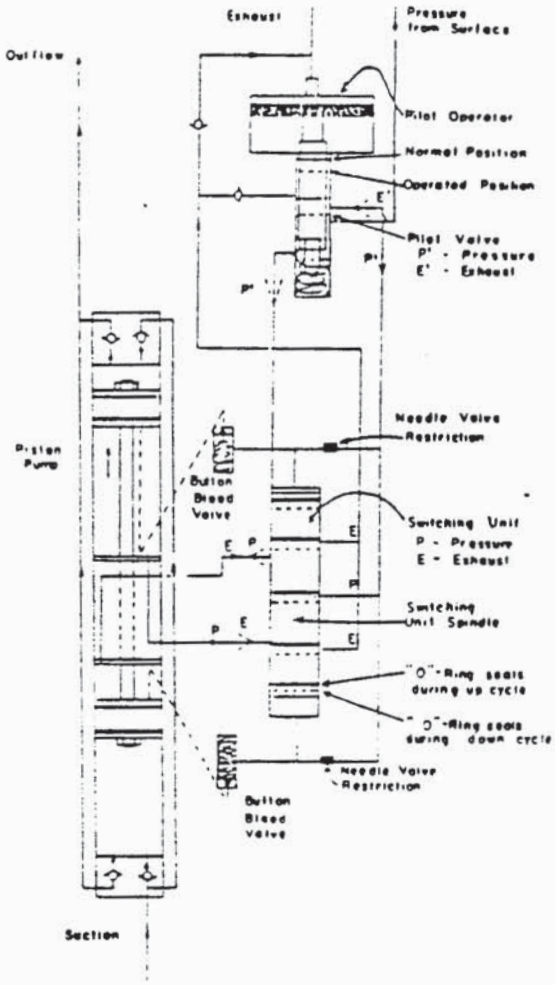


Figure 3 - Gas-Driven Piston Pump



control valves. When the pump is submerged, water enters the collapsible membrane through the bottom check valve. After the membrane has filled, gas pressure is applied to the annular space between the rigid housing and membrane, d@-or--ina the water upward through a sampling tube. When the pressure is released, the top check valve prevents the sample from flowing back down the discharge line, and water from the well again enters the pump through the bottom check valve.

Gas-operated squeeze pumps offer a number of advantages for use in groundwater monitoring programs. They can be constructed in diameters as small as 1-in. and from a wide variety of materials. They are also relatively portable and are capable of providing a fair range of pumping rates. Most important, the driving gas does not contact the water sample, thus eliminating possible contamination or gas stripping. However, they do require a gas source, and withdrawal of water from substantial depths may require large gas volumes and long pumping cycles.

### 5.7 Jet Pumps

Jet pumps are a common submersible pump used in small domestic water wells and may in some cases be suggested for use in monitoring wells. These pumps operate by injecting water through a pipe down into the well. A venturi device is located at the intake portion of the pump. As the water injected from the surface passes through the constricted portion of the venturi, the velocity increases and pressure decreases according to Bernoulli's principle. If the discharge velocity at the nozzle is great enough, the pressure at this point will be lowered sufficiently to allow water to be drawn into the venturi assembly through the intake and brought to the surface with the-,e original water injected into the well. This additional increment of water is then made available at the surface as the pump's output. Jet @s generally require priming with water, and the water taken from the well mixes with water circulating in the system. A simple modification can be added to this design to circulate a portion of the pumped water back through the system, eventually reducing the concentration of primary water effectively to zero. This type pump is not suitable for sampling water for volatile organics since the turbulence produced by the venturi system will strip volatiles from the water.

## 6.0 CHOOSING THE BEST METHOD

Since the nature of the pollutant or parameter being monitored is the primary factor for specifying well evacuation and sampling methods, evaluation of any proposed method is most conveniently based on the general class of pollutant or parameter that require monitoring in a particular program. For this purpose, pollutants and monitoring parameters can be categorized into the following classes: physical properties, metals, nonmetallic inorganics, general organic parameters and organics.

### 6.1 Physical Properties

Physical properties include such parameters as conductance, color, pH, temperature, and turbidity- In general, most sampling methods are acceptable for these parameters, provided they allow a thorough rinsing between sampling events. However, methods that affect gas composition of the sample will affect pH. Consequently, the sampler should not use gas lift methods for sampling when pH is a parameter of interest. Since gas lift methods may also leave water in the well in a disturbed and aerated condition, these methods are not suitable for well evacuation when pH is a parameter of interest.

### 6.2 Metals

Similarly, since concentration of metals can be significantly influenced by changes in pH, sampling for metals should not be allowed with gas lift or suction methods. The guidance provided above for well evacuation when pH is the parameter of interest also applies for metals. In addition, equipment used for monitoring metal concentrations should be metal free. Consequently, bailers and positive displacement pumps are most-. suitable for sampling metals, provided they are constructed of appropriate materials. The methods acceptable for well evacuation are less restricted, but gas lift methods or equipment that alters the metal concentration o.: water remaining in the well through leaching or absorption should be avoided.

### 6.3 Inorganic, Nonmetallic Constituents

Inorganic, nonmetallic constituents or parameters include acidity, alkalinity, bromide, chloride, fluoride, nitrogen, etc. most of the sampling and well evacuation methods described above are generally acceptable when considering the inorganic, nonmetallic parameters. However, for parameters affected by pH or dissolved gas changes, such as alkalinity, methods that minimize changes in dissolved gas composition are recommended for sampling. These methods include bailers, squeeze pumps, and piston pumps; gas lift techniques are not recommended for well evacuation.

### 6.4 Organics

Generalized organic parameters include parameters such as oil and grease, COD, TOC, and TOX. most sampling and well evacuation methods are suitable for these parameters, with the exception of the more sensitive parameters such as -TOX. These sensitive parameters require methods suitable for sampling volatile organic.

It has generally been recommended that sampling for volatile organics be done with a glass or Teflon bailer after flushing with a nonaerating pump. However, positive displacement pumps may also be acceptable in sampling, provided they are constructed with suitable materials (Teflon, glass, or stainless steel in most cases).

## 7.0 EXISTING IN-PLACE PUMPS

Occasionally ground water samples are obtained using wells which have existing in-place pumps. This limits the precautions the sampler can take to ensure a non-contaminated sample. Samples should be obtained from outlets as close as possible to the pump and should not be collected from leaky or faulty spigots or spigots that contain screens or aeration devices. The pump should be run for 5 - 10 minutes before the sample is collected, and the waste-water properly disposal of. A steady-flowing water stream at moderate pressure is desirable in order to prevent splashing and dislodging particles in the faucet or water line.

To collect the sample, remove the cap or stopper carefully from the sample bottle. Do not lay the bottle closure down or touch the inside of the closure. Avoid touching the inside of the bottle with your hands or the spigot. The sample bottle should not be rinsed out and it is not necessary to flame the spigot. The bottle should be filled directly to the top. The bottle closure and closure-covering should be replaced carefully and the bottle should be placed in a cooler (4 - 10'C) unless the sample is going to be processed immediately in the field.

## 8.0 SAMPLING FROM NATURAL SPRINGS

For springs in unconsolidated deposits, drive a well point or a slotted pipe one meter or less into the ground adjacent to the spring. Collect from the artesian flow or use a pump. Use plastic pipe and plastic well screens for trace metal determinations. To sample larger upwelling springs, attach the pump intake to a pole and submerge it i-n the mouth of the spring.

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SPECIAL CONSIDERATIONS FOR SAMPLING OF ORGANICS IN GROUNDWATER,

## 1.0 INTRODUCTION

Sampling for organic parameters in groundwater is relatively new, and recommended procedures are still in the process of being developed and standardized. Points that should be noted during collection of organic samples include the potential for sample contamination and the extremely fine detail, subject to expert rebuttal, that may be necessary in a legal action.

Grab samples and continuous samples from saturated groundwater zones for organic analysis are discussed in this section. volatile organics in the unsaturated zone .

## 2.0 GRAB SAMPLES FOR ORGANIC ANALYSIS

Grab samples of groundwater for non-volatile organic analysis may be collected by utilizing the system shown in Figure 1 where the sampled water contacts only sterile glass and Teflon, and the water table is within suction lift. The sampled water is then carefully transferred to appropriate glass sample containers '.or shipment to the laboratory.

For sampling at depths beyond suction lift, a non contaminating submersible pump should be used to pump the groundwater to the surface, through scrupulously cleaned Teflon tubing, directly into appropriate sample containers.

The most commonly employed sample containers are 40 @ glass vials for analyses requiring small sample volumes, such as total organic carbon, and one-gallon jugs for analyses requiring relatively large volumes, such as extractable organics. Both types of containers are equipped with Teflon-lined screw caps. Like all glassware used in the sampling and analytical procedures, sample containers are thoroughly cleaned prior to use by washing with detergent, rinsing extensively with tap water followed by high purity deionized water and heating to 56 o C for 2 hours.

Grab samples of groundwater to be analyzed for highly volatile organics by the Bellar-Lichtenberg volatile organic analysis (VOA) method are usually obtained by means of a Teflon bailer. Pumps are less desirable than bailers for VOA samples because of possible stripping of highly volatile constituents from the sample under the reduced or elevated pressure occurring in systems using pumps.

## 3.0 CONTINUOUS SAMPLES FOR ORGANIC ANALYSIS

Continuous procedures, using selected absorbents to concentrate and recover organic constituents from relatively large volumes of groundwater, may be employed for sampling organic pollutants in situations where the analytical sensitivity and sample uniformity attainable by grab sampling are inadequate. These procedures are applicable for most organic pollutants except those of very high volatility.

A special sampling system is shown in Figure 2 in which the water is pumped directly from the well through Teflon tubing (6 mm O.D.) to two glass columns of absorbents in series. In this illustration, a peristaltic pumps is located on the outlet side of the columns for sampling with suction lift. A non contaminating submersible pump may be used at greater depths and may be superior for practically all sampling uses. All components of the systems that contact the water sample prior to

Figure 1 - System for Grab Sampling

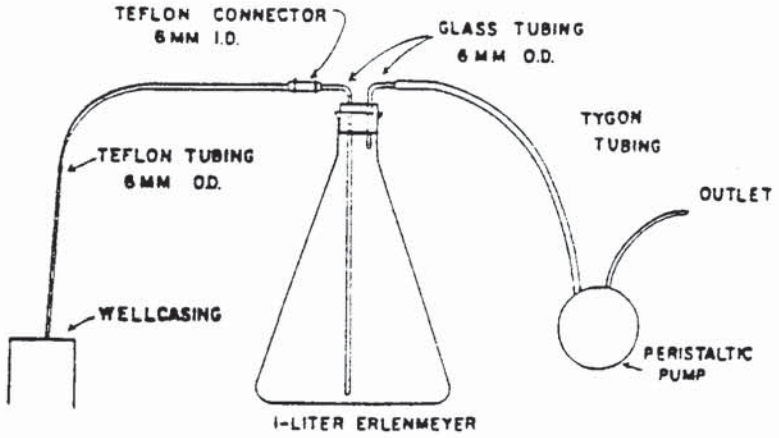
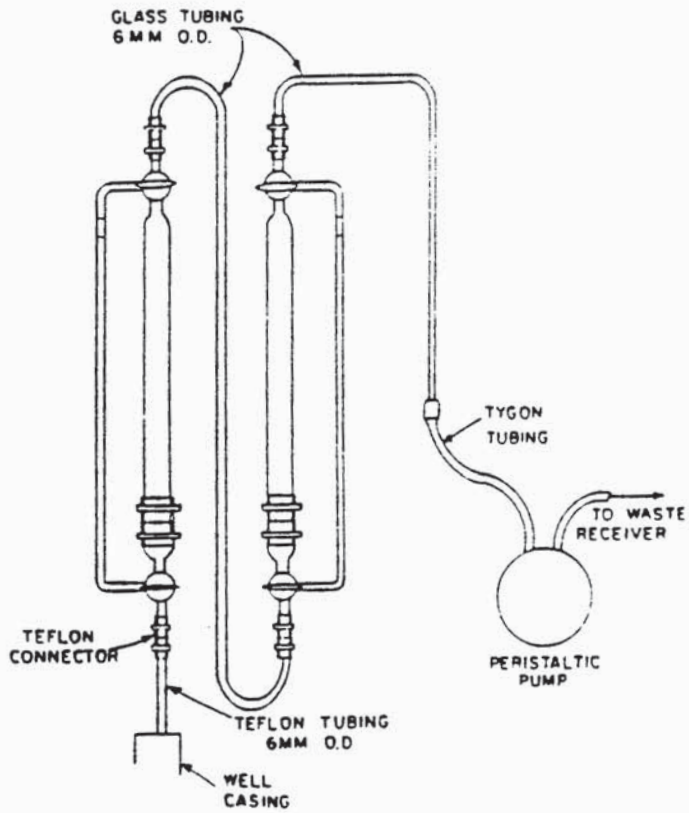


Figure 2 - Continuous Sampling Systems for Organics



emergence from the second column are, with the exception of the absorbent, glass or Teflon. Columns prepared from macroreticular resins, activated carbon, and polyamide particles have been employed in sampling systems. of these materials, macroreticular resin (XAD.-2) has been the most convenient and generally useful and is the current adsorbent of choice.

Sampling is conducted by continuously pumping groundwater through the sampling systems at flow rates usually ranging from 10 to 30 ml/min. The volumes sampled are dependent on the desired sensitivity of analysis. For analysis by modern gas chromatographic techniques, sampling of 50 liters of water is sufficient to provide a sensitivity of at least one pg/liter (1 ppb) for almost all compounds of interest. Volumes sampled are determined by measuring the water leaving the sampling systems in calibrated waste receivers.

## 4.0 REFERENCE

A. 1981. Manual of Ground Water Sampling Procedures.
NwWA/EPA Series. About 1981.

PROCEDURES FOR WATER LEVEL MEASUREMENT

## 1.0 INTRODUCTION

Water-level measurements are fundamental to ground-water and solute transport studies. Some of the major uses of water-level data are to indicate the directions of ground-water flow and areas of recharge and discharge, to evaluate the effects of marinade and natural stresses on the ground-water system, to define the hydraulic characteristics of aquifers, and to evaluate stream aquifer relations. uses for water level data are listed below:

1. Monitor the effect of mining or subsurface disposal operations.
2. Indicate the change in water level due to distribution or rate of regional groundwater withdrawal.
3. Show the relationship of groundwater to surface water.
4. Provide long-term records that can be used to evaluate the effect of management and conservation programs.
5. Estimate the amount, source, and area of recharge and estimate discharge.
6. Estimate the hydraulic characteristics of an aquifer.
7. Estimate evapotranspiration.
8. Estimate rate and direction of groundwater movement.
9. Delineate reaches of losing or gaining streams or canals.
10. Indicate the status or change in groundwater storage.

water level should be measured at each site prior to well evacuation, sampling or other disturbance of the water table. water level measuring techniques and their applications are s ummarized on Table i.

For comparability, water-level measurements must be referenced to the same datum (elevation). The measuring point is measured in reference to land surface datum and is the most convenient place to measure the water level in a well. Measurement points change from time to time, especially on private wells. The measuring-point correction of a water-level measurement converts the measurement to a distance above or below land surface at the well.

The measuring point must be as permanent as possible, clearly defined, marked, and easily located. If at all possible, position the point so that a leveling rod can be set on it directly over the well and the measuring tape can hang freely when it is in contact with the measuring point. Frequently, the top of the casing is designated as the measuring point; because the top of the casing is seldom smooth and horizontal, a particular point should be designated and marked clearly with paint and, if permitted, the letters MP with an arrow.

[X indicates applicability of the methods]

| Method | APPLICATION: Water-level measurements 500 ft or less | Water-level measurements in 1,500-ft range | Observation of natural water-level fluctuation | Pumping test[1] where fluid-level changes are large | Hydraulic tests with small fluid-level changes ( 0.2 ft) | Advantages | Disadvantages |
|---|---|---|---|---|---|---|---|
| Steel tape | X | X | | possible | possible | Most precise method. | Slow, must remove from well to read; delicate. |
| Electric cable | X | X | Non-recording devices. | X | X | Rugged, simple, adequate field precision.[2] | Large instrumental error; required periodic calibration. |
| Air line | X | X | | X | Lacks precision. | Fast, simple, not affected by foam. Precision depends on air gauge used. | Needs air compressor, air line must be airtight, limited by gauge inaccuracies. |
| Mechanical Recorder | X | | X | X | X | Precise, permanent record. | Limited to relatively straight holes less than 1,000-ft deep. |
| Transducer Systems | X | X | X | X | Possible, lacks precision at present. | High-speed response, permanent record. | Needs frequent attention. |

[1] Or other hydraulic test including packer test.
[2] High resolution (0.01 ft) when kept in hole for measuring small water level fluctuation.

Table 1 - Applications of Water Level Measuring Techniques (Modified from Garber and Koopman, 1968).

The reference point for water-level measurements is an arbitrary datum established by permanent marks set on or near the well. It is used to check the measuring point, and its greatest value is in re-establishing a measuring point if one is destroyed or changed.

## 3.0 PROCEDURES

### 3.1 Graduated Steel Tape

The graduated steel tape method is considered to be the most accurate method for measuring the water level in non flowing wells. Steel surveying tapes in lengths of 100, 200, 300, 500, and 1,000 feet are commonly used. A black tape is better than a chromium-plated tape. The tapes are mounted on hand-cranked reels or grriven tape drive is usually required. A slender weight is attached to the ring at the end of the tape to insure plumbness and to permit some feel for obstructions.

The lower few feet of tape is chalked by pulling the tape across a piece of blue carpenter's chalk. The wet chalk mark identifies the portion of the tape that was submerged. Lower the graduated steel-tape from the measuring point at the top of the well until a short length of the tape is submerged. The weight and tape should be lowered into the water slowly to prevent splashing. Submergence of the weight and tape may temporarily cause a water-level rise in wells or piezometers having very small diameters. This effect can be significant if the well is in materials of very low hydraulic conductivity. Under dry surface conditions, it may be desirable to pull the tape from the well by hand, being careful not to allow it to become kinked, and reading the water mark before rewinding the tape onto the reel. In this way, the water mark on the chalked part of the tape is rapidly brought to the surface before the wetted part of the tape dries. In cold regions, rapid withdrawal of the tape from the well is necessary before the wet part freezes and becomes difficult to read. Read the tape at the measuring point, and then read the water mark on the tape. The difference between these two readings is the depth to water below the measuring point.

Errors resulting from the effects of thermal expansion of tapes and of stretch due to the suspended weight of the tape and plumb weight can become significant at high temperatures &-,d-for measured depths in excess of 1,000 feet.

As a standard of good practice, the observer should make two measurements. If two measurements of static water level made

within a few mi

(generally regarded as the practical limit of precision) in observation wells having a depth to water of less than a couple hundred feet, continue to measure until the reason for the lack of agreement is determined or until the results are shown to be reliable. where water is dripping into the hole or covering its wall, it may be i @ possible to get a good water mark on the chalked tape.

### 3.2 Electrical Methods

many types of electrical instruments have been devised for measuring water levels; most operate on the principle that a circuit is completed when two electrodes are immersed in water. Some instruments consist of a single conductor that is lowered into the well where the metal well casing is used as the second conductor. More commonly, a two-conductor cable and special probe are

used. Various forms of electrolytic cells using two electrodes of dissimilar metals have been used, but current is more commonly supplied by batteries.

ordinarily, two-conductor electric tapes are 500-ft long and are mounted on a hand-cranked reel that contains space for the batteries and some device for signaling when the circuit is closed. Electrodes are generally contained in a weighted probe that keeps the tape taut while providing some shielding of the electrodes against false indications as the probe is being lowered into the hole. The electric tapes generally are marked at 5-ft intervals with clamped-on metal bands.

Before lowering the probe in the well, the circuitry can be checked by dipping the probe in water and observing the indicator. The probe should be lowered slowly into the well

tape is marked at the measuring point and partly withdrawn; the distance from the mark to the nearest tape band is measured and added to (or subtracted from) the band reading to obtain the depth to water. It is good practice to take a second or third check reading before withdrawing the electric tape from the well. The tape should not rub across the top of the casing because the metal bands can become displaced.

Electric tapes are more cumbersome and inconvenient to use than the wetted-tape method, and they normally give less accurate results. In some situations, however, they are superior. Where water is dripping into the hole or covering its walls, it may be impossible to get a good water mark on the chalked tape. In wells that are being pumped, particularly with large-discharge pumps, the splashing of the water surface makes consistent results by the wetted-tape method impossible. Where a series of measurements are needed in quick succession, such as in pumping tests, electric tapes have the advantage of not having to be removed from the well for each reading. Electric tapes are also safer to use in pumping wells because the water is sensed as soon as the probe reaches the water surface and there is less danger of lowering the tape into the pump impellers.

Independent electric tape measurements of static water levels using the sample tape should agree within +0.04 foot for depths of less than about 200 feet. At greater depths, independent measurements may not be this close. For a depth of about 500 feet, the maximum difference of independent measurements using the same tape should be within +0.1 foot.

In wells having a layer of oil floating on the water, the electric tape will not respond to the oil surface and, thus, the

> fluid level determined will be different than would be determined by a steel tape. The difference depends on how much oil is floating on the water. A miniature float-driven switch can be put on a two-conductor electric tape that permits detection of the surface of the uppermost fluid. The electric tape should be decontaminated after measurements in each well.
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> it is especially important to check the elec-lric line length by measuring with a steel tame after the line has been used for a long time or after it has been pulled hard in attempting to free the line. Some electric lines, especially the single line wire, are subject to considerable permanent stretch. in addition, because the probe is larger in diameter than the wire, the probe can become lodged in a well. Some operators attach the probe by twisting the wires together by hand and using only enough electrical tape to support the weight of the probe. In this manner, the point of probe attachment is the weakest point of

the entire line. Should the probe become "hung in the hole", the line may be pulled and breakage will occur at the probe attachment point, allowing the line to be withdrawn.

### 3.3 Air Line

The air line method is especially useful in pumped wells where water turbulence may preclude using mare precise methods. A small diameter air-type tube of known length is installed from the surface to a depth below the lowest water level expected. Compressed air (compressor, bottled air, or tire pump) is used to purge the water-.-from the tube. The pressure, in pounds per square inch (psi), needed to purge the water from the air line multiplied by 2.31 (feet of water for one psi) equals the length in feet of submerged air line. The depth to water below the center of the pressure gage can be easily calculated by subtracting the length of air line below the water surface from the total length of air line (assuming the air line is essentially straight).

Accuracy depends on the precision to which the pressure can be read. The accuracy of an air line or pressure gage measurement depends primarily on the accuracy and condition of the gage but is normally within one foot of the true level as determined by means of a steel-tape measurement. The air lines themselves, however, have been known to become clogged with mineral deposits or bacterial growth or to develop leaks and consequently yield false information. A series of air-line measurements should be checked periodically by the use of a steel tape or an electric water-level indicator.

The air line and any connections to it must be airtight throughout its entire length. If the line is broken or leaky, large errors may occur. A long-term increase in air line pressure may indicate a gradual clogging of the air line. A relatively sudden decrease in air line pressure may indicate a leak or break in the air line. Air line pressures that never go above a constant low value may indicate that the water level has dropped below the outlet orifice of the air line. To minimize the effect of turbulence, the lower end of the air line should be at least five feet above or below the pump intake. Corrections should be made for fluid temperatures much different from 20,C and for vertical differences in air density in the well column for cases where the depth to water is very great.

### 3.4 Recording Devices

Devices for recording changes in water levels may be mechanical, electronic, or electromechanical. A further distinction is the manner in which the device detects changes. A float or an electromechanical actuated water-seeking probe may be used to detect vertical changes of the water surface in the hole, or a mechanical or electrical pressure gage submerged several feet below the water surface may be used to detect changes in fluid pressure resulting from water-level changes. The principal advantage of pressure-sensing devices is that they may be used in packed or otherwise sealed-off zones in a well. In addition, their response to rapid changes of fluid pressure is generally better than that of mechanical devices. An increasing number of digital punched-tape recorders that record levels at prescribed times are being used on observation wells. However, the simplest recording device commonly in use consists of a recording chart drum rotated mechanically by a free float that follows the water level, while a clock drive moves a recording pen horizontally across the chart.

Where depth to water is more than a few feet below the top of the casing, special care must be taken to minimize friction between the float cable and the walls of the well. The float selected should be the largest diameter that can be accommodated by the casing. The error resulting from

float-line drag along the well casing is larger than the error caused by float drag. I@" the clearance between the float and the casing is small, the float cable should be arranged so that the counterweight does not have to pass the float, but is always above or below the water level. When the counterweight is immersed, a little extra weight should be used to counteract the water's buoyancy.

Water-level recorders should be protected from the weather and vandalism by a suitable shelter that is solidly anchored. The part of a recorder most susceptible to malfunction is the clock. To insure continuous records, field personnel who visit recorders should carry spare clocks. Malfunctioning clocks should be sent to a reliable clock-repair service for maintenance, and all clocks should be cleaned and adjusted periodically.

During each visit to a recorder installation, the water level should be measured (preferably by the wetted-tape method) and the measurement compared with the recorded value and the appropriate adjustments made in flowing wells where the static water level is above the top of the casing, float-activated recorders cannot be used. If the well can be shut in, however, a pressure recorder can be used.

### 3.5 Special Procedures for IMMISCIBLE Fluids

At those facilities where monitoring to determine the presence or extent of IMMISCIBLE contaminants is required, the sampler will need to use special procedures for the measurement of fluid levels. The procedures required will depend on whether light immiscibles that form lenses floating on top of the water table or dense immiscibles that sink through the aquifer and form lenses over lower pemeability layers are present.

in the case of light immiscibles, measurements of immiscible fluid and water level usually cannot normally be accomplished by using normal techniques. For example, a chalked steel tape measurement will only indicate the depth to the immiscible fluid (not the depth to water) and a conventional electric tape will not generally respond to nonconducting IMMISCIBLE fluids. Similar problems are found with other techniques.

To circumvent these problems, the use of special techniques and equipment can be specified. These techniques have been specially developed to measure fluid levels in wells containing immiscible fluids, particularly petroleum products. one method is similar to the chalked steel tape method. The difference is the use of a special paste or gel rather than ordinary carpenters chalk. Such indicator pastes, when applied to the end of the steel tape and submerged in the well, will show the top of the oil as a wet line and the top of the water as a distinct color change. Another method, similar to the electric tape method, uses a dual purpose probe and indicator system. The probe can detect the presence of any fluid (through the wetting effect) and can also detect fluids that conduct electricity. Thus, if a well is contaminated with low density, nonconducting immiscible fluids such as gasoline, the probe will first detect the surface of the gasoline, but it will not register electrical conduction. However, when the probe is lowered deeper to contact water, electrical conduction will be detected.

Both of these methods have disadvantages. The paste is not very effective with heavier and less refined petroleum products. Also, it can be a cumbersome technique when many wells must be measured owing to tape decontamination between wells. Also, this-'-s method cannot be used when sampling for cons-tituents normally found in the paste.