

**Field Sampling and Analysis Plan
Addendum 1-30-003B**

for

Additional Sampling

at

**Site 1 - Former Drum Marshaling Area
Naval Weapons Industrial
Reserve Plant (NWIRP)
Bethpage, New York**



**Northern Division
Naval Facilities Engineering Command
Contract Number N62472-90-D-1298
Contract Task Order 0213**

August 1995

**FIELD SAMPLING AND ANALYSIS PLAN ADDENDUM
FOR
ADDITIONAL SAMPLING
AT
SITE 1 - FORMER DRUM MARSHALING AREA
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BETHPAGE, NEW YORK**

**COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT**

**Submitted to:
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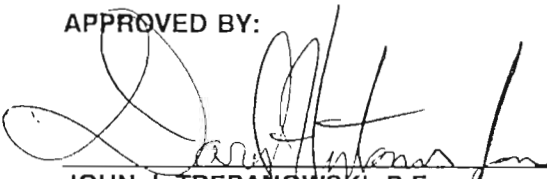
AUGUST 1995

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NOTICE

Field Sampling and Analysis procedures will be conducted in accordance with the Field Sampling and Analysis Plan (FSAP) for Site 1 - Formal Drum Marshaling Area Naval Weapons Industrial Reserve Plant (NWIRP) Bethpage, New York, Halliburton NUS, May 1995. This addendum to the original FSAP was prepared to include additional sampling and analysis required to establish an appropriate location for the proposed pilot-scale air sparging/vapor extraction system. This information is to be used in conjunction with the original Field Sampling and Analysis Report (HNUS, May 1995).

TABLE OF CONTENTS

| <u>SECTION</u> | <u>PAGE</u> |
|--|-------------|
| 1.0 PROJECT DESCRIPTION | 1-1 |
| 1.1 AUTHORIZATION | 1-1 |
| 1.2 PURPOSE | 1-1 |
| 1.3 SCOPE OF WORK | 1-1 |
| 2.0 FIELD SAMPLING PLAN | 2-1 |
| 2.1 SITE BACKGROUND | 2-1 |
| 2.2 FIELD OPERATIONS | 2-1 |
| 2.3 SAMPLE IDENTIFICATION SYSTEM | 2-1 |

APPENDICES

| | |
|----------|--------------------------------------|
| A | STANDARD OPERATING PROCEDURES |
|----------|--------------------------------------|

TABLES

| <u>NUMBER</u> | <u>PAGE</u> | |
|---------------|---|-----|
| 2-1 | Summary of Analysis, Bottle Requirements, Preservation Requirements and Holding Times, Subsurface Soil Samples - Site 1 | 2-2 |

FIGURES

| <u>NUMBER</u> | <u>PAGE</u> | |
|---------------|--|-----|
| 1 | Site 1 Proposed Sampling Locations | 1-2 |

1.0 PROJECT DESCRIPTION

1.1 AUTHORIZATION

C F Braun Engineering Corporation (C F Braun) has prepared this Field Sampling and Analysis Plan Addendum as part of the Remedial Design, Phase II, for Site 1 at the Naval Weapons Industrial Reserve Plant (NWIRP), located in Bethpage, New York. The FSAP and this addendum were prepared under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract No. N62472-90-D-1298, Contract Task Order (CTO) 0213.

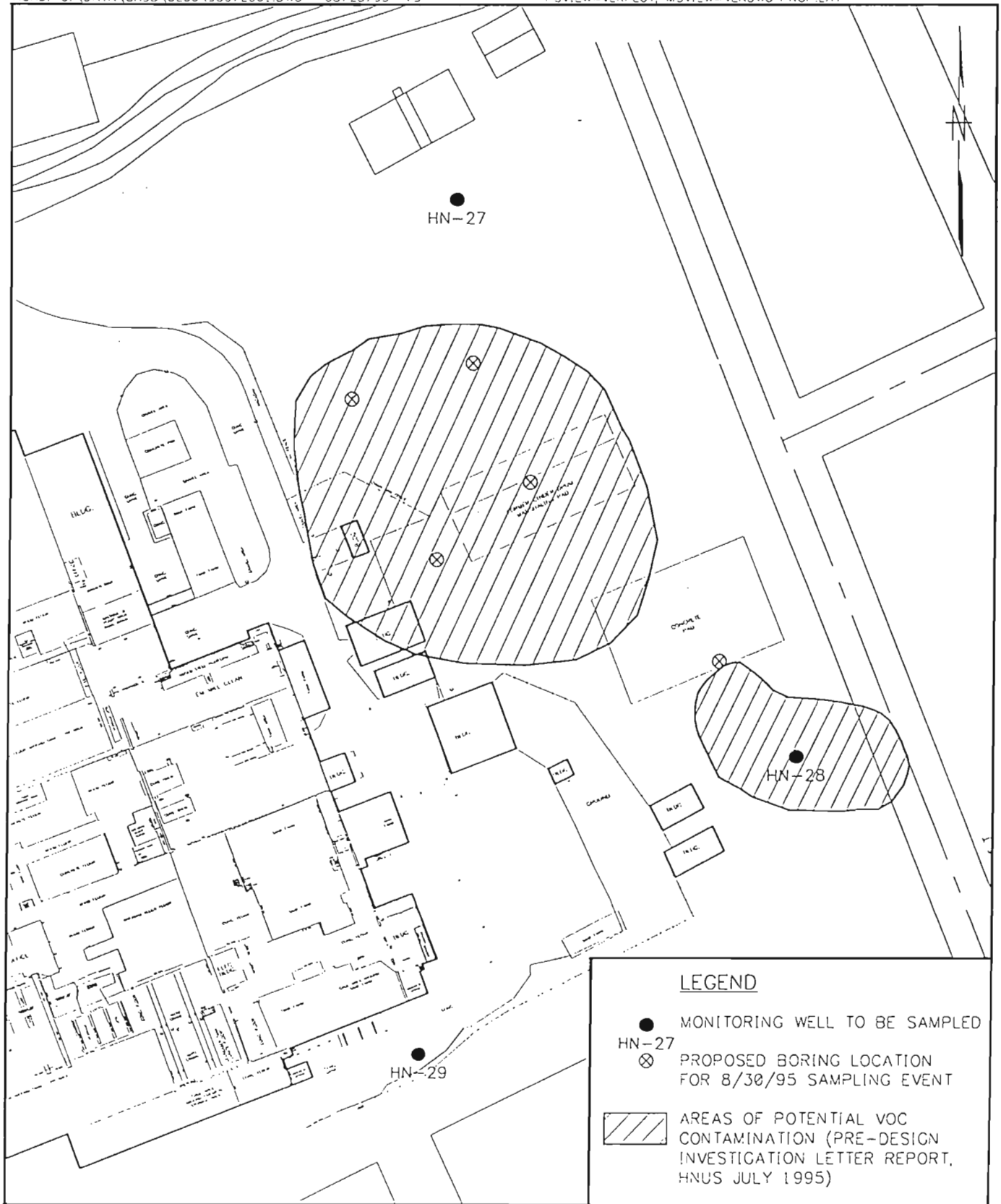
1.2 PURPOSE

The objective of this field work is to gather data to support the design of a remediation system within the area of potential volatile organic contamination at Site 1. The primary objective of this investigation is to establish the location of a pilot-scale remediation system.

1.3 SCOPE OF WORK

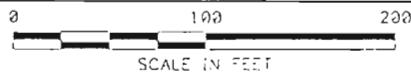
C F Braun has been tasked to perform additional field sampling and analysis at Site 1. The field work will evaluate the levels of contamination at Site 1 to provide adequate information to identify the location for a pilot-scale remediation system. This investigation will also determine the levels of groundwater contamination which currently exist in the area. Work shall be performed in accordance with the information provided in the Field Sampling and Analysis Plan (HNUS, May 1995) and this addendum.

A total of five soil borings will be drilled to the water table at locations identified on Figure 1. Three samples from each boring will be collected and submitted for volatile organic compound (VOC) analyses. Three existing monitoring wells will also be sampled and the groundwater submitted for analysis.



SITE 1
PROPOSED SAMPLING LOCATIONS
NWIRP, BETHPAGE, NEW YORK

FIGURE 1



C.F. BRAUN
 ENGINEERING CORP.

2.0 FIELD SAMPLING PLAN

2.1 SITE BACKGROUND

C F Braun has been tasked to perform additional investigation at the NWIRP Bethpage at Site 1 to further investigate soil contamination. The investigation is being performed prior to the installation of a pilot system to verify that the pilot system will be positioned within a significant area of contamination.

2.2 FIELD OPERATIONS

The field work for this project consists of the drilling and sampling of five soil borings outside of Plant 3 at Site 1 (see Figure 1). The borings will provide additional site characterization information in support of a soil vapor extraction air sparging remedial design. The borings will be sampled for volatile organic compounds (VOC) analyses. Sampling procedures will be performed as directed in the Field Sampling and Analysis Plan, (HNUS, May 1995).

Three existing monitoring wells (HN-27, HN-28, HN-29) will be sampled and submitted for VOC analysis to establish existing levels of groundwater VOC contamination. Sampling of the monitoring wells will follow guidelines established in Standard Operating Procedures (SOP) SA-1.1 "Groundwater Sample Acquisition" provided in Appendix A of this document.

The overall QA objective as discussed in the Field Sampling and Analysis Plan (HNUS, May 1995) will be followed for this round of sampling. Table 2-1 indicates the analysis required for this round of sampling.

2.3 SAMPLE IDENTIFICATION SYSTEM

Soil samples will be identified as described in the FSAP (HNUS, May 1995). Each groundwater sample submitted to the fixed base laboratory for chemical analysis will be assigned a unique sample tracking number. The sample tracking number will consist of an alpha-numeric code that identifies the sample medium and location. Any other pertinent information regarding sample identification will be recorded in the field log books and sample log sheets.

TABLE 2-1
SUMMARY OF ANALYSES, BOTTLE REQUIREMENTS, PRESERVATION REQUIREMENTS AND HOLDING TIMES
SUBSURFACE SOIL SAMPLES - SITE 1
NWIRP BETHPAGE, NEW YORK

| Analytical Parameter | Analytical Methodology | Number of Borings or wells | Matrix | Number of Samples ⁽¹⁾ | Container Type | Preservation and Holding Time |
|----------------------------|------------------------|----------------------------|--------|----------------------------------|--------------------------------|--|
| Volatile Organic Compounds | SW-846 8240 | 5 | Soil | 15 (3 per boring) | Two 60-mL glass volatile vials | Chill to 4° C; 7 days from date of sampling to date of analysis. |
| Volatile Organic Compounds | SW-846 8240 | 3 | Water | 3 | Two 40-mL glass volatile vials | Chill to 4° C; 7 days from date of sampling to date of analysis. |

(1) The number of samples only includes the number of environmental samples being collected. No field quality control blanks are required to be collected for this field effort.

The alpha-numeric coding to be used in the sample system is explained below.

(AAANN)

(Medium & Location)

Character Type:

A = Alpha

N = Numeric

Medium:

DGW = Design groundwater

Sample Location:

Monitoring well = Monitoring well identification number

For example, a groundwater sample collected from monitoring well HN-27 would be designated as DGW27.

Notes detailing the sample number, time, date, and type will be recorded in the field log book and/or sample logsheets.

Information regarding sample labels and tags to be attached before shipment to a laboratory is contained in Section 5.2 of the Halliburton NUS SOP SA-6.1 provided in the FSAP (HNUS, May 1995). No trip blanks, field duplicates, or field blanks shall be collected during this sampling activity.

APPENDIX A
STANDARD OPERATING PROCEDURES

SA-1.1 Groundwater Sample Acquisition



NUS
CORPORATION

**ENVIRONMENTAL
MANAGEMENT GROUP**

**STANDARD
OPERATING
PROCEDURES**

Number
SA-1.1

Page
1 of 14

Effective Date
05/04/90

Revision
2

Applicability
EMG

Prepared
Earth Sciences

Approved
D. Senovich
D. Senovich

Subject
GROUNDWATER SAMPLE ACQUISITION

TABLE OF CONTENTS

*REVISED 8/22/95
SITE SPECIFIC
DS*

SECTION

1.0 PURPOSE

2.0 SCOPE

3.0 GLOSSARY

4.0 RESPONSIBILITIES

5.0 PROCEDURES

- 5.1 GENERAL
- 5.2 SAMPLING, MONITORING, AND EVACUATION EQUIPMENT
- 5.3 CALCULATIONS OF WELL VOLUME
- 5.4 EVACUATION OF STATIC WATER (PURGING)
 - 5.4.1 General
 - 5.4.2 Evacuation Devices
 - 5.4.2.1 Bailers
 - 5.4.2.2 Suction Pumps
 - 5.4.2.3 Gas-Lift Samplers
 - 5.4.2.4 Submersible Pumps
- 5.5 SAMPLING
 - 5.5.1 Sampling Plan
 - 5.5.2 Sampling Methods
 - 5.5.3 Sample Containers
 - 5.5.4 Preservation of Samples and Sample Volume Requirements
 - 5.5.5 Handling and Transporting Samples
 - 5.5.6 Sample Holding Times
- 5.6 RECORDS
- 5.7 CHAIN-OF-CUSTODY

6.0 REFERENCES

7.0 ATTACHMENTS

| | | |
|---|------------------|----------------------------|
| Subject GROUNDWATER SAMPLE ACQUISITION | Number SA-1.1 | Page 2 of 14 |
| | Revision 2 | Effective Date 05/04/90 |

1.0 PURPOSE

The purpose of this procedure is to provide general reference information on the sampling of groundwater wells. The methods and equipment described are for the collection of water samples from the saturated zone of the subsurface.

2.0 SCOPE

This procedure provides information on proper sampling equipment and techniques for groundwater sampling. Review of the information contained herein will facilitate planning of the field sampling effort by describing standard sampling techniques. The techniques described shall be followed whenever applicable, noting that site-specific conditions or project-specific plans may require adjustments in methodology.

3.0 GLOSSARY

None.

4.0 RESPONSIBILITIES

Site Hydrogeologist or Geochemist - responsible for selecting and detailing the specific groundwater sampling techniques and equipment to be used, documenting, ~~these in the Project Operations Plan (POP)~~, and properly briefing the site sampling personnel.

Site Geologist - The Site Geologist is primarily responsible for the proper acquisition of the groundwater samples. When appropriate, such responsibilities may be performed by other qualified personnel (engineers, field technicians).

Site Manager - The Site Manager is responsible for reviewing the sampling procedures used by the field crew and for performing in-field spot checks for proper sampling procedures.

5.0 PROCEDURES

5.1 GENERAL

To be useful and accurate, a groundwater sample must be representative of the particular zone of the water being sampled. The physical, chemical, and bacteriological integrity of the sample must be maintained from the time of sampling to the time of testing in order to keep any changes in water quality parameters to a minimum.

Methods for withdrawing samples from completed wells include the use of pumps, compressed air, bailers, and various types of samplers. The primary considerations in obtaining a representative sample of the groundwater are to avoid collection of stagnant (standing) water in the well and to avoid physical or chemical alteration of the water due to sampling techniques. In a non-pumping well, there will be little or no vertical mixing of water in the well pipe or casing, and stratification will occur. The well water in the screened section will mix with the groundwater due to normal flow patterns, but the well water above the screened section will remain isolated and become stagnant. To safeguard against collecting non-representative stagnant water in a sample, the following approach shall be followed prior to sample acquisition:

| | | |
|---|------------------|----------------------------|
| Subject GROUNDWATER SAMPLE ACQUISITION | Number SA-1.1 | Page 3 of 14 |
| | Revision 2 | Effective Date 05/04/90 |

1. All monitoring wells shall be purged prior to obtaining a sample. Evacuation of three to five volumes is recommended for a representative sample. In a high-yielding groundwater formation and where there is no stagnant water in the well above the screened section, evacuation prior to sample withdrawal is not as critical.
2. For wells that can be purged to dryness with the sampling equipment being used, the well shall be evacuated and allowed to recover prior to sample acquisition. If the recovery rate is fairly rapid, evacuation of more than one volume of water is preferred.
3. For high-yielding monitoring wells which cannot be evacuated to dryness, there is no absolute safeguard against contaminating the sample with stagnant water. One of the following techniques shall be used to minimize this possibility:
 - A submersible pump, intake line of a surface pump or bailer shall be placed just below the water surface when removing the stagnant water and lowered as the water level decreases. Three to five volumes of water shall be removed to provide reasonable assurance that all stagnant water has been evacuated. Once this is accomplished a bailer may be used to collect the sample for chemical analysis.
 - The inlet line of the sampling pump (or the submersible pump itself) shall be placed near the bottom of the screened section, and approximately one casing volume of water shall be pumped from the well at a rate equal to the well's recovery rate.

Stratification of contaminants may exist in the aquifer formation, both in terms of a concentration gradients due to mixing and dispersion processes in a homogeneous layer, and in layers of variable permeability into which a greater or lesser amount of the contaminant plume has flowed. Excessive pumping can dilute or increase the contaminant concentrations in the recovered sample compared to what is representative of the integrated water column at that point, and thus result in the collection of a non-representative sample.

5.2 SAMPLING, MONITORING, AND EVACUATION EQUIPMENT

Sample containers shall conform with EPA regulations for the appropriate contaminants.

The following equipment shall be on hand when sampling ground water wells:

- Sample packaging and shipping equipment - Coolers for sample shipping and cooling, chemical preservatives, appropriate packing containers and filler, ice, labels and chain-of-custody documents.
- Field tools and instrumentation - Thermometer; ~~pH paper/meter; camera and film;~~ tags; appropriate keys (for locked wells); ~~engineers rule; water level indicator; where applicable, specific conductivity meter.~~
- Pumps
 - ~~Shallow-well pumps - Centrifugal, pitcher, suction, or peristaltic pumps with droplines, air-lift apparatus (compressor and tubing) where applicable.~~
 - ~~Deep-well pumps - submersible pump and electrical power generating unit, or air-lift apparatus where applicable.~~

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|---|------------------|----------------------------|
| Subject GROUNDWATER SAMPLE ACQUISITION | Number SA-1.1 | Page 4 of 14 |
| | Revision 2 | Effective Date 05/04/90 |

- Other sampling equipment - Bailers and monofilament line with tripod-pulley assembly (if necessary). Bailers shall be used to obtain samples for volatile organics from shallow and deep groundwater wells.
- Pails - Plastic, graduated.
- Decontamination solutions - Distilled water, Alconox, methanol, acetone.

Ideally, sample withdrawal equipment shall be completely inert, economical, easily cleaned, sterilized, and reused, able to operate at remote sites in the absence of power sources, and capable of delivering variable rates for well flushing and sample collection.

5.3 CALCULATIONS OF WELL VOLUME

To insure that the proper volume of water has been removed from the well prior to sampling it is first necessary to know the volume of standing water in the well pipe. This volume can be easily calculated by the following method. Calculations shall be entered in the field logbook and on the field data form (Attachment A):

- Obtain all available information on well construction (location, casing, screens, etc.).
- Determine well or casing diameter.
- Measure and record static water level (depth below ground level or top of casing reference point).
- Determine depth of well (if not known from past records) by sounding using a clean, decontaminated weighted tape measure.
- Calculate number of linear feet of static water (total depth or length of well pipe minus the depth to static water level).
- Calculate one static well volume in gallons ($V = 0.163Tr^2$).

where:

- V = Static volume of well in gallons.
- T = Thickness of water table in the well measured in feet, i.e., linear feet of static water.
- r = Inside radius of well casing in inches.
- 0.163 = A constant conversion factor which compensates for the conversion of the casing radius from inches to feet, the conversion of cubic feet to gallons, and pi.

- Determine the minimum amount to be evacuated before sampling.

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|---|------------------|----------------------------|
| Subject GROUNDWATER SAMPLE ACQUISITION | Number SA-1.1 | Page 5 of 14 |
| | Revision 2 | Effective Date 05/04/90 |

5.4 EVACUATION OF STATIC WATER (PURGING)

5.4.1 General

The amount of flushing a well shall receive prior to sample collection will depend on the intent of the monitoring program and the hydrogeologic conditions. Programs to determine overall quality of water resources may require long pumping periods to obtain a sample that is representative of a large volume of that aquifer. The pumped volume may be specified prior to sampling so that the sample can be a composite of a known volume of the aquifer. Alternately the well can be pumped until the parameters such as temperature, electrical conductance, and pH have stabilized. Onsite measurements of these parameters shall be recorded on the field data form.

For defining a contaminant plume, a representative sample of only a small volume of the aquifer is required. These circumstances require that the well be pumped enough to remove the stagnant water but not enough to induce significant groundwater flow from other areas. Generally three to five well volumes are considered effective for purging a well.

The site hydrogeologist, geochemist and risk assessment personnel shall define the objectives of the groundwater sampling program in the Work Plan, and provide appropriate criteria and guidance to the sampling personnel on the proper methods and volumes of well purging.

5.4.2 Evacuation Devices

The following discussion is limited to those devices commonly used at hazardous waste sites. Attachment B provides guidance on the proper evacuation device to use for given sampling situations. Note that all of these techniques involve equipment which is portable and readily available.

5.4.2.1 Bailers

Bailers are the simplest evacuation devices used and have many advantages. They generally consist of a length of pipe with a sealed bottom (bucket-type bailer) or, as is more useful and favored, with a ball check-valve at the bottom. An inert line is used to lower the bailer and retrieve the sample.

Advantages of bailers include:

- Few limitations on size and materials used for bailers.
- No external power source needed.
- Bailers are inexpensive, and can be dedicated and hung in a well to reduce the chances of cross-contamination.
- There is minimal outgassing of volatile organics while the sample is in the bailer.
- Bailers are relatively easy to decontaminate.

Limitations on the use of bailers include the following:

- It is time consuming to remove stagnant water using a bailer.
- Transfer of sample may cause aeration.
- Use of bailers is physically demanding, especially in warm temperatures at protection levels above Level D.

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|---|------------------|----------------------------|
| Subject GROUNDWATER SAMPLE ACQUISITION | Number SA-1.1 | Page 6 of 14 |
| | Revision 2 | Effective Date 05/04/90 |

5.4.2.2 Suction Pumps

There are many different types of inexpensive suction pumps including centrifugal, diaphragm, peristaltic, and pitcher pumps. Centrifugal and diaphragm pumps can be used for well evacuation at a fast pumping rate and for sampling at a low pumping rate. The peristaltic pump is a low volume pump (therefore not suitable for well purging) that uses rollers to squeeze a flexible tubing, thereby creating suction. This tubing can be dedicated to a well to prevent cross contamination. The pitcher pump is a common farm hand-pump.

These pumps are all portable, inexpensive and readily available. However, because they are based on suction, their use is restricted to areas with water levels within 20 to 25 feet of the ground surface. A significant limitation is that the vacuum created by these pumps can cause significant loss of dissolved gases and volatile organics. In addition, the complex internal components of these pumps may be difficult to decontaminate.

5.4.2.3 Gas-Lift Samplers

This group of samplers uses gas pressure either in the annulus of the well or in a venturi to force the water up a sampling tube. These pumps are also relatively inexpensive. Gas lift samplers are more suitable for well development than for sampling because the samples may be aerated, leading to pH changes and subsequent trace metal precipitation or loss of volatile organics.

5.4.2.4 Submersible Pumps

Submersible pumps take in water and push the sample up a sample tube to the surface. The power sources for these samplers may be compressed gas or electricity. The operation principles vary and the displacement of the sample can be by an inflatable bladder, sliding piston, gas bubble, or impeller. Pumps are available for 2-inch diameter wells and larger. These pumps can lift water from considerable depths (several hundred feet).

Limitations of this class of pumps include:

- They may have low delivery rates.
- Many models of these pumps are expensive.
- Compressed gas or electric power is needed.
- Sediment in water may cause clogging of the valves or eroding the impellers with some of these pumps.
- Decontamination of internal components is difficult and time-consuming.

5.5 SAMPLING

5.5.1 Sampling Plan

The sampling approach consisting of the following, shall be developed as part of the ^{FSAP} POP prior to the field work:

- Background and objectives of sampling.
- Brief description of area and waste characterization.
- Identification of sampling locations, with map or sketch, and applicable well construction data (well size, depth, screened interval, reference elevation).

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|---|------------------|----------------------------|
| Subject GROUNDWATER SAMPLE ACQUISITION | Number SA-1.1 | Page 7 of 14 |
| | Revision 2 | Effective Date 05/04/90 |

- Intended number, sequence volumes, and types of samples. If the relative degrees of contamination between wells is unknown or insignificant, a sampling sequence which facilitates sampling logistics may be followed. Where some wells are known or strongly suspected of being highly contaminated, these shall be sampled last to reduce the risk of cross-contamination between wells as a result of the sampling procedures.
- Sample preservation requirements.
- Working schedule.
- List of team members.
- List of observers and contacts.
- Other information, such as the necessity for a warrant or permission of entry, requirement for split samples, access problems, location of keys, etc.

5.5.2 Sampling Methods

The collection of a groundwater sample is made up of the following steps:

1. HSO or designee will first open the well cap and use volatile organic detection equipment (HNU or OVA) on the escaping gases at the well head to determine the need for respiratory protection.
2. When proper respiratory protection has been donned, sound the well for total depth and water level (using clean equipment) and record these data in a well sampling data sheet (Attachment A); then calculate the fluid volume in the well pipe.
3. Calculate well volume to be removed as stated in Section 5.3.
4. Select appropriate purging equipment (see Attachment B). If an electric submersible pump with packer is chosen, go to Step 10.
5. Lower purging equipment or intake into the well to a short distance below the water level and begin water removal. Collect the purged water and dispose of it in an acceptable manner. Lower the purging device, as required, to maintain submergence.
6. Measure rate of discharge frequently. A bucket and stopwatch are most commonly used; other techniques include using pipe trajectory methods, weir boxes or flow meters.
7. Observe peristaltic pump intake for degassing "bubbles." If bubbles are abundant and the intake is fully submerged, this pump is not suitable for collecting samples for volatile organics. Never collect volatile organics samples using a vacuum pump.
8. Purge a minimum of three-to-five casing volumes before sampling. In low permeability strata (i.e., if the well is pumped to dryness), one volume will suffice.
9. If sampling using a pump, lower the pump intake to midscreen or the middle of the open section in uncased wells and collect the sample. If sampling with a bailer, lower the bailer to sampling level before filling (this requires use of other than a 'bucket-type' bailer).

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|---|------------------|----------------------------|
| Subject GROUNDWATER SAMPLE ACQUISITION | Number SA-1.1 | Page 8 of 14 |
| | Revision 2 | Effective Date 05/04/90 |

Purged water shall be collected in a designated container and disposed of in an acceptable manner.

10. (For pump and packer assembly only). Lower assembly into well so that packer is positioned just above the screen or open section and inflate. Purge a volume equal to at least twice the screened interval or unscreened open section volume below the packer before sampling. Packers shall always be tested in a casing section above ground to determine proper inflation pressures for good sealing.
11. In the event that recovery time of the well is very slow (e.g., 24 hours), sample collection can be delayed until the following day. If the well has been bailed early in the morning, sufficient water may be standing in the well by the day's end to permit sample collection. If the well is incapable of producing a sufficient volume of sample at any time, take the largest quantity available and record in the logbook.
12. Add preservative if required. Label, tag, and number the sample bottle(s).
13. Replace the well cap. Make sure the well is readily identifiable as the source of the samples.
14. Pack the samples for shipping. Attach a custody seal to the front and back of the shipping package. Make sure that traffic reports and chain-of-custody forms are properly filled out and enclosed or attached.
15. Decontaminate all equipment

5.5.3 Sample Containers

For most samples and analytical parameters, either glass or plastic containers are satisfactory. VOC's

5.5.4 Preservation of Samples and Sample Volume Requirements

Sample preservation techniques and volume requirements depend on the type and concentration of the contaminant and on the type of analysis to be performed. Procedure SF-1.2 describes the sample preservation and volume requirements for most of the chemicals that will be encountered during hazardous waste site investigations. Procedure SA-4.3 describes the preservation requirement for microbial samples.

5.5.5 Handling and Transporting Samples

After collection, samples shall be handled as little as possible. It is preferable to use self-contained "chemical" ice (e.g., "blue ice") to reduce the risk of contamination. If water ice is used, it shall be bagged and steps taken to ensure that the melted ice does not cause sample containers to be submerged and thus possibly become cross-contaminated. All sample containers shall be enclosed in plastic bags or cans to prevent cross-contamination. Samples shall be secured in the ice chest to prevent movement of sample containers and possible breakage. Sample packing and transportation requirements are described in SA-6.2.

5.5.6 Sample Holding Times

Holding times (i.e. allowed time between sample collection and analysis) for routine samples are given in Procedure SF-1.2.

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|---|------------------|----------------------------|
| Subject GROUNDWATER SAMPLE ACQUISITION | Number SA-1.1 | Page 9 of 14 |
| | Revision 2 | Effective Date 05/04/90 |

5.6 RECORDS

Records will be maintained for each sample that is taken. The sample log sheet will be used to record the following information:

- Sample identification (site name, location, project number; sample name/number and location; sample type and matrix; time and date; sampler's identity).
- Sample source and source description.
- Purge data - prior to removal of each casing volume and before sampling, pH, electrical conductance, temperature, color, and turbidity shall be measured and recorded.
- Field observations and measurements (appearance; volatile screening; field chemistry; sampling method).
- Sample disposition (preservatives added; lab sent to, date and time; lab sample number, EPA Traffic Report or Special Analytical Services number, chain-of-custody number.
- Additional remarks - (e.g., sampled in conjunction with state, county, local regulatory authorities; samples for specific conductance value only; sampled for key indicator analysis; etc.).

5.7 CHAIN-OF-CUSTODY

Proper chain-of-custody procedures play a crucial role in data gathering. Procedure SA-6.1 describes the requirements for a correct chain-of-custody.

6.0 REFERENCES

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|---|------------------|----------------------------|
| Subject GROUNDWATER SAMPLE ACQUISITION | Number SA-1.1 | Page 10 of 14 |
| | Revision 2 | Effective Date 05/04/90 |

7.0 ATTACHMENTS

Attachment A - Well Sampling Data Sheet
Attachment B - Purging Equipment Selection

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|---|------------------|----------------------------|
| Subject GROUNDWATER SAMPLE ACQUISITION | Number SA-1.1 | Page 11 of 14 |
| | Revision 2 | Effective Date 05/04/90 |

**ATTACHMENT A
SAMPLE LOG SHEET**



SAMPLE LOG SHEET

- Monitoring Well Data
- Domestic Well Data
- Other _____

Page _____ of _____
Case # _____
By _____

Project Site Name _____ Project Site Number _____
NUS Source No. _____ Source Location _____

| Total Well Depth: | Purge Data | | | | |
|---|-----------------------|------------------|------------|-------------------|-------------------|
| | Volume | pH | S.C. | Temp. (°C) | Color & Turbidity |
| Well Casing Size & Depth: | | | | | |
| Static Water Level: | | | | | |
| One Casing Volume: | | | | | |
| Start Purge (hrs): | | | | | |
| End Purge (hrs): | | | | | |
| Total Purge Time (min.): | | | | | |
| Total Amount Purged (gal.): | | | | | |
| Monitor Reading: | | | | | |
| Purge Method: | | | | | |
| Sample Method: | | | | | |
| Depth Sampled: | | | | | |
| Sample Date & Time: | Sample Data | | | | |
| | pH | S.C. | Temp. (°C) | Color & Turbidity | |
| Sampled By: | | | | | |
| Signature(s): | Observations / Notes: | | | | |
| Type of Sample <input type="checkbox"/> Low Concentration <input type="checkbox"/> High Concentration <input type="checkbox"/> Grab <input type="checkbox"/> Composite <input type="checkbox"/> Grab - Composite | | | | | |
| Analysis: | Preservative | | Organic | Inorganic | |
| | | Traffic Report # | | | |
| | | Tag # | | | |
| | | AB # | | | |
| | | Date Shipped | | | |
| | | Time Shipped | | | |
| | | Lab | | | |
| | | Volume | | | |

**ATTACHMENT B
PURGING EQUIPMENT SELECTION**

Purging Equipment Selection

| Diameter Casing | Ballor | Peristaltic Pump | Vacuum Pump | Airlift | Diaphragm "Trash" Pump | | Submersible Diaphragm Pump | Submersible Electric Pump | Submersible Electric Pump w/Packer |
|--------------------|--------|---------------------|----------------|---------|------------------------------|--|----------------------------------|---------------------------------|--|
| | | | | | | | | | |
| <u>1.25-inch</u> | | | | | | | | | |
| Water level | | | | | | | | | |
| <25 ft | | X | X | X | X | | | | |
| Water level | | | | | | | | | |
| >25 ft | | | | X | | | | | |
| <u>2-inch</u> | | | | | | | | | |
| Water level | | | | | | | | | |
| <25 ft | X | X | X | X | X | | X | | |
| Water level | | | | | | | | | |
| >25 ft | X | | | X | | | X | | |
| <u>4-inch</u> | | | | | | | | | |
| Water level | | | | | | | | | |
| <25 ft | X | X | X | X | X | | X | | X |
| Water level | | | | | | | | | |
| >25 ft | X | | | X | | | X | | X |
| <u>6-inch</u> | | | | | | | | | |
| Water level | | | | | | | | | |
| <25 ft | | | | X | X | | | X | |
| Water level | | | | | | | | | |
| >25 ft | | | | X | | | X | | X |
| <u>8-inch</u> | | | | | | | | | |
| Water level | | | | | | | | | |
| <25 ft | | | | X | X | | | X | |
| Water level | | | | | | | | | |
| >25 ft | | | | X | | | X | | X |

| | | |
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| Subject GROUNDWATER SAMPLE ACQUISITION | Number SA-1.1 | Page 13 of 14 |
| | Revision 2 | Effective Date 05/04/90 |

| Manufacturer | Model name/ number | Principle of operation | Maximum outside diameter/length (inches) | Construction materials (w/lines & tubing) | Lift range (ft) | Delivery rates or volumes | 1982 price (dollars) | Comments |
|--|--|---|--|--|------------------------------|--|----------------------------|--|
| Bar-Cad Systems, Inc. | Bar-Cad Sampler | dedicated; gas drive (positive displacement) | 1.5/18 | PE, brass, nylon, aluminum oxide | 0-150 with std. tubing | 1 liter for each 10-15 ft of submergence | 220-350 | requires compressed gas; custom sizes and materials available; acts as piezometer |
| Cole-Parmer Inst. Co. | Master Files 7570 Portable Sampling Pump | portable; peristaltic (suction) | <1.0/NA | (not submersible) Teflon®; silicone Viton® | 0-30 | 670 mL/min with 7015- 20 pump head | 500-600 | AC/DC; variable speed control available; other models may have different flow rates |
| ECO Pump Corp. | SAMPLifier | portable; venturi | <1.5 or <2.0/NA | PP, PE, PVC, SS, Teflon®, Tefzel® | 0-100 | 0-500 mL/min depending on lift | 400-700 | AC, DC, or gasoline driven motors avail- able; must be primed |
| Caltek Corp. | Baker 219-4 | portable; grab (positive dis- placement) | 1.66/38 | Teflon® | no limit | 1076 mL | 120-135 | other sizes available |
| Geo-Engineering Inc. | GEO-MONITOR | dedicated; gas drive (positive displacement) | 1.5/16 | PE, PP, PVC, Viton® | probably 0-150 | app. 1 liter for each 10 ft of submergence | 185 | acts as piezometer; requires compressed gas |
| Industrial and Environmental Analysts, Inc. (IEA) | Aquarius | portable; bladder (positive dis- placement) | 1.75/43 | SS, Teflon®, Viton® | 0-250 | 0-2800 mL/min | 1500-3000 | requires compressed gas; other models available; AC, DC, manual operation possible |
| IEA | Syringe Sampler | portable; grab (positive dis- placement) | 1.75/43 | SS, Teflon® | no limit | 850 mL sample vol. | 1100 | requires vacuum and/or pressure from hand pump |
| Instrument Spec- ties Co. (ISCO) | Model 2600 Well Sampler | portable; bladder (positive dis- placement) | 1.75/60 | PC, silicone, Teflon®, PP, PE, Delrin®, acetal | 0-150 | 0-7500 mL/min | 990 | requires compressed gas (40 psi minimum) |
| Kock Geophysical Instruments, Inc. | SP-81 Submar- sible Sampling Pump | portable; helical rotor (positive displacement) | 1.75/76 | SS, Teflon®, PP, EPDM, Viton® | 0-160 | 0-4500 mL/min | 3500 | DC operated |
| Leonard Mold and Die Works, Inc. | GeoFilter Small Dia. Well Pump (#0500) | portable; bladder (positive dis- placement) | 1.75/38 | SS, Teflon®, PC, Neoprene® | 0-400 | 0-3500 mL/min | 1400-1500 | requires compressed gas (55 PSI minimum); pneumatic or AC/DC control module |
| Oil Recovery Systems, Inc. | Surface Sampler | portable; grab (positive dis- placement) | 1.75/12 | acrylic, Delrin® | no limit | app. 250 mL | 125-180 | other materials and models available; for measuring thick- ness of "floating" contaminants |
| O E D Environmental Systems, Inc. | Well Wizard® Monitoring System (P-100) | dedicated; bladder (positive dis- placement) | 1.66/36 | PVC | 0-230 | 0-2000 mL/min | 300-400 | requires compressed gas; piezometric level indi- cator; other materials available |

Source: Barcelo et al., 1983

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| Subject GROUNDWATER SAMPLE ACQUISITION | Number SA-1.1 | Page 14 of 14 |
| | Revision 2 | Effective Date 05/04/90 |

| Manufacturer | Model name/ number | Principle of operation | Maximum Outside diameter/length (inches) | Construction materials (w/lines & tubing) | Lift range (ft) | Delivery rates or volumes | 1982 price (dollars) | Comments |
|---|--|---|--|--|-----------------------|---------------------------------|----------------------------|---|
| Randolph Austin Co. | Model 500 Vari-Flow Pump | portable; per- staltic (suction) | <0.5/N/A | (not submersible) rubber, Tygon® or Neoprene® | 0-30 | see comments | 1200-1300 | flow rate dependent on motor and tubing selec- ted, AC operated; other models available |
| Robert Bennett Co. | Model 180 | portable; piston (positive dis- placement) | 1.8/22 | SS, Teflon®, Del- rin®, PP, Viton® acrylic, PE | 0-500 | 0-1800 mL/min | 2600-2700 | requires compressed gas; water level indicator and flow meter; custom models available |
| Slope Indicator Co. (SINCO) | Model 514124 Pneumatic Water Sampler | portable; gas drive (positive displacement) | 1.9/18 | PVC, nylon | 0-1100 | 250 mL/flush- ing cycle | 250-350 | requires compressed gas; SS available; piezometer model available; dedi- cated model available |
| Solinst Canada Ltd. | SW Water Sampler | portable; grab (positive dis- placement) | 1.9/27 | PVC, brass, nylon, Neoprene® | 0-330 | 600 mL | 1300-1800 | requires compressed gas; custom models available |
| TIMCO Mfg. Co., Inc. | Std. Bailor | portable; grab (positive dis- placement) | 1.66/ custom | PVC, PP | no limit | 250 mL/ft of bailor | 20-60 | other sizes, materials, models available; op- tional bottom-emptying device available; no solvents used |
| TIMCO | Air or Gas Lift Sampler | portable; gas drive (positive displacement) | 1.66/30 | PVC, Tygon®, Teflon® | 0-150 | 350 mL/flush- ing cycle | 100-200 | requires compressed gas; other sizes, materials, models available; no solvents used |
| Tole Devices Co. | Sampling Pump | portable; bladder (positive dis- placement) | 1.38/48 | SS, silicone, Delrin®, Tygon® | 0-125 | 0-4000 mL/min | 800-1000 | compressed gas re- quired; DC control module; custom built |
| <p>Construction Materials Abbreviations</p> <p>PE Polyethylene PP Polypropylene PVC Polyvinyl Chloride SS Stainless Steel PC Polycarbonate EPDM Ethylene-Propylene Diene (synthetic rubber)</p> <p>NOTE: Other manufacturers market pumping devices which could be used for ground-water sampling, though not expressly designed for this purpose. The list is not meant to be all-inclusive and listing does not constitute endorsement for use. Information in the table is from sales literature and/or personal communication. No slammer, scavenger type, or high-capacity pumps are included.</p> | | | | | | | | |

Source: Barcelona et al., 1983