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Volume 3, Appendix A
Draft Standard Operating Procedures and Amendments

Sampling and Analysis Plan (SAP) Phase 1, Task 4 Field Investigation

Draft

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FIELD PROCEDURE FP 1-2

USE OF FIELD NOTEBOOKS

Subject	Procedure No. FP 1-2	Rev. 0	Page 1 of 5
USE OF FIELD NOTEBOOKS	Issue Date 05/25/90		Effective Date 07/02/90
	Supersedes Procedure Number 630 FP 32	Rev. 0	Date
Acceptance - Program QA	Approval - Program Manager		

1.0 PURPOSE

The purpose of this procedure is to detail the minimum requirements for the proper generation and maintenance of logbooks used during the performance of a field investigation.

2.0 SCOPE

This procedure applies to the following logbooks when required to be maintained during the performance of a field investigation:

1. Site Logbook.
2. Field Operations Leader Logbook.
3. Health and Safety Logbook.
4. Field Equipment Logbook.
5. Decontamination Logbook.
6. Photographs.

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3.0 REQUIREMENTS

Logbooks are initiated at the start of the first on-site activity (e.g., initial reconnaissance survey). Entries are made each day that on-site activities take place which involve Engineering-Science (ES) or subcontractor personnel. A current logbook is maintained throughout the field effort for each activity.

The site logbook becomes part of the permanent project file. Because information contained in the site logbook may be admitted as evidence in cost recovery or other litigation, it is critical that this document be properly maintained.

4.0 REFERENCES

4.1 HAZWRAP, February 1989, *Quality Control Requirements for Field Methods*, DOE/HWP-69.

5.0 DEFINITIONS

Logbook - The logbook is a bound notebook with consecutively numbered pages that cannot be removed. Upon entry of data, the logbook requires signature by the responsible individual.

6.0 RESPONSIBILITIES

6.1 Project Manager

The site logbook is issued by the Project Manager to the Field Operations Leader or other person responsible for the direction of on-site activities (e.g., Reconnaissance Survey Team Leader, Sampling Team Leader). It is the responsibility of this person (or his designee) to keep the site logbook current while in his possession, and return it to the Project Manager or turn it over to another field team. Following the completion of all fieldwork, the site logbook is returned to the Project Manager for inclusion in the permanent project files.

6.2 Field Operations Leader

Field logbooks are issued by the Field Operations Leader to the person responsible for on-site activities. It is the responsibility of this person to keep the logbook current while in his possession and return it to the Field Operations Leader following completion of all fieldwork or when the logbook is full and a replacement logbook is needed.

7.0 EQUIPMENT

None specified.

8.0 PROCEDURE

8.1 General

The cover of each logbook will contain the following information:

- project name and HAZWRAP Work Assignment Number;
- project number;
- Project Manager's name;
- sequential book number;
- start date; and
- end date.

All entries should be made in black pen. No erasures are permitted. If an incorrect entry is made, the data should be crossed out with a single strike mark so as not to be obliterated and initialed and dated. At the completion of entries by any individual, the logbook must be signed at the bottom of every page.

8.2 Site Logbook

The site logbook is a controlled document which records all major on-site activities during a field investigation. At a minimum, the following activities or events should be recorded in the site logbook:

- arrival and departure of site visitors;
- arrival and departure of equipment;
- sample pick-up (e.g. chain-of-custody form numbers, carrier, time);
- sampling activities and sample logsheet numbers;
- start or completion of borehole, trench or monitoring well installation or sampling activities; and
- health and safety issues.

Daily entries into the logbook may contain a variety of information. At the beginning of each day the following information must be recorded:

- date;
- start time;
- weather;
- all field personnel present; and
- any visitors present.

During the day, a summary of all site activities and level of personal protection should be recorded in the logbook. The information need not duplicate that recorded in other field logbooks (e.g., sample logbook, Site Geologist's logbook, Health and Safety Officer's logbook, etc.), but should summarize the contents of these other logbooks and refer to the page locations in these logbooks for detailed information. An example of a site logbook page is shown in Attachment 9.1.

8.3 Field Operations Leader Logbook

The requirements for the field logbooks are the same as for the site logbook, except that the book is kept up to date in real time. In general, these books never leave the site and are sequentially numbered, if more than one are used. The front of the logbook lists the project number and name, the name of the contract under which the investigation is being conducted, and the date(s) of use. A field logbook is normally used by the rig geologist or by the Field Operations Leader to record specific details of each task. Although the field logbook contains the specific field information being collected based on a task, the number of the field logbook and page numbers used for a particular day's performance will be referenced in the site logbook to include a brief summary.

8.4 Health and Safety Logbook

The Health and Safety logbook is used to document protection levels, health and safety training sessions and equipment meter readings that substantiate protection levels. The Health and Safety logbook is also used to document any abnormal occurrences or accidents. The Health and Safety Logbook is maintained by the Project Health and Safety Officer or his designee.

8.5 Field Equipment Logbook

The purpose of the field equipment logbook (FEL) is to document the proper use, maintenance, and calibration of field testing equipment. Before using field equipment, the Field Operations Leader (supervisor) shall inspect and approve the use of the field testing equipment by initialing the appropriate page in the FEL. A calibration record shall be maintained for each instrument used on-site and shall be kept in the FEL.

The following items shall be tracked in the FEL:

- equipment calibration status;
- equipment decontamination status;
- equipment nonconformance; and
- equipment inspection and repair records.

The person using, maintaining, or calibrating field equipment shall document his or her actions in the FEL. Entries shall contain the following:

- names and signatures of persons making entry;
- date of entry;
- name of equipment and its identifying number;
- list or reference of procedure(s) used for calibration or maintenance;
- manufacturer, lot number, and expiration date of calibration standards;

Entries in the log shall be signed and dated by the person(s) making the entry. Every page in the log will be signed and dated by the field supervisor. This signature reflects his or her review and approval of the entry validity.

8.6 Decontamination Logbook

The decontamination logbook is used to document the proper decontamination of equipment used in the field investigation. Equipment shall be documented as to type, serial number, and procedure reference or description of decontamination method utilized. Bulk items (e.g., well construction materials, soil gas probes, etc.) shall also be identified by date or final destination for installation.

8.7 Photographs

The record of photographs taken at a site for the purpose of project documentation must be recorded in the site logbook or a field logbook. When movies, slides, or photographs are taken of a site or any monitoring location, they are numbered to correspond to logbook entries. The name of the photographer, date, time, site location, site description, and weather conditions are entered in the logbook as the photographs are taken. A series entry may be used for rapid-sequence photographs. The photographer is not required to record the aperture settings and shutter speeds for photographs taken within the normal automatic exposure range; however, special lenses, films, filters, and other image-enhancement techniques must be noted in the logbook. If possible, such techniques should be avoided, since they can adversely affect the admissibility of photographs as evidence. Chain-of-custody procedures depend upon the subject matter, type of film, and the processing it requires. Film used for aerial photography, confidential information, or criminal investigations require chain-of-custody procedures. Adequate logbook notations and receipts may be used to account for routine film processing. Once processed, the slides of photographic prints shall be serially numbered and labeled according to the logbook descriptions.

9.0 ATTACHMENTS

9.1 Typical Site Logbook Entry

TYPICAL SITE LOGBOOK ENTRY

START TIME: 08:00 **DATE:** 09 June 1990

SITE LEADER: ______________________________

PERSONNEL: ES	**DRILLER**	**EMR/OEPA**
____________	____________	____________
____________	____________	____________
____________	____________	____________
____________	____________	____________

WEATHER: Clear, 68°F, 2-5 mph wind from SE

ACTIVITIES:

1. Steam jenny and fire hoses were set up.
2. Drilling activities at well ____________ resumed. Rig geologist was ____________________. See Geologist's logbook, Not. 1, page 29-30, for details of drilling activity. Sample No. 123-21-S4 collected; see sample logbook, page 42. Drilling activities completed at 11:50 and a 4" stainless steel well installed. See Geologist's logbook, No. 1, page 31, and well construction details for well ____________.
3. Drilling Rig No. 2 steam-cleaned at decontamination pit. Then set up at location of well ____________.
4. Well ____________ drilled. Rig geologist was ____________________. See Geologist's logbook, No. 2, page _____ for details of drilling activities. Sample numbers 123-22-S1, 123-22-S2, and 123-22-S3 collected; see sample logbook, pages 43, 44, and 45.
5. Well ____________ was developed. Seven 55-gallon drums were filled in the flushing stage. The well was then pumped using the pitcher pump for one hour. At the end of the hour, water pumped from well was "sand-free".
6. OEPA arrives on-site at 14:25 hrs.
7. Large dump truck arrives at 14:45 and is steam-cleaned, Backhoe and dump truck set up over test pit ____________.
8. Test pit ____________ dug with cuttings placed in dump truck. Rig geologist was ____________________. See Geologist's logbook, No. 1, page 32, for details of test pit activities. Test pit subsequently filled. No samples taken for chemical analysis. Due to shallow ground-water table, filling in of test pit ____________ resulted in a very soft and wet area. A mound was developed and the area roped off.
9. Express carrier picked up samples (see Sample Logbook, pages 42 through 45) at 17:50 hrs. Site activities terminated at 18:22 hours. All personnel off-site, gate locked.

____

Field Operations Leader

AMENDMENTS TO:

FIELD PROCEDURE FP 1-2
USE OF FIELD NOTEBOOKS

The following are specific amendments to the referenced SOP. The amended portions of the SOP are marked and correspond to the comments listed below.

1. Amendment not implemented.

FIELD PROCEDURE FP 1-4
SURVEYING

Subject	Procedure No.	Rev.	
	FP 1-4	0	Page 1 of 13
	Issue Date		Effective Date
SURVEYING	07/31/90		08/06/90
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	630 FP 16	0	
Acceptance - Program QA	Approval - Program Manager		

1.0 PURPOSE

The purpose of this procedure is to describe the general requirements for performing engineering measurements and other land surveying operations at sites for purposes of establishing benchmarks, baselines, and monuments; and to map sampling station locations and altitudes.

2.0 SCOPE

This procedure describes the minimum standards for equipment, surveying procedures and required results associated with determining sampling station locations and altitudes at hazardous waste sites, and mapping this information. These measurements will rely primarily on the use of on-site pre-established benchmarks, baselines and monuments. This procedure addresses the overall requirements for sampling station surveying activities but does not take precedence over more detailed site-specific surveying needs which may be addressed in the project-specific Work Plan.

3.0 REQUIREMENTS

The chronology of performing surveying operations to locate sampling stations is dependent on the nature of the sampling to be performed and the site conditions. Surveying operations to define horizontal and vertical locations of on-site sampling stations may be performed before and after sampling stations are established. Examples include:

- Sampling grids established for site reconnaissance surveys or geophysical surveys will usually be staked out by the field team prior to surveying. These grids should be rectilinear, with all corners or inflection points staked and easily visible for later surveying.
- Planned surface soil sampling locations can sometimes be staked out and measured for altitude by the surveyors in advance of the sampling events.
- Unplanned surface soil sampling stations, or those which have been relocated a significant distance away from the planned locations to suit site conditions, may be staked for identification by the sampling personnel, and subsequent determination of positions and altitude by the Surveying Contractor.

- Monitoring well locations may be either staked out in advance of the survey by the Surveying Contractor under the direction of the Field Operations Leader, or selected by the Field Geologist and later measured for exact position by the Surveying Contractor. However, in either case, the altitude of the wellhead (top of the inner casing) must be measured by the Surveying Contractor after the well has been installed.

The surveying techniques to be employed, and the required accuracy and precision, are dependent upon the field conditions and the nature of the sampling stations and/or techniques to be employed.

4.0 REFERENCES

4.1 Bouchard, H. and F. Moffit, 1982. *Surveying*. Seventh Edition, Harper and Row, New York, N.Y.

4.2 U.S. Dept. of the Interior, Bureau of Land Management, *Standard Field Tables and Trigonometric Formulas*. Eighth Edition, U.S. Govt. Printing Office, Washington, D.C.

4.3 Adams, O.S., and C.N. Claire, 1971. *Manual of Plane Coordinate Computation*. U.S. Dept. of Commerce, Coast and Geodetic Survey, Special Publication No. 193. U.S. Govt. Printing Office, Washington D.C.

4.4 Gossett, F.R., 1971. *Manual of Goedetic Triangulation*. U.S. Dept. of Commerce, Coast and Geodetic Survey, Special Publication No. 247. U.S. Govt. Printing Office, Washington D.C.

4.5 Rappleye, H.S., 1948. *Manual of Geodetic Leveling*. U.S. Dept. of Commerce, Coast and Geodetic Survey, Special Publication No. 239. U.S. Govt. Printing Office, Washington D.C.

4.6 Pafford, F.W., 1983. *Handbook of Survey Notekeeping*. R.E. Krieger Publishing Co., Melbourne, FL.

5.0 DEFINITIONS

Accuracy - The extent to which a set of data represents the "true" value, i.e., is free of measurement error. The accuracy of some equipment can be determined by comparing measurements made using the equipment to a known standard.

Alidade - A stadia-equipped leveling telescope, with limited capability for measuring vertical angles, which is attached to a straight edge at its base. The device is used to construct topographic maps in the field on a plane table.

Azimuth - The azimuth of a line is the angle between a meridian and the line, and is always measured from the meridian in a clockwise direction.

Baseline - A straight line established in the field by two or more monuments. The baseline is often used as a primary horizontal reference for layout in determining the locations of site activities, features, or secondary horizontal surveying stations. For convenience, baselines are also provided with intermediate stationing stakes or hubs at major stations (i.e., 50' or 100') along their length.

Base Map - A detailed site map, often a topographic/boundary map, which is used as a basis to create other site maps by imposing additional information (i.e., sampling locations, boring or test pit locations, planned excavation limits, etc.).

Bathymetric Map - A topographic map of an underwater area, sometimes called a Hydrographic Map.

Bearing - Bearing of a line is the acute angle a line makes with the 4 cardinal compass directions (N, E, W, S). A bearing is designated by the original cardinal direction from which it is measured, the acute angle the line makes with the original cardinal direction, and the adjacent cardinal direction toward which the acute angle is turned.

Benchmark - A permanent point of known altitude. Benchmarks can either be established by others (e.g., U.S. Coast & Geodetic Survey USGS, etc.) and used as references by the Surveyor for establishing site-specific benchmarks, or can be on-site or near-site benchmarks established directly by the Surveyor. The benchmark shall be clearly marked to indicate:

- The place on the benchmark having the known altitude.
- The benchmark's known altitude and the datum to which it refers.
- The name of the organization which installed the benchmark and its date of installation.

Benchmarks must be permanently installed in a manner so that they will not be disturbed by natural elements or man's activities (i.e., fixed to a rock outcrop, massive concrete, or a long metal pipe embedded in the ground). Benchmarks must be constructed of appropriate materials (usually brass plates embedded into concrete or bedrock) so that they remain accurate and readable for a sufficient period to serve the needs of the work assignment. Where appropriate, benchmarks are to be installed in protected areas, or provided with appropriate protection, to preclude their disturbance during their service life.

Contour Interval - The vertical distance between mapped contour lines.

Contour Line - The locus of all points of equal altitude.

Datum Plane - A level surface serving as a reference from which vertical distances are measured. Unless otherwise specified, all altitudes shall refer to Mean Sea Level, as determined by the 1929 General Adjustment. Additionally, the location of the regional MSL datum references must be identified when describing the reference datum plane (i.e., MSL,

Electronic Distance Meter (EDM) - An electronic transmitting and receiving device used to determine distance by measuring the signal travel time between the device and a distant reflecting prism.

Engineers Level - A precision engineering measurement device with a sighting telescope, capable of being leveled (manually or automatically), and used to measure surface altitudes.

Horizontal Plane - A plane tangent to a level surface and perpendicular to a vertical line at the point of tangency. Any line contained in this plane is a horizontal line.

Leveling - The process of determining the altitudes of points on or near the earth's surface or of establishing points at predetermined altitudes.

Leveling Accuracy - Order of accuracy for leveling is determined by comparing the two differences of altitude obtained by running levels in both directions over a line, and comparing the difference in feet against the following standard:

- First Order l.e. 0.017 x (M)
- Second Order l.e. 0.035 x (M)
- Third Order l.e. 0.05 x (M)
- Fourth Order 0.1 to 0.5 x (M)

Where M is the length of the line in miles, l.e. indicates less than or equal to, and g.t. indicates greater than.

Leveling Rod - A precisely graduated rod used in level surveys for transferring vertical measurements between points.

Level Net - A connected series of levels used to measure altitudes at intermediate stations. The net must begin and end at a known benchmark (the same benchmark in a closed net, or two different benchmarks in a linear net) so that level survey errors may be balanced throughout the net.

Licensed Surveyor - A person responsible for the performance of surveying operations, who is licensed by the state in which the site is located, to perform such surveying activities as a Registered or Licensed Surveyor.

Map Symbols - A series of graphical conventions drawn on a map to depict specific artificial and natural site features.

Meridian - Meridians are the mapped projections of great circles on the earth's surface meeting at the poles. For purposes of ordinary surveying, where relatively small areas are considered, meridians are treated as parallel straight lines that lie in a horizontal plane. Thus, meridians are nominally indicated on maps as reference lines in a north-south direction. Meridians passing through the earth's magnetic poles (determined by compass observations) are called Magnetic Meridians. Meridians which are established for convenience in preparing a map (a nominally selected north-south direction) are called Map, or Local Meridians. On maps, the northern directions of the applicable meridians are usually indicated by arrows pointing toward the top of the sheet, as True North, Magnetic North and Map North; any angular differences between these arrows is also indicated.

Monument - A permanent point of known horizontal coordinates used to locate various site features or locations with respect to the particular horizontal coordinate system. Monuments may be either reference monuments established by others (e.g., U.S. Coast & Geodetic Survey) and used by the Surveyor in establishing site-specific monument, or can be on-site or near-site monuments established directly by the Surveyor. The monument shall be clearly marked to indicate:

- The point on the monument having known coordinates (usually a cross permanently scribed or chiselled into the face of the monument).
- The coordinates of the monument and the coordinate system to which they refer.
- The name of the organization which installed the monument and its date of installation.

Monuments must be constructed and/or permanently installed in a manner to insure that they will remain undisturbed, accurate and readable, and be easily identifiable, throughout their service life. Typically, monuments consist of a bronze disk permanently fastened to bedrock or a substantial structure. Where such a massive base is not convenient and/or available, the monument disk may be installed in standard concrete monument bases (5" square top, 6" square bottom, 30" in length) firmly set in the ground. If judged appropriate by the Project Manager, permission may be granted to use stakes or iron pipes as monuments, though such monuments are not usually judged sufficient for permanent horizontal control for a site. Unless otherwise specified, all horizontal control coordinates will refer to the Plane Coordinate System for the state in which the site is located.

Photogrammetry - A method of measuring the earth's surface using stereo-paired aerial photos, in order to produce a topographic map.

Photomosaic Map - A scaled, but non-topographic map of an area created by assembling a series of adjoining aerial photographs.

Plane Table - A tripod-mounted drawing board capable of being leveled and revolved, used to construct topographic maps in the field.

Precision - The ability of a measurement to yield an exact repeatable value.

Range - Two vertical stakes or towers installed a short distance apart, so that when one is on the same line as the stakes, they appear to be colinear. Using two intersecting sets of ranges, one can determine the horizontal location of the point of intersection.

Recording Bathometer - An electronic transmitting and receiving device capable of continuously measuring and recording depth of surface water bodies, to produce continuous underwater bottom profiles.

Remote Sensing - The science of using aerial photographs to collect visible and/or invisible spectra to measure and/or study environmental or geologic surface features.

Scale - A measure of the correspondence between map distances and horizontal ground distances. Map scales are either in terms of linear measurement (i.e., 1" = 100'), or proportional (1:500,000).

Sounding Line - A weighted tape (sometimes called a lead line) used for measuring water depths.

Stadia - A range-finding method to determine distance by sighting a leveling rod through a stadia transit having two additional sighting stadia crosshairs, and computing the distance between the transit and the leveling rod using standard geometric relationships.

State Plane Coordinate System - An effort by Federal agencies in establishing triangulation throughout the country to tie together the various survey systems in use in the various states (i.e., cadastral, metes and bounds, township and district, etc.) to a common system. The states have adopted this effort and have expanded the system locally within each of their respective states. However, not all locations within a particular state are covered by the State Plane Coordinate System, i.e., the State has not expanded the system from the nearest monument established by the Federal Agencies for this purpose.

Stereo-Paired Aerial Photos - Two aerial photos of an area, each taken from a slightly different camera location, such that when viewed through an appropriate stereoscope a three-dimensional illusion of the area is seen.

Survey Party - A crew of specially trained people who perform field survey activities and related office calculations under the overall direction of a Licensed Surveyor.

Theodolite - A high precision transit capable of measuring vertical and horizontal angles to precision of 30 seconds or better.

Tide Staff - A vertical rod or board installed in a body of water, and graduated in altitude increment, so that one can measure the altitude of the water surface (i.e., tide level) over time.

Topographic Map - A map of an area, indicating all ground relief by contour lines, surface water bodies, and significant natural features or man-made facilities.

Transit - A precision engineering measurement device having a sighting telescope, used for measuring vertical and horizontal angles.

Traverse - A series of connected transit lines whose lengths and bearings are known. An open traverse forms a segmented line. Usually a traverse is closed to form a polygon, so that measurements may be balanced throughout the traverse survey. Traverses are used as reference baselines for performing other horizontal control surveying operations.

Traverse Accuracy - Order of accuracy for measured distances in a traverse are determined by evaluating the closure error in position of the traverse as a portion of the total traverse distance measured, against the following standards:

- First Order 1 in 25,000
- Second Order 1 in 10,000
- Third Order 1 in 5,000
- Fourth Order 1 in 1,500

Vertical Line - If the earth is assumed to be a perfect sphere, a vertical line at any point on the surface is the line (or its extension) to the center of the earth.

Vertical Plane - Any plane containing a vertical line is a vertical plane.

Witnessing - process of referencing an important survey point in the field by measuring distances from the point to nearby permanent or semi-permanent objects. This is an aid in locating the point, should it become hidden by vegetation or buried beneath the ground surface, or as a means for re-establishing the point should it be destroyed or disturbed. Property corners, horizontal control measurements, and other important transit stations, are usually witnessed.

Another common usage for witnessing is the flagging of survey points established in the field so that the general area may be readily seen and the point quickly found. This might be the case where a survey point established on a low stake is obscured by vegetation. The immediate vicinity of the stake would be identified by the use of bright paint or colored ribbon on a tall stake (driven next to the point) or applied on nearby trees, rocks or other local objects.

6.0 RESPONSIBILITIES

6.1 Surveyor

The Surveyor (Surveying Contractor) is responsible for assuring that all surveying field operations, office calculations, map preparation and related surveying activities conform with these guidelines and the specific requirements of the surveying subcontract (including health and safety requirements).

6.2 Project Manager

The Project Manager has overall responsibility for establishing the specific technical requirements for surveying services to establish site-specific benchmarks, baselines and monuments, and to coordinate and technically review the Surveying Contractor's performance of such services. Specific technical activities may be delegated to other project personnel (e.g., Field Operations Leader) who may have more detailed knowledge of these technical requirements and will be on-site to observe the technical execution of these activities by the Surveyor.

6.3 Subcontract Administrator

The Subcontract Administrator is responsible for the procurement of the Surveying Contractor's services and the administration of this subcontract. Technical and health and safety specifications detailing the scope of surveying services required will be developed and provided by the appropriate site project technical personnel (Project Manager or designee), using this Procedure and specific site information and/or requirements.

6.4 Field Operations Leader

The Field Operations Leader is responsible for day to day review of the actual field activities performed on-site by the Surveying Contractor (this may be delegated to an appropriate technical field person).

7.0 EQUIPMENT

Equipment to be furnished by the Surveying Contractor shall be of types which are appropriate for obtaining the results and accuracies specified for the particular site. Typical equipment will include an Electronic Distance Meter (EDM), a 20-second or better theodolite, a self-leveling level, a calibrated steel engineers tape (0.01 feet), taping pins, plumb bobs, range poles, leveling rod, hand level, etc. All measuring devices must be recently calibrated in accordance with the particular manufacturer's recommendations, and where appropriate, calibrated against a comparable National Bureau of Standards calibrated device. All equipment must be properly stored, handled and operated in a manner to avoid loss of calibration during the course of the work. Should any device lose its calibration it shall be immediately recalibrated and any questionable measurements previously made with that device shall be checked, repeated and/or corrected, as appropriate.

8.0 PROCEDURE

8.1 Accuracy and Precision Required

The required survey accuracy and precision depends on the intended purpose of the survey work. Such requirements could range from gross estimation of a sampling station for inclusion on a small-scale vicinity map to determination of monitoring wellheads to 0.01 feet to establish groundwater gradients. However, in general, no more than Third Order Accuracy would be required for sampling station location and altitude measurements.

Borings and Test Pits

Horizontal locations and ground surface altitudes for borings and test pits are graphically indicated on the Site Map, and boring/test pit logs respectively, and are used to construct geologic sections or profiles. Horizontal locations should be staked out to the nearest foot, and ground surface altitudes measured to 0.1 feet. The surveyors may stake the location in advance indicating the boring number, grid coordinates and ground surface altitude on the stake. They should also have one or more tall witness stakes with colored flagging around the staked location to make it more readily visible. In paved areas, it is usually more convenient to spray paint the location and other information directly on the paving. A greater degree of layout accuracy may be required in confined areas, where the drilling or excavation must be performed carefully to avoid disturbance to underground facilities (i.e., utilities, tunnels, foundations, etc.).

If the Field Operations Leader finds it necessary to relocate a staked-out location a short distance away, he/she should measure the bearing and distance of the relocation using a compass and tape, and note this in the site logbook. This will allow an accurate as-built location to be plotted on the final map. Similarly, the ground surface altitude of the relocated position may be measured, using a hand level, a folding rule, and the staked-out ground altitude as a reference.

If the borings/test pits are to be surveyed after completion, care should be taken to measure the original surface altitude as accurately as possible (e.g., a mound or depression may remain in the trench area). The location and outline of the trench/test pit must be adequately staked to permit the required surveying, and witness stakes or other markings (as described above) should be used to facilitate locating the trench.

Monitoring or Pumping Wells and Piezometers

In general, horizontal location and ground surface altitude criteria for wells and piezometers are similar to those of test pits or borings. However, the surveyor should measure and mark the altitude of the top of the inner casing (wellhead) to 0.01 feet as this point will be used as a reference to measure precise groundwater altitudes. The wellhead altitude should be noted, and also permanently recorded directly on the casing. The well location and ground surface altitude may be surveyed either before or after well installation, but the inner wellhead (top of casing) altitude must always be surveyed afterward.

Surface Water Sampling Locations

When grab samples are obtained form the edges of surface water bodies, the samplers should try to install a location stake at the shoreline marked with the station number, coordinates, and water surface altitude. In certain cases, this may not be required, since the sampler can estimate and mark the approximate location and altitude directly on a Site Topographic Map. Such locations do not require great location accuracy (within several feet), since they are usually only indicated graphically on the Site Map.

When samples are to be taken within the surface water body away from the shoreline, better horizontal control is usually required. Sampling locations are determined by the sampler using on-shore baselines or ranges.

Surface Soil/Waste Sampling Locations

Measurement and layout requirements for obtaining a single grab sample of soil or waste are comparable to those for obtaining surface water grab samples from the shoreline. Where a composited sample is to be collected from a sampling grid, the surveyors should stake out the grid, and indicate the station number(s), coordinates or orientation of the grid, and ground altitude(s) on the stakes. Generally, a precision of no better than the nearest foot for location, and 0.1 feet for altitude will suffice for grab or grid surface sampling.

Air Sampling Stations

Air sampling stations generally need no more layout precision than grab sampling (nearest foot horizontally and 0.1 feet vertically).

Other Sampling Locations

Some other sampling points can be located using methods and precisions similar to those described above. For example, biological sampling stations can be established with the same surveying methods and precision as for air, water or soil/waste grab sampling. For unusual or unique sampling methods, appropriate surveying requirements must be developed in consideration of the specific intentions and site conditions. For sampling man-made facilities such as drums, tanks and pipelines, it is usually most convenient if the sampler identify these locations at the time of sampling, directly on a topographic map of these facilities.

8.2 Field Methods

All survey observations and measurements shall be properly recorded by the Party Chief or Notekeeper in bound field books.

All field activities shall be conducted in an efficient and professional manner, with the minimum practical damage to the site environment. Thus, site clearing, tree removal, and similar impacts upon the existing site environment shall be limited to only that which is unavoidable to effectively perform the specified surveying tasks. Such site altering requirements must be identified to the Project Manager well in advance of such undertakings, assuring that questions relating to debris disposition, special equipment access and scheduling well be incorporated into the project-specific Work Plan and cost estimates developed for the site.

8.3 Office Analysis

All office analysis employed in the reduction of field data, calculations, production of maps, etc., shall follow commonly-accepted professional survey practices which are appropriate for the task at hand, including all appropriate procedures for quality control to check and review the work. Where a computer is used to reduce data, the program employed shall have first been verified to yield repeatable results within the required limits of accuracy. All office calculations, data reduction, map making, etc., shall be performed in a neat, sequential and logical order, and documented so that the work can be easily followed and reviewed in the future.

8.4 Site Authorizations and Requirements

Access to the site and any adjacent private properties for purposes of conducting survey activities will be arranged by the Field Operations Leader with assistance as required prior to the commencement of field work. No Surveying Contractor personnel are to enter onto any portion of the site without first obtaining clearance, or to enter upon any adjacent private property without informing the Project Manager or his on-site representative.

All on-site activities by the Surveying Contractor shall meet all applicable state and local regulations, and the Surveying Contractor must be licensed in that state to perform the work. The Surveying contractor shall be responsible for obtaining all necessary state and/or local permits necessary of the work.

All on-site surveying activities will be subject to the ongoing requirements of the Health and Safety Plan. Surveying contractor personnel must meet the requirements of the Health and Safety Plan, and when required by site conditions, follow the directions of the Health and Safety Officer or designee to protect personnel and/or the environment.

The Surveying Contractor shall make every effort to establish and/or maintain good relations with adjoining property owners and occupants. All field surveying personnel employed on-site should be made thoroughly cognizant of the importance and sensitivity to the entire program of both this aspect of the work and the successful completion of the Surveying

Contractor's particular assignment. Key surveying personnel should familiarize themselves with the Community Relations Plan for the site, if one has been prepared, and should notify the Field Operations Leader of any interactions with the community that occur during the course of the surveying efforts.

8.5 Reports and Documentation

The Surveying Contractor shall submit to the Project Manager, at the completion of each survey assignment, a report of what was involved in the activity, including personnel, manpower, survey approach used, and any technical evaluations that were made in the performance of the work.

The installed locations of all benchmarks, baselines and monuments shall be appropriately documented on a base map to indicated their relative locations with respect to each other, and with respect to other site features. Benchmarks will be described regarding their construction, location (on map), altitude and reference datum plane. Baselines will be indicated on the map and will show the bearing, length and coordinates and/or stationing of the ends of each baseline segment. Monuments will also be described regarding their construction, location (on map) in addition to their grid coordinated.

Final maps will be submitted as an original or mylar reproducible, in one of four standard sizes (as specified in the subcontract), namely; 8-1/2" x 13", 30" x 42", 24" x 36", or 15" x 21". If one sheet is not sufficient, the mapped area may be divided into sections, one per sheet, and appropriate references and match lines provided. Maps shall be of a suitable scale to show appropriate detail clearly. Although this varies with the size of the site mapped, appropriate map scales generally range form 1"=50' to 1"=200'. The scale utilized will be clearly shown on the map. Each map will also indicated a true north meridian, preferably oriented toward the top of the page, and will be provided with appropriate borders, title boxes, notes, data references and means of identifying author, checker, etc.

All survey field data (measurements, comments, observations and sketches) will be permanently recorded in numbered, bound field books. Entries shall be neat and of sufficient size to be legible, and each group of data or page shall be signed and indicate the full names of field crew personnel, instrument number, weather conditions, data and other appropriate entries to identify the data sources. Original completed field books shall be stored appropriately in a safe place in the Surveying Contractor's offices, as justification for derived survey outputs.

Any calibrations performed upon surveying equipment in connection with this work shall be properly documented with regard to personnel, date, instrument number, calibration reading, procedures and standards employed, adjustments made, comments and/or observations, etc. Such documentation of calibration activities shall be properly filed, and a copy provided to the Project Manager upon request.

8.6 Certification

All surveying operations shall be performed under the direction of a Licensed (or Registered) Land Surveyor (licensed in that particular state), who shall sign and seal all final drawings, maps and reports submitted for this assignment.

9.0 ATTACHMENTS

9.1 Planning Checklist

PLANNING CHECKLIST

Utilizing the information provided in this procedure and/or references, the following listing is provided as a general checklist to be used in planning Survey subcontracts:

- Approximate Location and limits of site (provide a marked-up USGS Quad map or other existing survey).
- Approximate locations and orientations of baselines (indicate on map).
- Number and appropriate locations of benchmarks and monuments (indicate on map).
- Construction/installation details for benchmarks, monuments and witness points.
- Reference datum plane and grid system to be used.
- Locations of nearest reference benchmarks and monuments (if known).
- Required orders of accuracy and degrees of precision for horizontal and vertical survey control.
- Preferred instrument types, survey techniques, data recording and reduction methods.
- Maps and blueprints required (size, scale, number details, etc.)
- Calibration and certification requirements.
- Reports required.
- Site access requirements.
- Permit requirements.
- Community relations requirements.
- Project authorities and responsibilities.
- Time requirements for performing the work.
- Field manpower requirements for performing the work.
- Data storage requirements.
- Health and Safety requirements.
- QA requirements.
- Technical references and/or procedures which may apply to this work.

FIELD PROCEDURE FP 1-4
SURVEYING

The following are specific amendments to the referenced SOP. The amended portions of the SOP are marked and correspond to the comments listed below.

None.

FIELD PROCEDURE FP 2-1

OPERATION AND CALIBRATION OF MSA MODEL 261 COMBUSTIBLE GAS INDICATOR

Subject	Procedure No. FP 2-1	Rev. 0	Page 1 of 4
OPERATION AND CALIBRATION OF MSA MODEL 261 COMBUSTIBLE GAS INDICATOR	Issue Date 05/25/90		Effective Date 07/02/90
	Supersedes Procedure Number 630 FP 25	Rev. 0	Date
Acceptance - Program QA	Approval - Program Manager		

1.0 PURPOSE

The purpose of this procedure is to define the steps necessary for calibration, operation and maintenance of the Mine Safety Appliances (MSA) Model 261 combustible gas indicator.

2.0 SCOPE

2.1 This procedure applies to the calibration, operation and maintenance of the MSA Model 261 combustible gas indicator during a field investigation.

2.2 This procedure may also be used in conjunction with the manufacturer's instructions for other combustible gas indicators.

3.0 REQUIREMENTS

Measurement of combustible gases is an important and necessary requirement during field investigations for the health and safety of workers. Detection of combustible gases during field investigations is also a precursor of the presence of contaminants at the site.

4.0 REFERENCES

Mine Safety Appliances Model 261 Combustible Gas Indicator Instruction Manual.

5.0 DEFINITIONS

None.

6.0 RESPONSIBILITIES

The Field Operations Leader is responsible for ensuring that the necessary equipment is available for the calibration, use and maintenance of the measuring equipment. The Field Operations Leader is also responsible for ensuring that the calibration and methodology is consistent and that workers have been instructed in the proper use of equipment.

7.0 EQUIPMENT

7.1 MSA Model 261 Combustible Gas Indicator with appropriate sample lines.

7.2 MSA calibration test system.

7.3 Battery charger

7.4 Screwdriver.

8.0 PROCEDURE

The procedure for calibration prior to daily use, operation, and maintenance of the MSA Model 261 combustible gas indcator is outlined below. Calibration frequencies other than prior to daily use should be specified in the project-specific work plan. If using a different instrument, the owner's manual should be consulted for instructions.

8.1 Calibration

1. Open the instrument lid and turn the center ON-OFF control to HORN OFF position. Both meter pointers will move and one or both alarms may light.

2. The % LEL meter pointer should be set to zero by lifting and adjusting the ZERO LEL control knob. Adjustment should be made within 30 seconds after instrument is turned on to prevent accidental activation of the meter latch circuit.

3. The % OXYGEN meter pointer should be set to 20.8% by lifting and adjusting the CALIBRATE O_2 control knob.

4. Press the ALARM RESET button; the alarm(s) should reset and the green pilot light should flash.

5. Place a finger over the sample inlet fitting or the end of the sample line probe. Observe the flow indicator float. If the float drops out of sight indicating no flow, the system has a good seal. If the float does not drop, check the system for leaks.

6. Press the CHECK Button and observe the % LEL meter. The pointer must read 80% LEL or higher as marked by the BATTERY zone on the meter. If the pointer reading is less, the battery pack must be recharged; no test should be attempted as the instrument will malfunction.

7. Turn the ON-OFF control knob to the ON position. The pilot lamp should light continuously.

8. Attach one end of the sampling lines to the unit and the other to the recommended calibration gas (i.e. MSA, PENTANE: 0.75% {by volume} in air, 50% LEL).

9. Open the calibration gas flow control valve.

10. After approximately 15 seconds, the LEL meter pointer should be stable and within the range specified for the calibration gas. If the meter point is not in the correct range, stop the gas flow and remove the right hand side (speaker) panel. Turn on the flow and adjust the "5" control with a small screwdriver to obtain the reading specified for the particular calibration gas.

11. Shut off the gas flow; remove the sampling line from the gas control valve; replace the side panel.

8.2 Operation

1. Open the instrument lid and turn the center ON-OFF control to HORN OFF position. Both meter points will move and one or both alarms may light.

2. The % LEL meter point should be set to zero by lifting and adjusting the ZERO LEL control knob. Adjustment should be made within 30 seconds after instrument is turned on to prevent accidental activation of the meter latch circuit.

3. The % OXYGEN meter pointer should be set to 20.8% by lifting and adjusting the CALIBRATION O_2 control knob.

4. Press the ALARM RESET button. The alarm(s) should reset and the green pilot light should flash.

5. Place a finger over the sample inlet fitting or the end of the sample line probe. Observe the flow indicator float. If the float drops out of sight indicating no flow, the system has a good seal. If the float does not drop, check the system for leaks.

6. Press the CHECK button and observe the % LEL meter. The pointer must read 80% LEL or higher as marked by the BATTERY zone on the meter. If the pointer reading is less the battery pack must be recharged, no test should be attempted as the instrument will malfunction.

7. Turn the ON-OFF control knob to the ON position. The pilot lamp should light continuously.

8. Accessory equipment such as sampling lines, robes, carrying harness, filters or line traps should be attached as required. Tighten all connections and test for flow indication as described above (see Step 5, above).

9. The MSA Model 261 is now ready for atmospheric sampling.

8.3 Preventive Maintenance

After daily use of the MSA combustible gas indicator for field investigations, the unit shall be inspected for cleanliness and cleaned with soap and water as necessary.

Sampling inlet lines shall be examined for cracks, tears and blockage and repaired or replaced.

The battery shall be recharged after daily use as a low battery will cause the unit to malfunction.

9.0 ATTACHMENTS

None.

AMENDMENTS TO:

FIELD PROCEDURE FP 2-1
OPERATION AND CALIBRATION OF MSA MODEL 261
COMBUSTIBLE GAS INDICATOR

The following are specific amendments to the referenced SOP. The amended portions of the SOP are marked and correspond to the numbered items listed below.

1. The work to be performed during this project will not require the use of a combustible gas indicator. Photoionization and flame ionization detectors will be used during field activities. If conditions warrant, however, a combustible gas indicator will be used during the field activities and the SOP will be a source of guidance for its use.

FIELD PROCEDURE FP 2-2

OPERATION AND CALIBRATION OF HNU MODEL PI-101 PHOTOIONIZATION DETECTOR

Subject	Procedure No. FP 2-2 · Rev. 0 · Page 1 of 4
	Issue Date 05/25/90 · Effective Date 07/02/90
OPERATION AND CALIBRATION OF HNu MODEL PI-101 PHOTOIONIZATION DETECTOR	Supersedes Procedure Number 630 FP 26 · Rev. · Date
Acceptance - Program QA	Approval - Program Manager

1.0 PURPOSE

The purpose of this procedure is to define the steps necessary for calibration, operation and maintenance of the HNu Model PI-101 photoionization detector (PID).

2.0 SCOPE

2.1 This procedure applies to the calibration, operation and maintenance of the HNu Model PI-101 photoionization detector (PID) during a field investigation.

2.2 This procedure may also be used, in conjunction with the manufacturer's instruction, for other photoionization detectors.

3.0 REQUIREMENTS

Measurement of organic vapors is an important and necessary requirement during field investigations for the health and safety of workers. Detection of organic vapors during field investigations may also be a precursor of the presence of contaminants at the site.

4.0 REFERENCES

4.1 HNu Model PI-101 Instruction Manual.

5.0 DEFINITIONS

None.

6.0 RESPONSIBILITIES

The Field Operations Leader is responsible for ensuring that the necessary equipment is available for calibration and maintenance. The Field Operations Leader should also ensure that the calibration methodology is consistent and that workers have been instructed in the proper use of equipment.

7.0 EQUIPMENT

7.1 HNU Model PI-101 photoionization detector with appropriate probe assembly lamp (10.2 eV or 11.7 eV).

7.2 Calibration test system.

7.3 Battery charger.

7.4 Screwdriver.

8.0 PROCEDURE

The procedure for calibration prior to use, operation, and maintenance of the HNu PI-101 PID is outlined below. Calibration frequencies other than prior to daily use shall be specified in the project-specific work plan. If using a different instrument, the owner's manual should be consulted for instructions.

8.1 Calibration

1. Before attaching the probe to the readout module, ensure that the function switch on the control panel is in the "OFF" position.

2. Attach the probe to the meter by plugging the 12-pin plug into the socket on the readout module and rotating in to the lock position.

3. Turn the 6-position function switch to the "BATTERY CHECK" position. The meter needle should read within or above the green battery area on the scale. If it does not, or if the red indicator light, located near the function switch, comes on, the battery requires charging.

4. Turn the function switch to any range setting and glance briefly into the end of the probe to see if the ultraviolet light is emitting a purple glow. Avoid prolonged exposure to UV light; it may cause eye damage.

5. Set the function switch to the "STANDBY" position and rotate the "ZERO" knob until the meter reads zero.

6. Connect one side of a "T" adaptor to a pressurized container of calibration gas equipped with a flow control valve, the second side of the "T" directly to the 8-inch extension tube on the photoionization probe, and the third side to a flow indicator or meter, or vent it directly to the air.

7. Open the valve of the pressurized container until a slight flow is indicated on the flow meter. The instrument draws in the volume of sample required for detection, and the flow on the flow meter indicates an excess of sample.

8. Adjust the meter span pot knob so that the instrument is reading the exact value of the calibration gas. (If the instrument span setting is changed, the instrument switch should be turned back to the "STANDBY" position and the electronic "ZERO" should be readjusted as necessary.)

The calibration gas should be prepared in the same gas matrix (air, nitrogen, hydrogen, etc.) being measured, otherwise an inaccurate reading may be obtained. Calibration with toxic gases should be performed in a hood, since the photoionization detector is a nondestructive analyzer. The increased response that is seen in oxygen-free gases can be attributed to a reduction in the quenching effect of ions by oxygen and is typical of any PID. The quenching effect of oxygen is constant from about 10 percent O_2 to very high levels. (1)

If a gas standard prepared in nitrogen is used for measurements in air, then fill a 0.5- to 1.0-liter bag with the standard. Then add 50 or 100 cc of pure oxygen to bring the level up to 10 to 12 percent. Any error between this value and 20 percent oxygen is quite small. The probe on the photoionization detector is inserted into the neck of the sealed bag and the instrument is calibrated as discussed above.

8.2 Operations

1. Before attaching the probe to the readout module, ensure that the function switch on the control panel is in the "OFF' position.

2. Attach the probe to the meter by plugging the 12-pin plug into the socket on the readout module. Rotate the plug until it is locked into position. Attach the 6-inch metal extension tube to the probe handle by screwing it into its socket.

3. Turn the 6-position function switch to the "BATTERY CHECK" position. The meter needle should read within or above the green battery on the scale. If it does not, or if the red indicator light located near the function switch comes on, the battery requires charging.

4. Turn the function switch to any range setting and glance into the end of the probe briefly to see if the ultraviolet light is emitting a purple glow. Avoid prolonged explosure to UV light; it may cause eye damage. Note than an HNu can be quickly checked for operability by holding a felt tip pen adjacent to the probe. This should induce a response in the deflection needle.

5. Set the function switch to the "STANDBY" position and rotate the "ZERO" knob until the meter reads zero.

6. Switch the function switch to the proper measurement range. (The instrument is calibrated to measure 0-20, 0-200, and 0-2,000 parts per million {ppm} benzene in air with the span position set at 9.8.) For additional sensitivity, the span potentiometer can be turned counterclockwise (smaller numbers) to increase the gain. By changing the span setting from 10.0 to 1.0, the sensitivity is increased ten-fold. The 0-20, 0-200, and 0-2,000 ppm scales become 0-2, 0-20, and 0-200 ppm, respectively.

7. Insert the end of the probe into the atmosphere to be measured and read

the organic vapor concentration in ppm directly from the meter. (A small fan is used to draw the vapor past the photoionization sensor. While sampling, use caution not to block the inlet of the probe. If the extension of the probe has been accidently obstructed, the instrument readings or the response time will increase.)

8.3 Preventive Maintenance

After daily use of the HNu PID for field investigations, the unit shall be inspected for cleanliness and cleaned with soap and water as necessary.

The battery should be recharged after daily use because a low battery will cause the unit to malfunction. Note that the lamp must be attached in order to charge the unit.

9.0 ATTACHMENTS

None.

AMENDMENTS TO:

FIELD PROCEDURE FP 2-2
OPERATION AND CALIBRATION OF HNU MODEL PI-101
PHOTOIONIZATION DETECTOR

The following are specific amendments to the referenced SOP. The amended portions of the SOP are marked and correspond to the comments listed below.

1. A manufacturer prepared 100 part per million isobutylene calibration gas will be used to calibrate the HNU.

FIELD PROCEDURE FP 2-3

OPERATION AND CALIBRATION OF FOXBORO OVA MONITOR

Subject	Procedure No. FP 2-3	Rev. 0	Page 1 of 3
OPERATION AND CALIBRATION OF FOXBORO OVA MONITOR	Issue Date 05/25/90		Effective Date 07/02/90
	Supersedes Procedure Number 630 FP 27	Rev. 0	Date
Acceptance - Program QA	Approval - Program Manager		

1.0 PURPOSE

The purpose of this procedure is to outline the steps necessary for calibration, operation and maintenance of the Foxboro Organic Vapor Analyzer (OVA).

2.0 SCOPE

2.1 This procedure applies to the calibration, operation and maintenance of the Foxboro Organic Vapor Analyzer.

2.2 This procedure may also be used in conjunction with the manufacturer's instruction for other organic vapor analyzers.

3.0 REQUIREMENTS

Employee exposure to inhalation of organic vapors can be monitored during the site activities via organic vapor measurements using an organic vapor analyzer (in conjunction with a photoionization detector and/or a combustible gas indicator).

A Century Systems Model OVA-128 Organic Vapor Analyzer or an HNU Model PI-101 Total Organic Vapor Analyzer (Reference FP 2-2) will generally be used to monitor organic vapors in the air on investigation sites, and vapors being emitted from boreholes, wells, as well as soil, rock and water samples.

4.0 REFERENCES

Foxboro Century Systems OVA-128 Organic Vapor Analyzer Instruction Manual.

5.0 DEFINITIONS

None

6.0 RESPONSIBILITIES

The Field Operations Leader is responsible to ensure that the necessary equipment is available for the calibration, use and maintenance of the measuring equipment. The Field Operations Leader is also responsible to ensure that the calibration and methodology is consistent and that workers have been instructed in the proper use of equipment.

7.0 EQUIPMENT

7.1 Foxboro Century Systems Model OVA-128 Portable Organic Vapor Analyzer

The OVA-128 is a very commonly used, highly sensitive instrument designed to measure trace quantities of organic materials in the air. It is essentially a hydrogen flame ionization detector used for volatile organic compounds with a sensitivity to analyze in the ppm range in air in the presence of moisture, nitrogen oxides, carbon monoxide, and carbon dioxide. The instrument consists of two major assemblies: The Probe/Readout Assembly and the Side Pack Assembly. The instrument is also equipped with two options: a recorder and a gas chromatograph.

7.2 Probe/Readout Assembly

7.3 Battery Recharging Unit

7.4 Strip Chart Recorder

7.5 Refilling Adaptor Fitting

8.0 PROCEDURE

The procedure for calibration prior to daily use, operation, and maintenance of the Foxboro OVA Monitor is outlined below. Calibration frequencies other than prior to daily use shall be specified in the project-specific work plan. The owner's manual should be consulted for detailed instructions.

8.1 Calibration

The Century Systems OVA-128 Portable Organic Vapor Analyzer is calibrated, after following the proper procedure to turn the instrument on, by setting the "CALIBRATE" switch to X1 and adjusting the meter to read 1 ppm using the "CALIBRATE ADJUST" (zero) knob. The meter is now ready for use.

8.2 Operation

The operation of the OVA-128 is described in detail in the Instruction and Service Manual provided with the instrument and should be studied before use and utilized during operations. A summary of operation is also mounted on the inside corner of the instrument. Proper operation of the instrument can be ensured by occasionally examining the response in the deflection of the needle when a volatile (odorous) felt pen is held adjacent to the probe; this will also be an indication to the user whether the flame is still burning.

8.3 Preventive Maintenance

The analyzer must be kept clean for accurate operation. Foreign materials can be rinsed off or blown out of the detector. The internal battery should be fully charged before going into the field every one to four days. The charging interval depends on use, and a battery check indicator on the instrument should be examined routinely. The cord between the analyzer and the recorder should be inspected for visible evidence of damage and replaced if required. All other maintenance should be performed at an authorized service center. Hydrogen should be refilled at a specialist gas or welding shop.

9.0 ATTACHMENTS

None

AMENDMENTS TO:

FIELD PROCEDURE FP 2-3
OPERATION AND CALIBRATION OF FOXBORO OVA MONITOR

The following are specific amendments to the referenced SOP. The amended portions of the SOP are marked and correspond to the comments listed below.

None.

FIELD PROCEDURE FP 3-1

DECONTAMINATION OF SAMPLING EQUIPMENT

Subject	Procedure No. FP 3-1	Rev. 1	Page 1 of 6
	Issue Date 07/31/90		Effective Date 08/06/90
DECONTAMINATION OF SAMPLING EQUIPMENT	Supersedes Procedure Number 630 FP 11	Rev.	Date
Acceptance - Program QA	Approval - Program Manager		

1.0 PURPOSE

The purpose of this procedure is to provide reference information on the proper decontamination of sampling equipment used to perform field investigations.

2.0 SCOPE

This procedure addresses decontamination of sampling equipment and should be consulted when equipment decontamination procedures are being developed as part of project-specific plans. Personnel decontamination guidelines are presented in the project-specific Health and Safety Plan. Decontamination of monitoring well construction materials is described in Field Procedure FP 3-2, and decontamination of hand tools and drilling equipment is described in Field Procedure FP 3-3.

3.0 REQUIREMENTS

To ensure that chemical analysis results are reflective of the actual concentrations present at sampling locations, equipment used in sampling activities must be properly cleaned and decontaminated. This will minimize the potential for cross-contamination between sampling locations, and the transfer of contamination off-site.

4.0 REFERENCES

4.1 HAZWRAP, February 1989, *Quality Control Requirements for Field Methods*, DOE/HWP-69.

4.2 United States Environmental Protection Agency. *A Compendium of Superfund Field Operations Methods*, EPA/540/P-87/001, December 1987.

4.3 United States Environmental Protection Agency. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, EPA SW-846, Third Edition, November 1986.

5.0 DEFINITIONS

Negative Contamination - Occurs when the measured concentration of the analyte is artificially low as a result of volatilization, adsorption and related losses.

Positive Contamination - Occurs when the measured concentration of the analyte is artificially high due to leaching or the introduction of foreign matter into the sample.

Cross-Contamination - A type of positive contamination caused by the introduction of part of one sample with a second sample during sampling or storage.

Detergent - Shall be a standard brand of non-phosphate laboratory grade detergent such as Alconox or Liquinox.

Acid Solution - A combination of reagent-grade acid and deionized water.

Solvent - Shall be pesticide-grade solvent.

Tap or Potable Water - Shall be water from a municipal water treatment system.

Deionized Water - Volatile-free, ion-free, and organic-free water produced on-site from a deionization chamber equipped with carbon filters.

6.0 RESPONSIBILITIES

6.1 Project Manager

The Project Manager is responsible for ensuring that decontamination procedures for all chemical sampling and field analytical equipment are programmed prior to the actual field effort and that personnel required to accomplish the task have been briefed and trained to execute the task.

6.2 Field Operations Leader

The Field Operations Leader is responsible for ensuring that project-specific plans and the implementation of field investigations are in compliance with this procedure.

7.0 EQUIPMENT

7.1 Disposable gloves

7.2 Laboratory-grade non-phosphate detergent

7.3 Tap water

7.4 Ten percent nitric acid solution (1)

7.5 Deionized volatile-free water

7.6 Aluminum foil

7.7 Pesticide-grade methanol

7.8 Pesticide-grade Hexane

7.9 Scrub brushes

7.10 Five to 10 gallon stainless steel or plastic buckets

8.0 PROCEDURE

8.1 Decontamination

Prior to the collection of samples, the equipment used to collect water, soil, sediment and other samples will be decontaminated by one of the following methods.

Method 1

Decontamination procedure for equipment used to collect metal samples only:

- Wash and scrub with laboratory-grade non-phosphate detergent.
- Rinse several times with tap water.
- Rinse plastic or Teflon-coated equipment with 10% nitric acid; rinse stainless steel equipment with 1% hydrochloric acid.
- Rinse twice with deionized analyte-free water.
- Air dry.
- Wrap in aluminum foil (shiny side out) or polyethylene sheeting.

Method 2

Decontamination procedure for equipment used to collect organic samples only:

- Wash and scrub with laboratory grade non-phosphate detergent.
- Rinse several times with tap water.
- Rinse with deionized analyte-free water.
- Rinse with pesticide-grade methanol.
- If total petroleum hydrocarbons, oil & grease, or PCBs are analytes, rinse with pesticide-grade hexane. (2)
- Air dry.
- Check with HNu or OVA for complete removal of solvents.
- Wrap in aluminum foil (shiny side out).

Method 3

Decontamination procedure for equipment used to collect samples for both organics and metals analyses:

- Wash and scrub with laboratory-grade non-phosphate detergent.
- Rinse several times with tap water.

- Rinse plastic or Teflon-coated equipment with 10% nitric acid; rinse stainless steel equipment with 1% hydrochloric acid.
- Rinse with deionized analyte-free water.
- Rinse with pesticide-grade methanol.
- If total petroleum hydrocarbons, oil & grease, or PCBs are analytes, rinse with pesticide-grade hexane. ②
- Air dry.
- Check with HNU or OVA for complete removal of solvents.
- Rinse twice with deionized analyte-free water.
- Wrap in aluminum foil (shiny side out).

NOTE 1: Sampling Equipment Decontamination Procedures. Sampling equipment, other than down-hole sampling equipment, will be cleaned once a day in a batch so that the final rinsate may be collected for a field equipment blank. After cleaning, field equipment may be placed temporarily on polyethylene sheeting, but ultimately will be wrapped in aluminum foil. Care will be taken when choosing the site of the staging area to avoid fugitive dust, fuel, oils, gasoline, organic solvents, or any potential airborne source of contamination. If new equipment, such as drill bits and spoons, has been painted at the factory, this paint will be removed before use.

Down-hole sampling equipment may be decontaminated on-site during drilling activities. The sampling method used will determine where this sampling equipment will be decontaminated.

NOTE 2: Disposal of all wastes generated during the field activities is described in the project-specific Work Plan.

8.2 Requirements and Limitations

Bailers and Bailing Line

The potential for cross contamination between sampling points via the use of a common bailer, or its attached line, is high unless strict procedures for decontamination are followed. It is recommended that one bailer and its associated line be used for each sample point. Braided nylon or polypropylene lines may be used with a bailer and will be discarded after each use. Before the initial sampling and after each succeeding sampling point, the bailer must be decontaminated using procedures outlined for sampling equipment. This procedure does not eliminate the need for decontamination of dedicated bailers.

In addition to these cleaning procedures, the following line and bailer handling procedures are required. Prior to transport, the bailer and bailing line should be wrapped in aluminum foil or polyethylene sheeting. At the site, while the sample(s) is being obtained, care should be taken to prevent the bailer, line, and any other down-hole tubing or pumps from contact with the ground surface.

Sampling Pumps

Most sampling pumps are normally low volume (less than two gpm) pumps. These include peristaltic, diaphragm, air-lift, pitcher and bladder pumps. If these pumps are used for sampling from more than one sampling point, they must be decontaminated between samples. (3)

The procedures to be used for decontamination of sampling pumps are generally the same as those described in Method 2. Each of the liquid fractions is to be pumped through the system. The amount of pumping is dependent upon the size of the pump and the length of the intake and discharge hoses.

Filtering Equipment

One aspect of the sampling plan may involve the filtering of ground-water samples and subsequent preservation. This should occur as soon after sample retrieval as possible; preferably in the field as soon as the sample is obtained. Three basic filtration systems are most commonly used: the in-line disposal filter, the inert gas over-pressure filtration system, and the vacuum filtration system.

For the in-line filter, decontamination is not required since the filter cartridge is disposable; however, the cartridge must be disposed of in an approved receptacle, and the intake and discharge lines must still be decontaminated.

For the over-pressure and vacuum filtration systems, the portions of the apparatus which come in contact with the sample must be decontaminated as described above.

Water Level Indicators

Water level indicators that consist of a probe that contacts with the ground water must be decontaminated using the following steps:

1. Rinse with deionized volatile-free water.
2. Pesticide-grade methanol rinse followed by a pesticide-grade hexane rinse if oils, greases or PCBs are present. (4)
3. Check with HNu or OVA for complete removal of solvents.
4. Wrap tip in aluminum foil (shiny-side out) for transport.

Probes

Probes (e.g., pH or specific ion electrodes, geophysical probes, or thermometers) that come in direct contact with the sample, will be decontaminated using the procedures specified above unless manufacturers' instructions indicate otherwise; in those cases, the method of decontamination must be clearly described in the project-specific Work Plan. For probes which make no direct contact (e.g., OVA equipment) the probe will be wiped with a clean paper-towel or cloth wetted with methanol.

8.3 Quality Control Procedures for Decontamination

The effectiveness of field cleaning procedures shall be monitored by following Quality Assurance - Quality Control procedures outlined in the project-specific Work Plan.

9.0 ATTACHMENTS

None.

AMENDMENTS TO:

FIELD PROCEDURE FP 3-1
DECONTAMINATION OF SAMPLING EQUIPMENT

The following are specific amendments to the referenced SOP. The amended portions of the SOP are marked and correspond to the comments listed below.

1. Ten percent nitric acid or ten percent hydrochloric acid.

2. A pesticide-grade methanol rinse, followed by a pesticide-grade hexane rinse followed by a deionized water rinse.

3. Most sampling pumps are normally low volume pumps. These include peristaltic, diaphragm, and bladder pumps. If these pumps are used for purging from more than one sampling point, they must be decontaminated between sampling stations. Pumps will only be used for purging wells prior to sampling and therefore will only be decontaminated by rinsing the outside and passing deionized water through the equipment. Following decontamination, a field rinsate blank sample will be collected. If a floating layer is encountered in a monitoring well, the site coordinator will be notified and the pumping equipment will be rinsed with methanol to remove the floating-layer residue before the deionized water rinse.

4. Pesticide-grade methanol rinse followed by a deionized water rinse.

FIELD PROCEDURE FP 3-2

DECONTAMINATION OF MONITORING WELL CONSTRUCTION MATERIAL

Subject	Procedure No. FP 3-2 · Rev. 0 · Page 1 of 4
	Issue Date 05/25/90 · Effective Date 07/02/90
DECONTAMINATION OF MONITORING WELL CONSTRUCTION MATERIAL	Supersedes Procedure Number 630 FP 19 · Rev. 0 · Date
Acceptance - Program QA	Approval - Program Manager

1.0 PURPOSE

The purpose of this procedure is to provide reference information on the proper decontamination of monitoring well construction materials used in performing field investigations.

2.0 SCOPE

This procedure addresses decontamination of monitoring well construction materials only, and should be consulted when equipment decontamination procedures are being developed as part of project-specific work plans. Personal decontamination guidelines are present in the project-specific Health and Safety Plan. Decontamination of sampling equipment is described in Field Procedure FP 3-1 and decontamination of hand tools and drilling equipment is described in Field Procedure FP 3-3.

3.0 REQUIREMENTS

To ensure that chemical analysis results are reflective of the actual concentrations present at sampling locations, monitoring well construction materials involved in sampling activities must be properly cleaned and decontaminated. This will minimize the potential for cross-contamination between sampling locations, and the transfer of contamination off-site.

4.0 REFERENCES

4.1 HAZWRAP, February 1989, *Quality Control Requirements for Field Methods*, DOE/HWP-69.

4.2 United States Environmental Protection Agency. *A Compendium of Superfund Field Operations Methods*, EPA/540/P-87/001, December 1987.

4.3 United States Environmental Protection Agency. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, EPA SW-846, Third Edition, November 1986.

5.0 DEFINITIONS

Negative Contamination - Occurs when the measured concentration of the analyte is artificially reduced as a result of volatilization, adsorption and related losses.

Positive Contamination - Occurs when the measured concentration of the analyte is artificially high due to leaching or the introduction of foreign matter into the sample.

Cross Contamination - A type of positive contamination caused by the introduction of part of one sample with a second sample during sampling or storage.

Detergent - Shall be a standard brand of non-phosphate laboratory-grade detergent such as Alconox or Liquinox.

Acid Solution - Shall be made from reagent-grade acid and deionized volatile-free water.

Solvent - Shall be pesticide-grade solvent.

Tap or Potable Water - Shall be water from a municipal water treatment system.

6.0 RESPONSIBILITIES

6.1 Project Manager

The Project Manager is responsible for ensuring that decontamination procedures for all chemical sampling and field analytical equipment are programmed prior to the actual field effort and that personnel required to accomplish the task have been briefed and trained to execute the task.

6.2 Field Operations Leader

The Field Operations Leader is responsible for ensuring that project-specific plans and the implementation of field investigations are in compliance with this procedure.

7.0 EQUIPMENT

1. Portable high-pressure steam or hot water generator
2. Insulated gloves
3. Laboratory-grade, non-phosphate detergent
4. Tap water
5. ASTM type II water
6. Sheet plastic
7. Pesticide-grade methanol
8. Scrub brushes
9. Five- to 10-gallon bucket

8.0 PROCEDURE

8.1 Construction Materials Decontamination

Prior to drilling, monitoring well construction materials will be decontaminated at a designated area. The cleaning area will be designed to contain decontamination wastes and waste waters, and can be a lined excavated pit or a bermed concrete or asphalt pad. For the latter, a floor drain must be provided that is connected to a holding tank. A shallow, above-surface tank may be used, or a pumping system with discharge to a waste tank may be installed.

At certain sites, due to the type of contaminants or proximity to residences, concerns may exist about air emissions from steam cleaning operations. These concerns can be alleviated by utilizing one or more of the following practices:

- Locate the steam cleaning area on-site to minimize potential impacts.
- Enclose steam cleaning operations.

The location of the steam cleaning area will be identified in the project-specific Work Plan.

Well casings and screens shall be cleaned in the field prior to use or shall be delivered to the site previously decontaminated with accompanying written certification by the factory or manufacturer attesting to decontamination procedures. Factory rinsate test results for parameters selected for each site shall be included. Field rinsate may be tested by field screening methods if available at the site. Critical contamination levels shall be determined prior to field work by the Project Manager and stated in the project-specific Work Plan. (1)

Concentraticn levels above those previously determined as critical levels will require field steam cleaning of casings and screens. Analyses to be conducted, acceptable concentration levels for rinsates and specific rinsate sampling procedures shall be described in the project-specific Work Plan for each site.

8.2 Additional Cleaning Method

If critical levels are still not met, the following methods shall be utilized.

1. Wash and scrub with detergent (low phosphate if P is an analyte).
2. Tap water rinse.
3. Rinse with 10 percent nitric acid for PVC casing or a 1 percent HCL acid if stainless steel casing is used.
4. Tap water rinse.

5. Rinse with a methanol followed by hexane if oils, greases or PCBs are analytes. ②

6. Deionized water rinse (demonstrated analyte free).

7. Allow to air dry.

8. Wrap in aluminum foil, shine side out, for transport.

If metals are not analytes, Steps "3" and "4" may be omitted. If organics are not being sampled, Step "5" may be omitted. Solvents must be specified as pesticide grade or better. Preferably, all decontamination of equipment should be performed prior to going into the field. If this is not possible, equipment must be cleaned and decontaminated not less than six hours before installation.

9.0 ATTACHMENTS

None.

AMENDMENTS TO:

FIELD PROCEDURE FP 3-2
DECONTAMINATION OF MONITORING WELL CONSTRUCTION MATERIAL

The following are specific amendments to the referenced SOP. The amended portions of the SOP are marked and correspond to the comments listed below.

1. Well casings and screens shall be cleaned in the field prior to use or shall be delivered to the site previously decontaminated. The manufacturer decontaminated materials will be accompanied by a certificate attesting to the decontamination procedures.

2. 5. Deionized water rinse.
   6. Allow materials to air dry.
   7. Wrap materials in polypropylene sheeting.
   8. Delete.

FIELD PROCEDURE FP 3-3

DECONTAMINATION OF HAND TOOLS AND DRILLING EQUIPMENT

Subject	Procedure No. FP 3-3	Rev. 0	Page 1 of 4
DECONTAMINATION OF HAND TOOLS AND DRILLING EQUIPMENT	Issue Date 05/25/90		Effective Date 07/02/90
	Supersedes Procedure Number 630 FP 20	Rev. 0	Date
Acceptance - Program QA	Approval - Program Manager		

1.0 PURPOSE

The purpose of this procedure is to provide reference information on the proper decontamination of drilling equipment and hand tools used in the conduct of field investigations.

2.0 SCOPE

This procedure addresses decontamination of drilling equipment and hand tools only, and should be consulted when equipment decontamination procedures are being developed as part of project-specific work plans. Personal decontamination guidelines are present in the project-specific Health and Safety Plan. Decontamination of sampling equipment is described in Field Procedure FP 3-1 and decontamination of monitoring well construction materials is described in Field Procedure FP 3-2.

3.0 REQUIREMENTS

To ensure that chemical analysis results are reflective of the actual concentrations present at sampling locations, various drilling equipment and hand tools used in sampling activities must be properly cleaned and decontaminated. This will minimize the potential for cross-contamination between sampling locations, and the transfer of contamination off-site.

4.0 REFERENCES

4.1 HAZWRAP, February 1989, *Quality Control Requirements for Field Methods*, DOE/HWP-69.

4.2 United States Environmental Protection Agency, December 1987, *A Compendium of Superfund Field Operations Methods*, EPA/540/P-87/001,.

4.3 United States Environmental Protection Agency, November 1986, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, EPA SW-846, Third Edition.

5.0 DEFINITIONS

Negative Contamination - Occurs when the measured concentration of the analyte is artificially reduced as a result of volatilization, adsorption and related losses.

Positive Contamination - Occurs when the measured concentration of the analyte is artificially high due to leaching or the introduction of foreign matter into the sample.

Cross-Contamination - Is a type of positive contamination caused by the introduction of part of one sample into a second sample during sampling or storage.

Detergent - Shall be a standard brand of non-phosphate laboratory-grade detergent such as Alconox or Liquinox.

Acid Solution - Shall be made from reagent-grade acid and deionized water.

Solvent - Shall be pesticide-grade solvent.

Tap or Potable Water - Shall be water from a municipal water treatment system.

Deionized Analyte-free Water - Ion free-organic free water produced on-site from a Deionization Chamber equipped with a carbon filter.

6.0 RESPONSIBILITIES

6.1 Project Manager

The Project Manager is responsible for ensuring that decontamination procedures for all chemical sampling and field analytical equipment are established prior to the actual field effort and that personnel required to accomplish the task have been briefed and trained to execute the task.

6.2 Field Operations Leader

The Field Operations Leader is responsible for ensuring that project-specific plans and the implementation of field investigations are in compliance with this procedure.

7.0 EQUIPMENT

7.1 Portable high-pressure steam or hot water generator.

7.2 Insulated gloves.

7.3 Laboratory-grade non-phosphate detergent.

7.4 Tap water.

7.5 Deionized volatile-free water.

7.6 Sheet plastic.

7.7 Pesticide-grade methanol.

7.8 Scrub brushes.

7.9 Five- to 10-gallon bucket.

8.0 PROCEDURE

All drilling equipment involved in field sampling activities will be decontaminated prior to drilling, excavation and sampling activities. Such equipment includes drilling rings, backhoes, down-hole tools, augers, and hand tools.

8.1 Steam Cleaning

Prior to drilling or leaving the site, equipment not directly utilized for sampling, will be decontaminated at a designated area. This includes drilling rigs, augers, backhoes, hand tools and down-hole tools. The decontamination area will be designed to contain decontamination wastes and waste waters, and can be a lined excavated pit or a bermed concrete or asphalt pad. For the latter, a floor drain must be provided that is connected to a holding tank. A shallow, above-surface tank may be used or a pumping system with discharge to a waste tank may be installed.

At certain sites, due to the type of contaminants or proximity to residences, concerns may exist about air emissions from steam cleaning operations. These concerns can be alleviated by utilizing one or both of the following practices:

- Locate the steam cleaning area on-site to minimize potential impacts.
- Enclose steam cleaning operations.

The location of the decontamination area will be identified in the project-specific Work Plan. Transport vehicles used on-site for personnel and/or equipment will be cleaned prior to leaving the site. Decontamination wastes will be collected and contained for eventual treatment on-site and/or disposal at an approved facility in accordance with the project-specific Work Plan.

8.2 Equipment Decontamination

Decontamination of equipment associated with sampling that will not come into contact with the sample medium.

- clean with high-pressure steam or hot water cleaner;
- wash with potable water and a non-phosphate laboratory-grade detergent; and
- rinse with potable water.

The drill rig, drill pipe, and all down-hole equipment will steam cleaned prior to entering the site and will be decontaminated in accordance with these procedures before work (1) is begun. Prior to use on each site, the rig will be decontaminated as described. All down-hole equipment will be decontaminated between each borehole. (1)

9.0 ATTACHMENTS

None.

AMENDMENTS TO:

FIELD PROCEDURE FP 3-3
DECONTAMINATION OF HAND TOOLS AND DRILLING EQUIPMENT

The following is a list of specific amendments to the referenced SOP. The amended portions of the SOP are marked and correspond to the comments listed below.

1. The tires, auger racks, and rear portion of the drill rig drill pipe, and all down-hole equipment will be steamed cleaned prior to use at the site and will be decontaminated in accordance with these procedures before work is begun.

FIELD PROCEDURE FP 5-1

MONITORING OF HOLLOW STEM AUGER DRILLING ACTIVITIES

Subject	Procedure No. / Rev.
	FP 5-1 0 Page 1 of 4
MONITORING OF HOLLOW STEM AUGER DRILLING ACTIVITIES (1)	Issue Date: 05/25/90 Effective Date: 07/02/90
	Supersedes Procedure Number: 630 FP 23 Rev.: 0 Date:
Acceptance - Program QA	Approval - Program Manager

1.0 PURPOSE

The purpose of this procedure is to describe the methods and sequence of operations for recording field observations pertinent to the documentation of drilling activities.

2.0 SCOPE

This procedure applies to hollow stem auger drilling activities used to install monitoring wells, and drilling activities to determine the type, thickness, and certain physical and chemical properties of the soil, water, and rock strata which underlie the site. (2)

3.0 REQUIREMENTS

Complete documentation must be kept to ensure proper installation of monitoring wells, knowledge of geologic data, and contract compliance by the drilling subcontractor.

4.0 REFERENCES

4.1 HAZWRAP, February 1989, *Quality Control Requirements foi Field Methods*, DOE/HWP-69.

4.2 U.S. Environmental Protection Agency. *Manual of Water Well Construction Practices*, Office of Water Supply, USEPA, Washington, D.C.

5.0 DEFINITIONS

5.1 Hollow stem auger drilling consists of screwing augers with an open center into the ground. Cuttings are brought to the surface by the rotating action of the auger. Samples can be taken using split-spoon or thin wall tube samples inserted through the hollow stem and driven into the substrata in advance of the auger. (3)

6.0 RESPONSIBILITIES

6.1 Field Operations Leader

The Field Operations Leader is responsible for ensuring that field personnel have been trained in the use of this procedure, and for verifying that auger drilling activities are being performed in compliance with the project-specific work plan. He should also determine the disposal methods for products generated by drilling, such as drill cuttings and well development water, as well as any specialized supplies or logistical support required for the drilling operations. These activities should be documented in the site logbook.

6.2 Field Geologist

The Field Geologist is responsible for monitoring drilling activities and documenting observations made during drilling in a bound field logbook. He will summarize these activities on the Daily Drilling Report (Attachment 9.1). The Field Geologist will also generate a detailed boring log for each test hole. This log shall include a description of materials, samples, method of sampling, blow counts, and other pertinent drilling and testing information that may be obtained during drilling in accordance with Field Procedure FP 7-3, *Borehole Logging*. (4)

7.0 EQUIPMENT (5)

7.1 Field logbook.

7.2 Drilling subcontract.

7.3 Daily Drilling Report Form (Attachment 9.1).

8.0 PROCEDURE

8.1 Prior to arriving at the site, the Field Geologist will confer with the Field Operations Leader regarding the pertinent aspects of the drilling contract related to daily drilling activities.

8.2 A field logbook will be kept by each Field Geologist and will be used to record at least the following information:

- Date
- Location
- Weather
- Drilling company
- Drill crew names and telephone numbers
- Descriptions of the material being drilled

The Field Geologist will record, at a minimum, the following observations:

- Start and stop time of all drilling activities, including:
  - mobilization;
  - drilling/reaming/augering

(6)

- sampling;
- drill rig decontamination;
- cementing;
- geophysical well logging; and
- any other relevant events.

- Footage for the above activities.
- Type and quantity of drilling equipment (especially auger flights and drill stems).
- Condition of drilling equipment; should ensure that it is clean and no leaks in the system that would input the boring or well.
- Problems causing delays during drilling activities. (7)

8.3 A Daily Drilling Report (Attachment 9.1) will be completed at the conclusion of drilling activities for the day. This report is required to document work conducted by the subcontractor and will be filled out as follows:

- Assign unique number to form.
- Enter unique code assigned to the borehole in the upper right-hand corner of the form in the space provided for boring ID. (8)
- Enter descriptive name of the project and the project number in the space provided.
- Enter current date in the space provided.
- Enter type of equipment used for drilling operation.
- Enter diameter of the borehole in the space provided.
- Enter names of the Field Operations Leader and Field Geologist monitoring the drilling in the space provided.
- Enter the name of the drilling company, the driller, and the driller's helper in the spaces provided.
- Check the box applicable to the activities accomplished during the day in the space provided for daily activities.
- Circle the method(s) used (drilled/augered/cored or reamed) for the type of work accomplished and enter the start and stop depths (below surface level) in the blanks provided in the section titled "Footage.

- Enter the size in inches of bit(s) used in the space provided.
- Describe the type(s) of sample taken and the method(s) used; enter the quantity either in feet, volume or number of samples logged in the space provided.
- Enter number of hours to the nearest tenth of an hour in the applicable box or boxes (stand-by time is normally a delay caused by the contractor or the client; down time is a delay caused by the drilling subcontractor) in the space provided; comments should include, as a minimum, the following:
  - reason and start and stop times for standby or down time;
  - explanation of "other" time;
  - explanation of large deviations from planned progress; and
  - clear, concise comments relevant to any justification of work stoppage.
- Enter amount of material actually used by the subcontractor; comments include any necessary explanations for the amount entered in the space provided.
- Have driller verify the identified activities and sign the form in the space provided; the driller receives a copy of the form daily.
- Enter the start and stop footage below the land surface in the space provided for well construction information.
- Enter casing material under "Casing Type"; enter "Casing Size" in inches (specify O.D. or I.D.); check "Drain Hole" and "Stamped ID", in the space provided for well casing information.
- Sign and date (Field Geologist) the form in the space provided for verification of activities.
- Payment for standby hours and well acceptance must be approved by the Field Operations Leader or his designee. Sign and date (Field Operations Leader) in the space provided. This signature is required for payment of standby hours and well approval.
- Distribute copies of the Daily Drilling Report to individuals designated by the Field Operations Leader.

8

9.0 ATTACHMENTS

9.1 Daily Drilling Report. 9

ATTACHMENT 9.1
FP 5-1

DAILY DRILLING REPORT

	DAILY DRILLING REPORT	Boring ID: ________

Project: ________________ Date: ________

Drilling Method: ________ Borehole Diameter: ________

Supervisor/Geologist: ________ Driller: ________

Drilling Company: ________ Helper: ________

DAILY ACTIVITIES:

- ☐ Mobilization
- ☐ Decontamination
- ☐ Set-up
- ☐ Drilling/Augering/Coring
- ☐ E-logging (standby)
- ☐ Reaming
- ☐ Setting Surface Casing
- ☐ Well Installation
- ☐ Well Development
- ☐ Clean-up
- ☐ Std. Penetration Test
- ☐ Other: ________

Footage:

Drilled/Augered/Cored: ______ ft to ______ ft; Reamed: ______ ft to ______ ft

Bit Sizes: ________ ________

Sample Type: ________ Quantity: ______ S.P. Tests (qty): ______

Time: Drill/Rig: ______ hr. Well Development: ______ hr.

Decon.: ______ hr. Down Time: ______ hr.

Standby: ______ hr. Other: ______ hr.

Comments: ________________

Material Used: Bentonite: ______ bags Bentonite: ______ buckets

Cement: ______ bags ______: ______

Sand: ______ bags Comments: ______

DRAFT

Verification of Activities: ________________ Date: ________
(Driller Signature)

WELL CONSTRUCTION:

Screen Setting: ______ ft to ______ ft BLS

Blank Casing Setting: ______ ft to ______ ft BLS

Sand Pack Setting: ______ ft to ______ ft BLS

Seal Setting: ______ ft to ______ ft BLS

Grout Setting: ______ ft to ______ ft BLS

Surface Casing:

Casing Type: ________

Casing Size: ________

Drain Hole: ☐ Yes ☐ No

Stamped ID: ☐ Yes ☐ No

Comments: ________________

Development Method(s): ________________

Verification of Activities: ________________ Date: ________
(Supervisory Geologist Signature)

Approved for Payment: ______ Standby Hours. Well Accepted: ☐ Yes ☐ No

________________ Date: ________
(Field Supervisor Signature)

AMENDMENTS TO:

FIELD PROCEDURE FP 5-1
MONITORING OF HOLLOW STEM AUGER DRILLING ACTIVITIES

The following are specific amendments to the referenced SOP. The amended portions of the SOP are marked and correspond to the comments listed below.

1. MONITORING OF HOLLOW STEM AUGER AND CABLE TOOL DRILLING ACTIVITIES.

2. This procedure applies to hollow stem auger and cable tool drilling activities used to install monitoring wells and drilling activities to determine the type, thickness and certain physical and chemical properties of the soil, water, and rock strata which underlie the site.

3. 5.2 Cable tool drilling is a procedure which creates a borehole by advancing a chisel-like bit and steel casing through the substrata. Cuttings and samples are brought to the surface using a sand bailer. Cable tool drilling can create a plumb borehole in both consolidated material (i.e., bedrock) and large diameter unconsolidated material (i.e., large boulders). Samples from the borehole can be collected from the sand bailer.

4. Amendment not implemented.

5. Amendment not implemented.

6. Use of drilling fluid and quantity used during drilling/reaming/augering.

7. Record the amount of water used during drilling.

8. Amendment not implemented.

9. Amendment not implemented.

FIELD PROCEDURE FP 5-2

MONITORING WELL INSTALLATION

1.0 PURPOSE

The purpose of this procedure is to establish acceptable methods for proper monitoring well design and construction.

2.0 SCOPE

This procedure is applicable to the construction of semi-permanent monitoring wells at field investigation sites. The methods described herein may be modified by project-specific requirements for monitoring well construction. In addition, many states have specific regulations pertaining to monitoring well construction and permitting. These requirements must be fully developed when preparing the project-specific work plan.

3.0 REQUIREMENTS

The objectives for each monitoring well and its intended use must be clearly defined before the monitoring system is constructed. Within the monitoring system, different monitoring wells may serve different purposes and, therefore, require different types of construction. During all phases of the well construction, attention must be given to clearly documenting the basis for construction decisions, the details of well construction, and the materials used.

Siting of monitoring wells shall be performed after a preliminary estimation of the hydraulic gradients and ground-water flow direction. In most cases, these can be determined through review of geologic data and the site terrain. In addition, production wells or other monitoring wells in the area may be used to determine the flow direction.

4.0 REFERENCES

4.1 Driscoll, Fletcher G. 1986. *Groundwater and Wells*, 2nd Edition, Johnson Division, St. Paul, Minnesota, pp. 1089.

4.2 HAZWRAP, February 1989, *Quality Control Requirements for Field Methods*, DOE/HWP-69.

5.0 DEFINITIONS

Monitoring Well - A well which will provide for the measurement of total well depth, the collection of representative groundwater samples, the detection and collection of representative light- and dense-phase organics, and measuring piezometric data.

6.0 RESPONSIBILITIES

6.1 Project Manager

The Project Manager is responsible for selecting the well casing and screen materials, the screen length and placement, and the filter pack and seal materials to be used for each monitoring well. The Project Manager should work in cooperation with the Field Operations Manager to ensure that all contract items are fulfilled and that the project is executed in a scientifically sound manner.

6.2 Field Operations Manager

The Field Operations Manager is responsible for ensuring that field personnel have been trained in the use of this procedure and for verifying that monitoring well installation activities are performed in compliance with the contract. The Field Operations Manager will obtain the information necessary for the Project Manager to select screen size and well packing material and siting well installation locations.

6.3 Field Geologist

The Field Geologist is responsible for ensuring the well is installed according to the contract specifications. If notification of the driller does not result in corrective action, the Field Geologist will thoroughly document the driller's failure to follow procedures and notify the Field Operations Manager as soon as possible.

7.0 EQUIPMENT

7.1 Field Logbook and Indelible Ink Pens
7.2 Monitoring Well Construction Log
7.3 Folding or Retractable Engineers Rule
7.4 Weighted Tape
7.5 Slot Size or Feeler Gauge.

8.0 PROCEDURE

8.1 Design Considerations

Monitoring Well Depth, Diameter and Screen Length

- Standard well diameters are two, four, six, or eight inches. For most monitoring programs a two or four-inch well is preferred. Smaller wells have a smaller volume of stagnant water, well construction costs are lower, and the water table stabilizes readily.

- In specifying well diameter, sampling requirements must be considered. A total of up to four gallons or water may be required for a single sample to account for full organic and inorganic analyses and split samples. The standing water in the monitoring well available for sampling after complete recharge is dependent on the well diameter as follows:

Casing Inside Diameter, Inches	Standing Water Depth to Obtain One Gallon Water (ft)	Total Depth of Standing Water For Four Gallons (ft)
2	6.13	25
4	1.53	6
6	0.68	3

- The borehole diameter should be at least four inches larger than the well riser pipe diameter.
- Wells deeper than 35 feet must be at least four inches in diameter. | (1)

Riser Pipe and Screen Materials

- Schedule 40 PVC has sufficient tensile and compressive strength for wells up to 75 feet. Schedule 80 PVC is generally used for wells greater than 50 feet.
- The inside diameter for schedule 80 PVC is smaller and may be an important factor when considering the size of bailers or pumps to be used for the sampling. Due to this problem, the minimum well pipe size recommended for schedule 80 is four inches I.D.
- Steel screens and risers must be decontaminated before use according to FP 3-2.
- Galvanized steel is not recommended for metals analyses, as zinc and cadmium levels in ground water samples may be elevated from zinc coating.
- Type 316L stainless steel or other alloys should be considered for use in sulfidic waters.
- Threaded, flush joint casing is required. No glues are allowed. | (2)
- For deep wells the screen must be chosen to withstand the column weight without collapsing. The screen shall pass no more than 10 percent of pack material or in-situ aquifier material.
- The field geologist shall specify the combination of screen slot size and gravel pack gradation.

| (3)

Annual Materials

Material placed in the annular space between the borehole and well-riser pipe includes a gravel pack when necessary, a bentonite seal, and cement grout. In general, all of these should be installed via a tremie pipe placed in the annular space. The so called "gravel pack" is usually a fine to medium grained uniform sand. The quantity of sand placed in the annular space is dependent upon the length of the screened interval but should always extend two to three feet above the top of the screen. At least two to three feet of bentonite pellets or granular bentonite shall be placed above the gravel pack.

Bentonite expands by absorbing water and provides a seal between the screened interval and the rest of the annular space and formation. Cement grout is placed on top of the bentonite to the surface. The grout effectively seals the well and eliminates the possibility of surface runoff reaching the screened interval. Grouting also replaces material removed during drilling and prevents hole collapse and subsidence around the well. A tremie pipe shall be used to introduce grout from the bottom of the hole upward, to prevent bridging and to provide a better seal. In some shallow holes, it may be more practical to pour the cement from the surface without a tremie line.

Grout is a general term which has several different connotations. For all practical purposes within the monitoring well installation industry, grout refers to the solidified material which is installed and occupies the annular space above the bentonite seal. Grout, most of the time, is made up of two assemblages of material, i.e., a cement-bentonite grout or a neat cement grout. A cement bentonite grout normally is a mixture of cement, bentonite and water at a ratio of one 90 pound bag of Portland Type I cement, three to five pounds of granular or flake-type bentonite and six gallons of water. Neat cement is made up of one 90 pound bag of Portland Type I cement and six gallons of water.

Protective Equipment

When the well is completed and grouted to the surface, protective steel casing is often placed over the top of the well. This casing generally has a hinged cap and can be locked to prevent vandalism. A vent hole shall be provided in the riser pipe just below the cap to allow venting of gases and maintain atmospheric pressure as water levels rise or fall in the well with the exception of wells installed to monitor gases. The protective casing has a larger diameter than the well and is set into the wet cement grout over the well upon completion. In addition, at least one one-fourth inch hole is drilled just above the cement collar through the protective casing which acts as a weep hole for the flow of water which may enter the annulus during well development, purging, or sampling.

Three three-inch diameter Schedule 40 steel guard posts filled with cement is usually placed around the protective steel riser pipe. The posts are generally eight feet in total length and installed approximately four feet into the ground with independent concrete footings.

Protective casing which is level with the finished surface is used in roadway or parking lot applications where the top of a monitoring well must be below the pavement. The top of the well is placed four to five inches below the pavement and cemented to approximately six or seven inches below the pavement. A protective sleeve is set into the wet cement around the well with the top set level with the pavement. A locking gasket cap is placed on the well to seal out water and a manhole type lid placed over the protective sleeve. The top of the well resembles a small manhole. If the cement grout seal is effective and does not leak, the hole below the pavement will hold water. A drainage system may be required to direct pooled water away from the well head.

8.2 Monitoring Well Construction

Predrilling Activities

Underground utility maps for the immediate vicinity of the drilling site will be reviewed and proposed drilling locations will be staked in the field for inspection. Digging permits will then be obtained. No drilling will be done without the required digging permits.

- Inspect the screen to insure that no damage has occurred during shipment and decontamination. Also record the type and class of material and screen slot size. Check the slot size with a feeler gauge to insure that the screens are properly labeled.

- Prior to placing well materials in the borehole place a 1 to 2 foot backfill of filter pack material below the base of the screen. The filter pack will consist of chemically inert (e.g. clean quartz sand, silica or glass beads) well rounded and dimensionally stable.

- Assemble the well casing and screen and place the material in the borehole. Attach centralizers as specified in the Project Work Plan to ensure that each well is straight as possible and centered in the borehole. A sump or sampling cup device 1 to 2 foot long may be attached to the bed of the well to aid in collecting fine-grained sediments and to capture dense minerals contaminants for analysis.

  NOTE: All well screen, riser pipe, sump, bottom plug and cap will be threaded and flush jointed. No glues or solvents are to be used in monitoring well installation.

- Record the depth of the base of the well, the top of the screen, and the screen length in the monitoring well construction log.

Placement of Filter Pack and Annular Seal

- Place the monitoring well filter pack by slowly pouring filter pack material directly or pumping a sand slurry through a tremie pipe into the annulus between the well screen and the open borehole wall. If the borehole will not stand open place filter pack material directly into the annulus between the auger wall and the well casing and screen. Then gradually pull back the auger string in small increments (2 feet at a time) to allow the sand to settle around the screen below the augers. Care will be taken to prevent filter pack material from bridging between the borehole wall or augers and the well screen and riser pipe.

NOTE: The filter pack material will be chemically inert (e.g., clean quartz sand, silica, or glass beads) with particles that are well-rounded. Fabric filters are not permitted.

- The filter pack material will be placed from the bottom of the well to a nominal two feet above the top of the screen. The depth to the top of the sand pack will be recorded. Note the number of bags of sand used.

- Tremie, or for shallow wells ($\leq$ 35 feet) gravity feed, bentonite pellets or chips (not powder) onto the top of the filter pack to form a 2 to 3 foot seal. Bentonite pellets must be used if the seal is to be seated below the water table. Granular, flake or slurried bentonite may be used above the water table. If a tremie pipe is used, slowly withdraw the pipe as the bentonite is added to ensure even placement around the annulus. Check the depth with a weighted tape. (5)

- Follow manufacturer's specifications for hydration time. Record the depth to the top of the bentonite seal, the number of buckets/bags of bentonite used, and the amount of water added for hydration (if applicable) on the Monitoring Well Construction Log.

  NOTE: The annular seal material must be chemically compatible with the well materials and contaminants and chemically insert so it does not affect the quality of groundwater samples. The permeability of annular seals will be one to two orders of magnitude less than the surrounding formation.

- Tremie a neat cement-bentonite grout above the bentonite seal by pumping it through a tremie pipe (with its bottom opening set top of the well seal to prevent disturbance of the seal during pumping activities), and allow the grout to rise in the borehole annulus to the bottom of the frost line.

NOTE: Cement-bentonite grout typically consists of one 94-pound sack of Portland cement and 3 to 5 pounds of powdered bentonite with 6.5 of Portland cement and 3 to 5 pounds of powdered bentonite with 6.5 gallons of water. Mix the bentonite and water first, and then add the cement (Driscol 1986). Check the density with a mud balance to ensure proper mixture ratio.

- Place concrete from the frost line to the base of the well completion. ASTM Type II cement should be used where ground-water contains dissolved sulfates.

Above Ground Well Completion

- Notch the north side of the well casing with a hacksaw or file. The notch will be the point from which surveys and subsequent water level measurements will be measured. Ensure no filings or PVC shavings enter the well.

- For wells that are completed above the ground surface the finish casing should extend approximately 2-1/2 feet above the land surface with a protective steel riser pipe equipped with a hinged, loose-fitting cap that can be locked to prevent unauthorized entry. Sufficient space must be allowed between the protective casing lid and the top of the well riser pipe for a well cap. the minimum size for 2-inch well is 6-inch protective casing. The riser pipe should extend approximately 2 feet above the land surface. (6)

- Construct a concrete pad around the protective casing within 24 hours of well installation. The pad shall slope away from the casing in all directions. Embed a brass surveyors pin in the concrete pad and stamp the well Identification Number and elevation of the top of the casing in the pin and on the top of the Protective Casing and the Inner Casing. The pad size shall be as stated in the project-specific work plan.

- Drill a 1/4 inch diameter weep hole into the side of the protective casing near the top of the concrete pad to permit drainage.

- Install three 3-inch diameter by 8-foot long, concrete-filled (schedule 40) steel guard posts radially around the concrete pad. The guard posts will extend approximately four feet into the ground with independent concrete footings.

Flush Mount Completions

For wells that are completed flush with the land surface, install a well vault over the well riser pipe. The vault will be water-tight and equipped with a locking mechanism to prevent unauthorized entry. A system for drainage also should be installed. For flush-mount completions, the top of the well is four to five inches below ground surface and concreted to at least six inches below ground surface.

Monitoring Well Installations in Confined Aquifers

1. Advance an oversized borehole through unconsolidated surface deposits to a depth of 2 to 3 ft into the top of the confining bed. In general, the borehole should be 2 in. in diameter larger than the casing to be installed when a tremie is to be used.

2. Condition the borehole by circulating air (or mud, if used) or by rotating augers without drilling until the hole is cleaned of cuttings.

3. While performing Step 2, make-up the necessary length(s) of surface casing. Surface casing may be of mild or galvanized steel.

4. Pressure grout bentonite pellets or chips to fill the portion of the borehole in the confining bed. If the bentonite seal is to be set below the static water level, only pellets may be used. The bentonite should hydrate in the presence of groundwater, but potable or distilled water may be added if needed.

5. Insert the surface casing into the borehole and push firmly into the bentonite seal in the confining bed.

6. Mix Portland cement with bentonite powder (as previously described) and water to make a pumpable slurry. Weigh the bentonite before mixing; the addition of more than 3 lbs of bentonite will severely reduce grout strength.

7. Insert the tremie pipe into the borehole and begin pumping grout. Slowly withdraw the tremie pipe as the annulus fills to ensure even placement with no bridging.

8. Allow grout to cure for 48 hours or longer before proceeding. | (7)

9. After grout has cured, rig up with a smaller diameter bit and proceed with drilling. Advance the borehole to the desired depth. The hole should be drilled a few feet deeper than necessary to allow for cave-ins during casing placement. If more than one aquifer will be encountered during drilling, the well must be cased in separate stages to prevent cross-contamination. Step 1 through 8 of this section should be followed for each separate aquifier that must be cased off.

10. Condition the borehole by circulation air (or mud, if used) until the hole is cleaned of cuttings. Pull the drill string out of the borehole when no additional cuttings reach the surface. Check the hole depth with a weighted surveyor's type.

11. Make up the casing string in manageable sections while conditioning the borehole. The casing and screen (if used) must be decontaminated in accordance with FP 3-2 before make-up. Tighten casing joints to the manufacturer's specifications.

12. Insert the first segment of the casing string and lower to a convenient height for adding the second casing segment. Chock the casing, add the second segment, then release the chock and lower the casing. Repeat this process until the full casing string is hanging in the well. Centralizers, beginning at the top of the screen, should be placed at 30 to 40 ft. intervals, according to the project-specific work plan. The casing string should be allowed to hang in the well rather than set on bottom. Casing

strings with Teflon screens should never be set on the bottom because the weight of casing will significantly reduce the slot size and may collapse the screen.

13. Insert the tremie to near the bottom of the screen and begin running the filter material through the tremie. Slowly withdraw the tremie so that the filter pack is placed evenly around the screen without bridging. One to two feet of filter pack material must be spotted at the bottom of the hole, under the screen. The filter pack must be installed to at least 2 to 3 ft. above the top of the screens. If the top of the screen is below the bottom of the confining layer, extend the filter pack to the confining layer, if appropriate. Develop the well according to FP 5-2 to settle the filter pack and, if used, remove slurry water.

14. If the filter pack was placed as a slurry, withdraw the tremie pipe, rinse with potable water, and dry before proceeding to add the bentonite seal. The potable rinsewater does not have to be contained. If the filter pack was installed dry, do not remove the tremie unless a larger diameter pipe is needed for installing the bentonite seal and grout. Check the depth of the filter pack to ensure that it rises above the top of the screen.

17. Tremie bentonite pellets or chips onto the top of the filter pack. Bentonite pellets must be used for installations below the water table. Granules, chips flakes, or slurries are suitable for use above the water table. Bentonite slurry or pellets must be used where the seal is installed below the water table. the bentonite seal must extend 2 to 3 ft. into the confining layer, if possible. Slowly withdraw the tremie pipe as bentonite is added to ensure even placement around the casing without bridging.

18. Hydrate the bentonite according to the manufacturer's specifications. Record amount of water used.

19. Mix Portland cement with powdered bentonite (as previously described) and water to make a pumpable slurry. Weigh the bentonite before mixing; addition of more than 3 lbs of bentonite will severely reduce grout strength.

20. Tremie the grout into the annulus. Slowly withdraw the tremie pipe as the annulus fills to ensure even placement. Grout the well to within 2 to 3 ft of the surface, but not above the average frost line.

21. After installing grout, dismantal and clean tremie equipment.

Monitoring Well Completion and Borehole Records

The Field Geologist will record the lithology and complete a drilling record for all single borings and the deepest borehole drilled at each multiple hole drilling location.

See Section 9.0 Attachments for specific well type. Borehole logging will be in accordance with FP 7-3.

9.0 ATTACHMENTS

9.1 Standard Monitoring Well Construction

9.2 Monitoring Well Construction When Water Table is Near Land Surface.

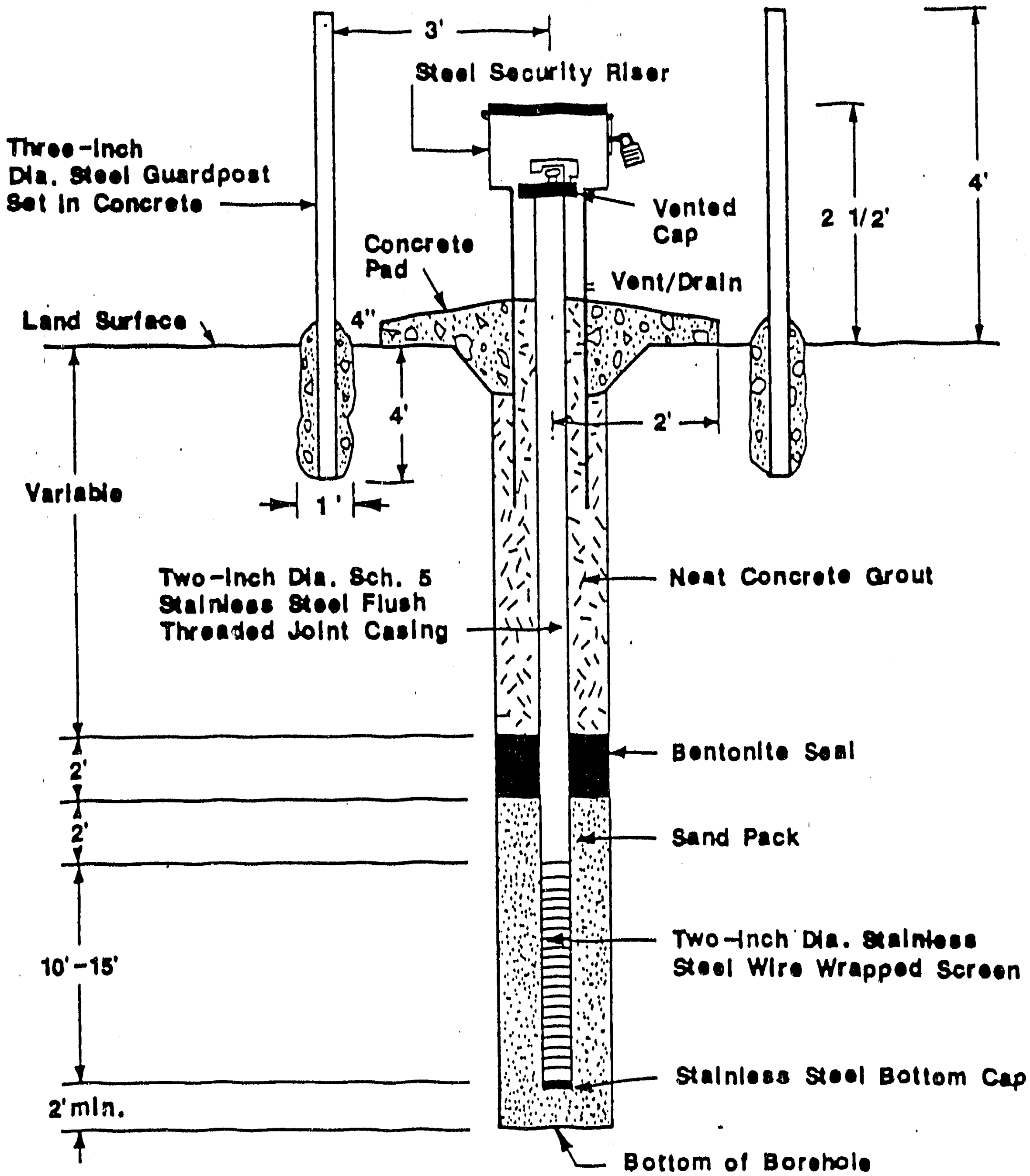
9.3 Monitoring Well Construction With Sealed Cap and Flush Surface Presentation.

9.4 Monitoring Well Construction With Telescoped Casing.

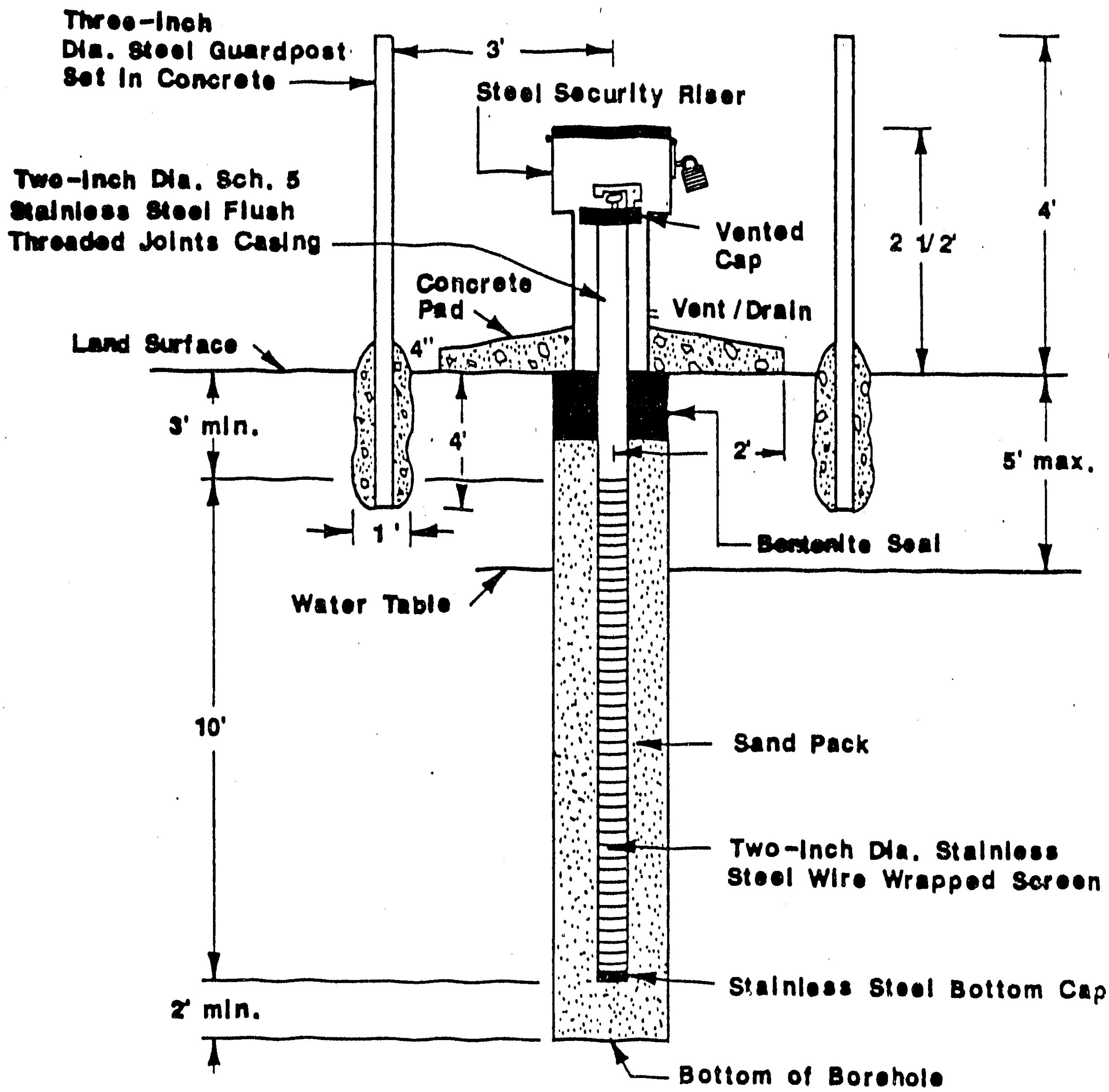
9.5 Monitoring Well Construction Logs:

- Standard
- Standard Flush Mount
- Double Cased
- Double Cased Flush Mount
- Open Hole
- Open Hole Flush Mount

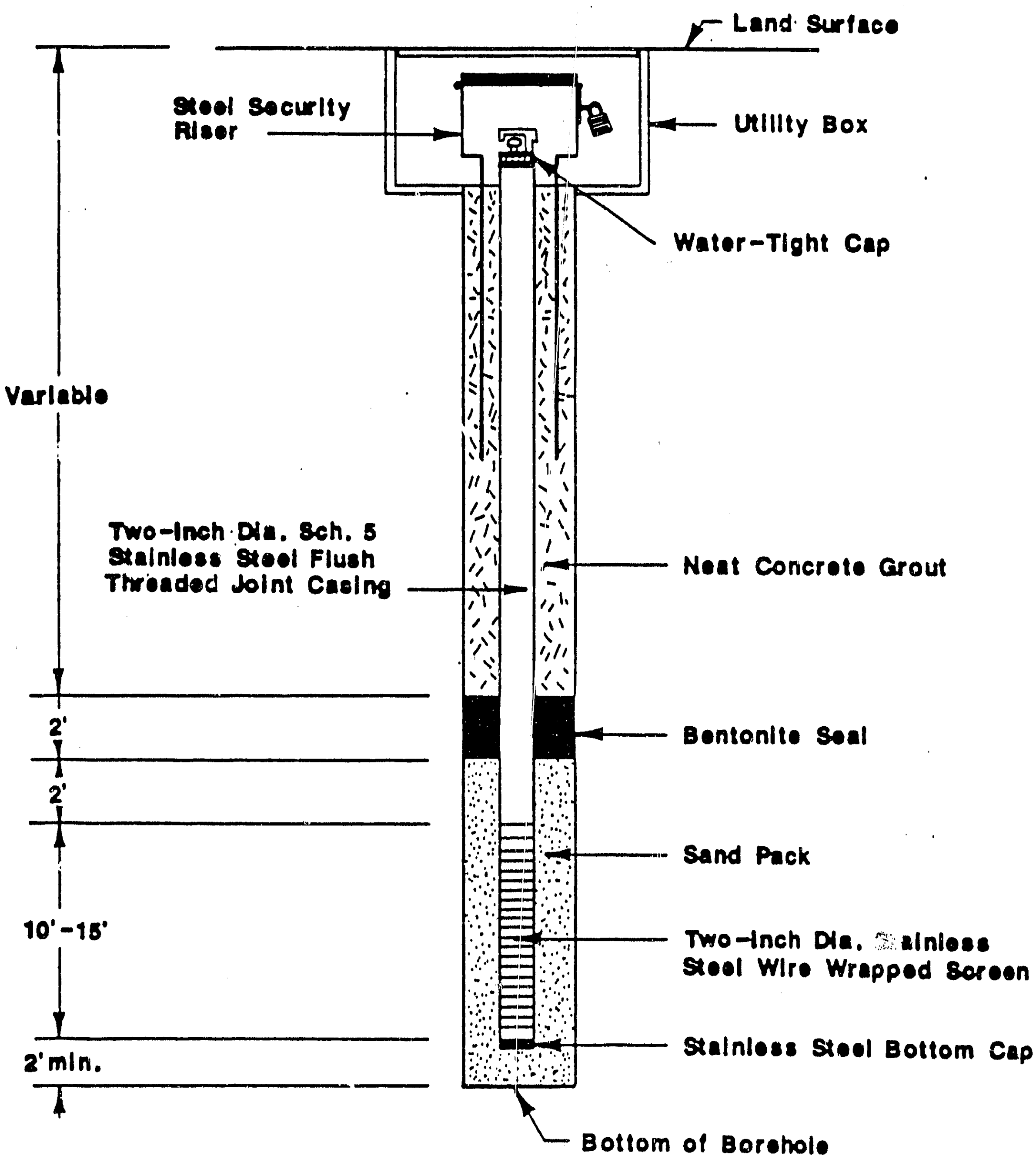
STANDARD MONITORING WELL CONSTRUCTION



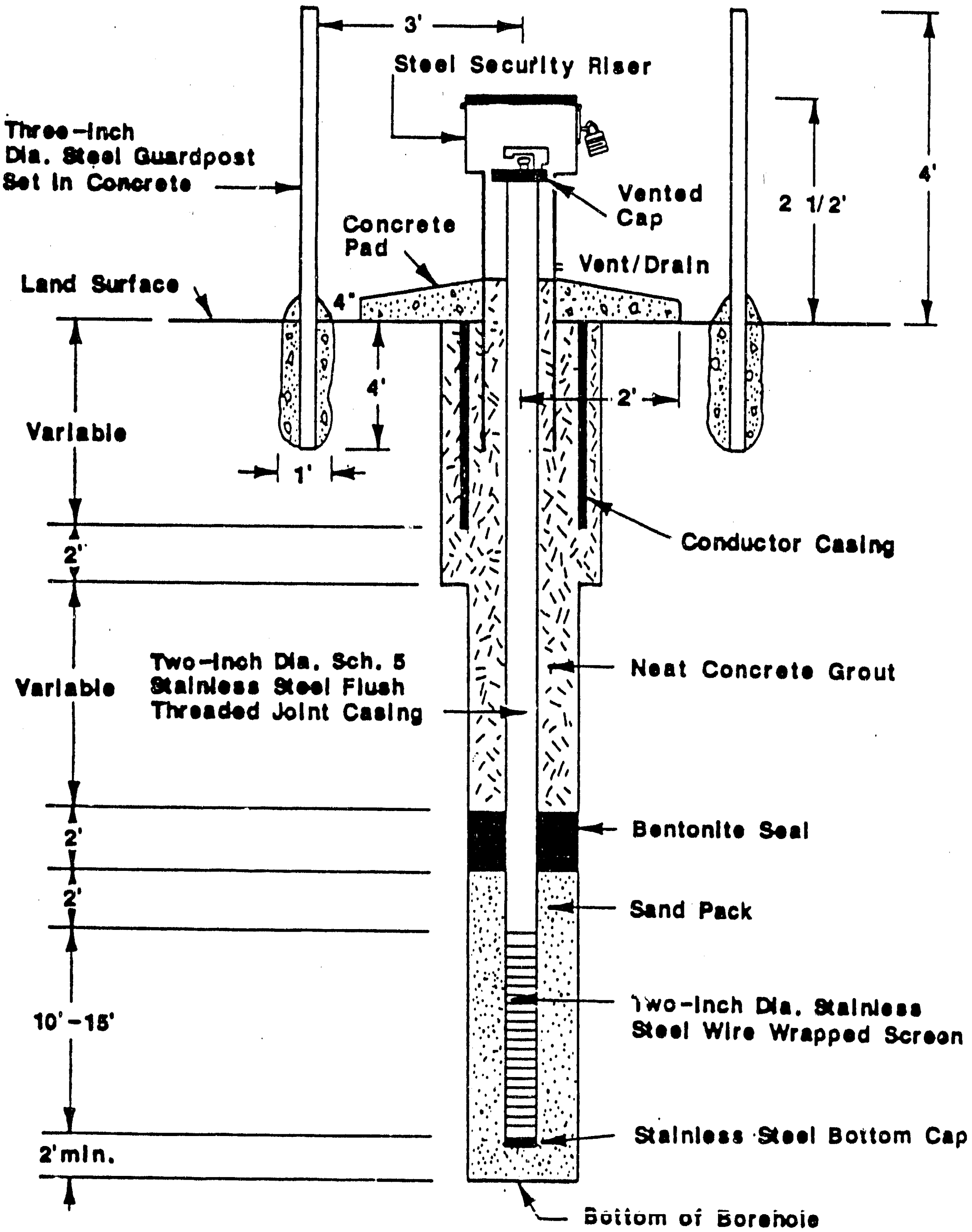
MONITORING WELL CONSTRUCTION WHEN WATER TABLE IS NEAR LAND SURFACE



MONITORING WELL CONSTRUCTION WITH SEALED CAP AND FLUSH SURFACE PRESENTATION



MONITORING WELL CONSTRUCTION WITH TELESCOPED CASING



ATTACHMENT 9.5
FP 5-2
7 Pages

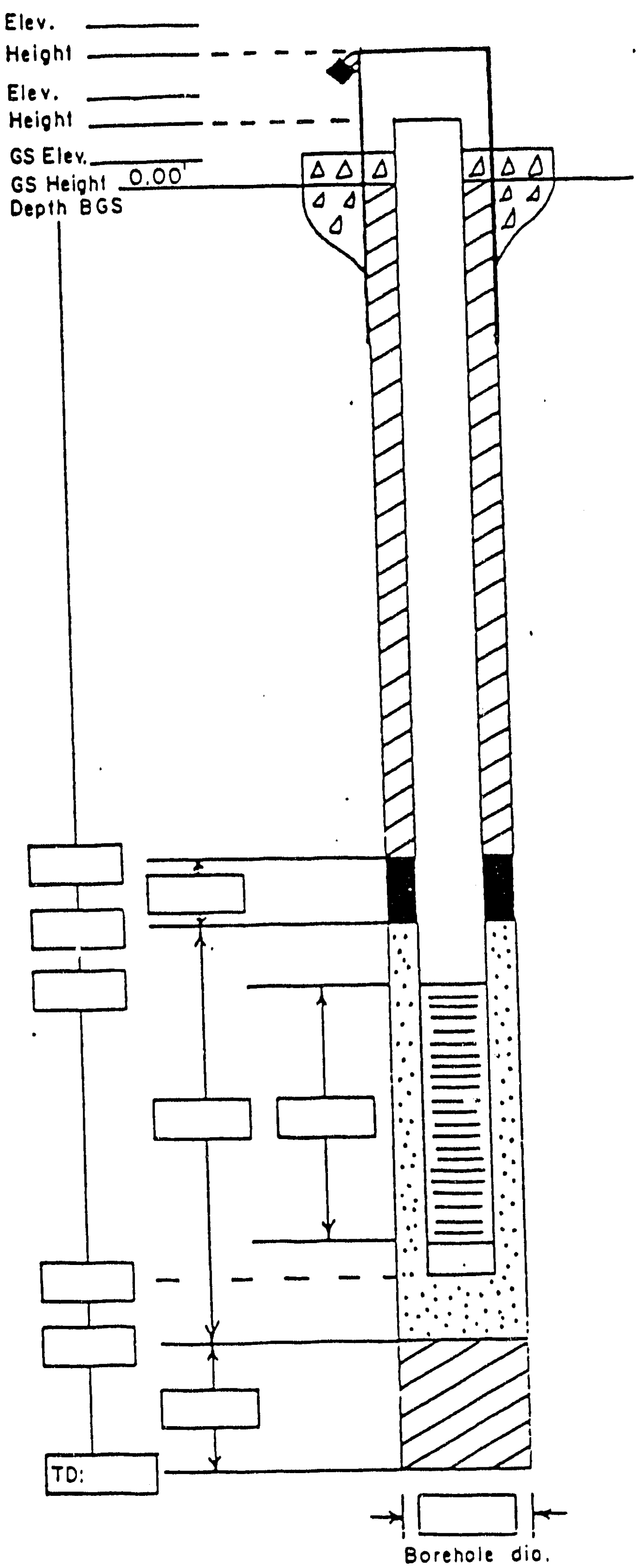
MONITORING WELL CONSTRUCTION LOGS

- Standard
- Standard Flush Mount
- Do·ıble Cased
- Double Cased FLush Mount
- Open Hole
- Open Hole Flush Mount

REV. DATE: JAN. 1989

MONITORING WELL CONSTRUCTION LOG - Standard

WELL NO.:	Installation:	Site:
Project No.:	Client/Project:	
HAZWRAP Contractor:	Drlg Contractor:	
Comp. Start: (: __ m)	Comp. End: (: __ m)	
Built By:	Well Coord.:	



PROTECTIVE CSG
Material/Type ________
Diameter ________
Depth BGS ________ Weep Hole (Y/N)

GUARD POSTS (Y/N)
No. ________ Type ________

SURFACE PAD
Composition & Size ________

RISER PIPE
Type ________
Diameter ________
Total Length(TOC to TOS) ________

GROUT
Composition & Proportions ________
____
Tremied (Y/N)
Interval BGS ________

CENTRALIZERS (Y/N)
Depth(s) ________

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

FILTER PACK
Type ________
Amt Used ________
Tremied (Y/N)
Source ________
Gr. Size Dist. ________

SCREEN
Type ________
Diameter ________
Slot Size & Type ________
Interval BGS ________

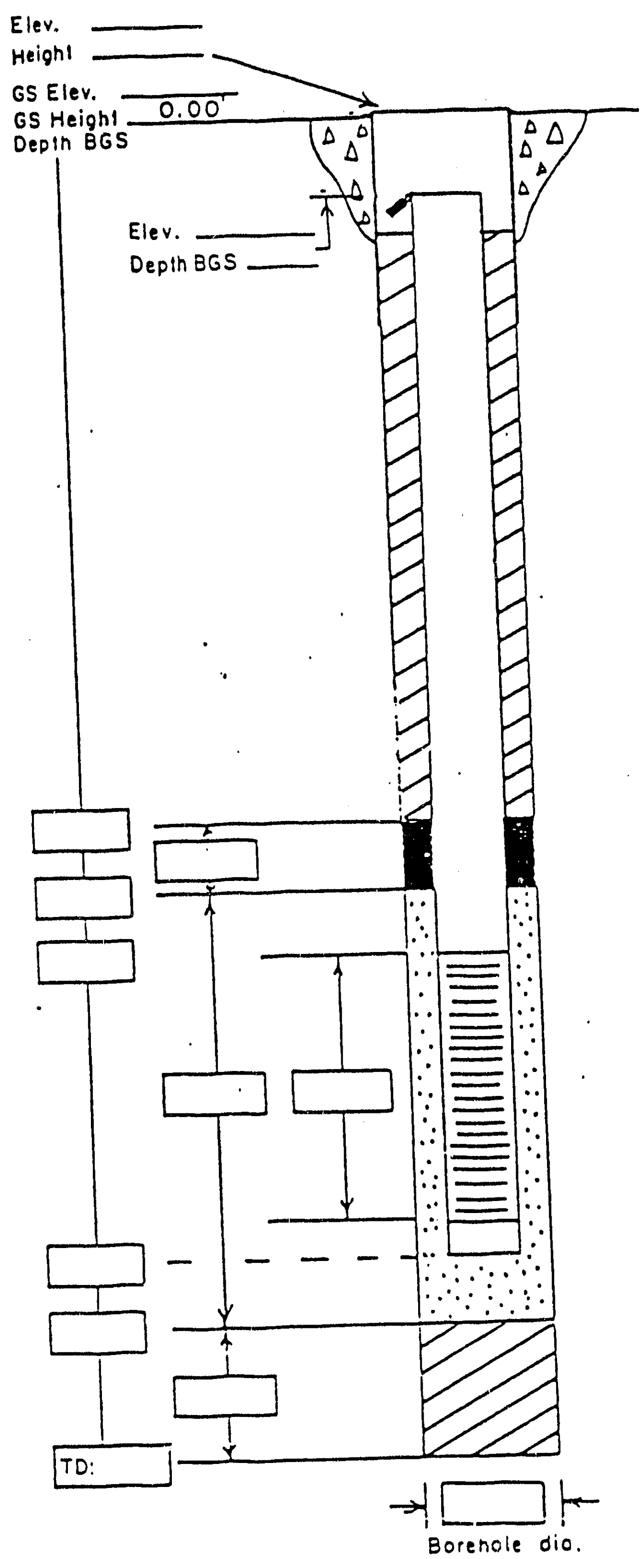
SUMP (Y/N)
Interval BGS ________ Length ________
Bottom Cap (Y/N)

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

REV. DATE: JAN 1989

MONITORING WELL CONSTRUCTION LOG - Standard Flush Mount

WELL NO.:	Installation:	Site:
Project No.:	Client/Project:	
HAZWRAP Contractor:	Drlg Contractor:	
Comp. Start: (: __m)	Comp. End: (: __m)	
Built By:	Well Coord.: ______	



PROTECTIVE CSG
Material/Type ______
Diameter ______ Water Tight Seal (Y/N)
Depth BGS ______ Weep Hole (Y/N)

SURFACE PAD
Composition & Size ______

RISER PIPE
Type ______
Diameter ______
Total Length (TOC to TOS) ______

GROUT
Composition & Proportions ______

Tremied (Y/N)
Interval ______

CENTRALIZERS (Y/N)
Depth(s) ______

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

FILTER PACK
Type ______
Amt Used ______
Tremied (Y/N)
Source ______
Gr. Size Dist. ______

SCREEN
Type ______
Diameter ______
Slot Size & Type ______
Interval BGS ______

SUMP (Y/N)
Interval BGS ______ Length ______
Bottom Cap (Y/N)

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

REV. DATE: JAN 1989

MONITORING WELL CONSTRUCTION LOG - Double Cased

Site:

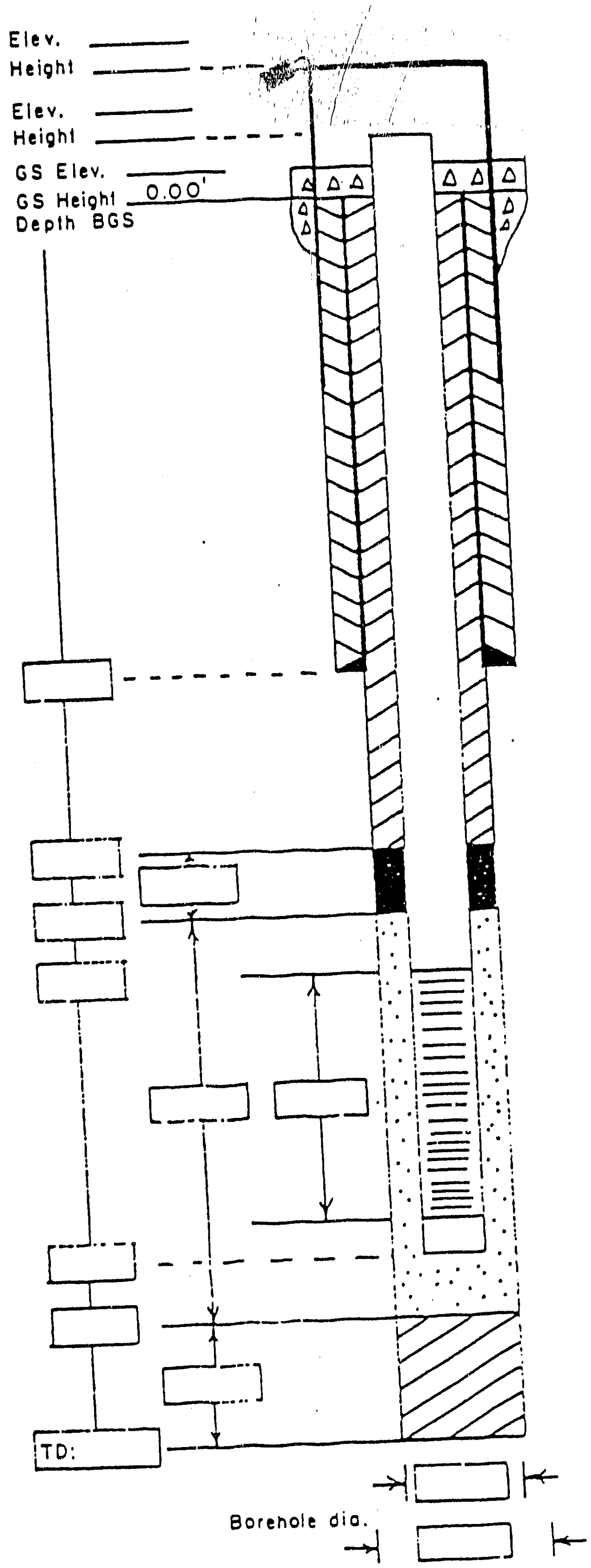
WELL NO.: Installation:

Project No: Client/Project:

HAZWRAP Contractor: Drlg Contractor:

Comp. Start: (: __ m) Comp. End: (: __ m)

Built By: Well Coord:



PROTECTIVE CSG
Material/Type
Diametr r
Depth BGS ____ Weep Hole (Y/N)

GUARD POSTS (Y/N)
No. ____ Type

SURFACE PAD
Composition & Size

SURFACE CSG
Type
Diameter ____ Total Length
GROUT: Setup/Hydration Time
Composition & Proportions
Interval BGS
Tremied (Y/N)

RISER PIPE
Type
Diameter
Total Length (TOC to TOS)

GROUT
Composition & Proportions
Interval BGS
Tremied (Y/N)

CENTRALIZERS (Y/N)
Depth(s)

SEAL
Type
Source
Setup/Hydration Time ____ Vol. Fluid Added
Tremied (Y/N)

FILTER PACK
Type
Amount Used
Source
Gr. Size Dist.
Tremied (Y/N)

SCREEN
Type
Diameter
Slot Size & Type

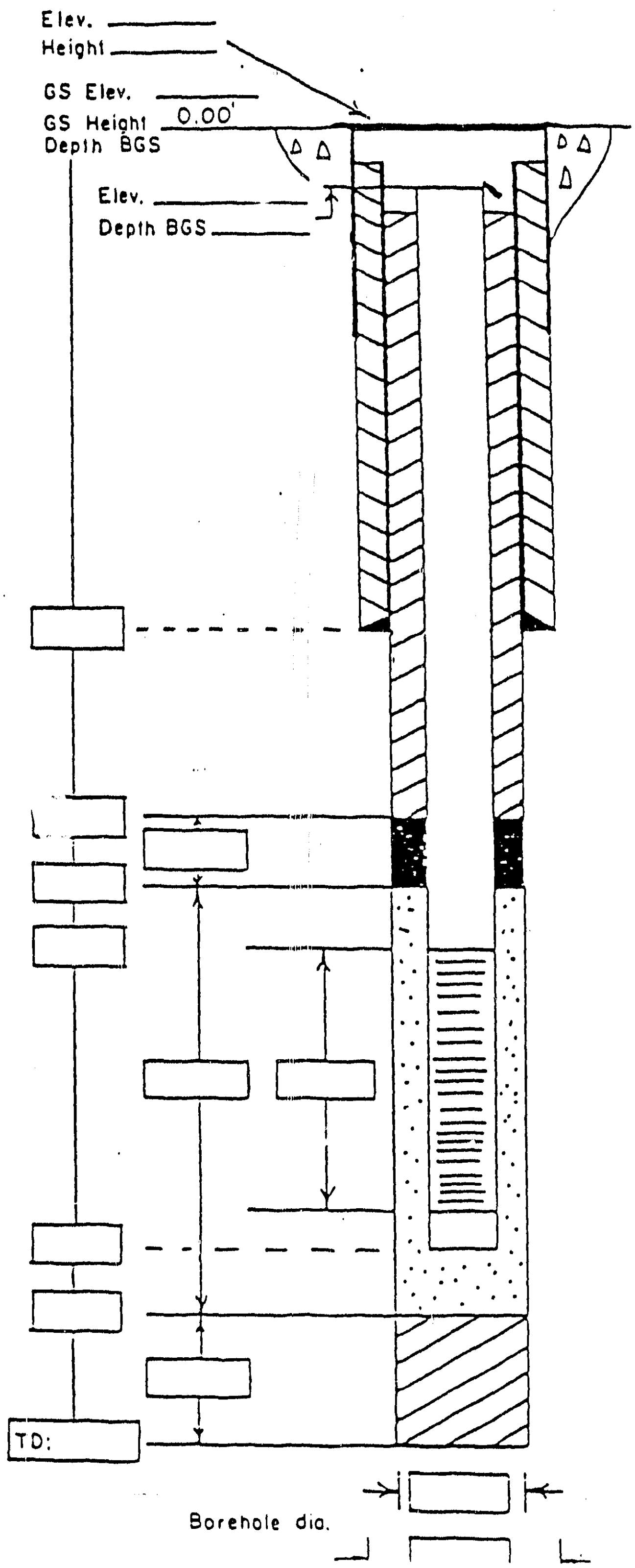
SUMP (Y/N)
Interval BGS ____ Length
Bottom Cap (Y/N)

BACKFILL PLUG
Material
Setup/Hydration Time
Tremied (Y/N)

REV. DATE: JAN 1989

MONITORING WELL CONSTRUCTION LOG – Double Cased Flush Mount

WELL NO.:	Installation:	Site:
Project No:	Client/Project:	
HAZWRAP Contractor:	Drlg Contractor:	
Comp. Start: (: _ m)	Comp. End: (: _ m)	
Built By:	Well Coord: ______	



PROTECTIVE CSG
Material/Type ______
Diameter ______ Water Tight Seal (Y/N)
Depth BGS ______ Weep Hole (Y/N)

SURFACE PAD
Composition & Size ______

SURFACE CSG
Type ______
Diameter ______ Total Length ______
GROUT: Setup/Hydration Time ______
Composition & Proportions ______
______
Interval BGS ______
Tremied (Y/N)

RISER PIPE
Type ______
Diameter ______
Total Length (TOC to TOS) ______
GROUT
Composition & Proportions ______
______
Interval BGS ______
Tremied (Y/N)

CENTRALIZERS (Y/N)
Depth(s) ______

SEAL
Type ______
Source ______
Setup/Hydration Time ______ Vol. Fluid Added ______
Tremied (Y/N)

FILTER PACK
Type ______
Amount Used ______
Source ______
Gr. Size Dist. ______
Tremied (Y/N)

SCREEN
Type ______
Diameter ______
Slot Size & Type ______

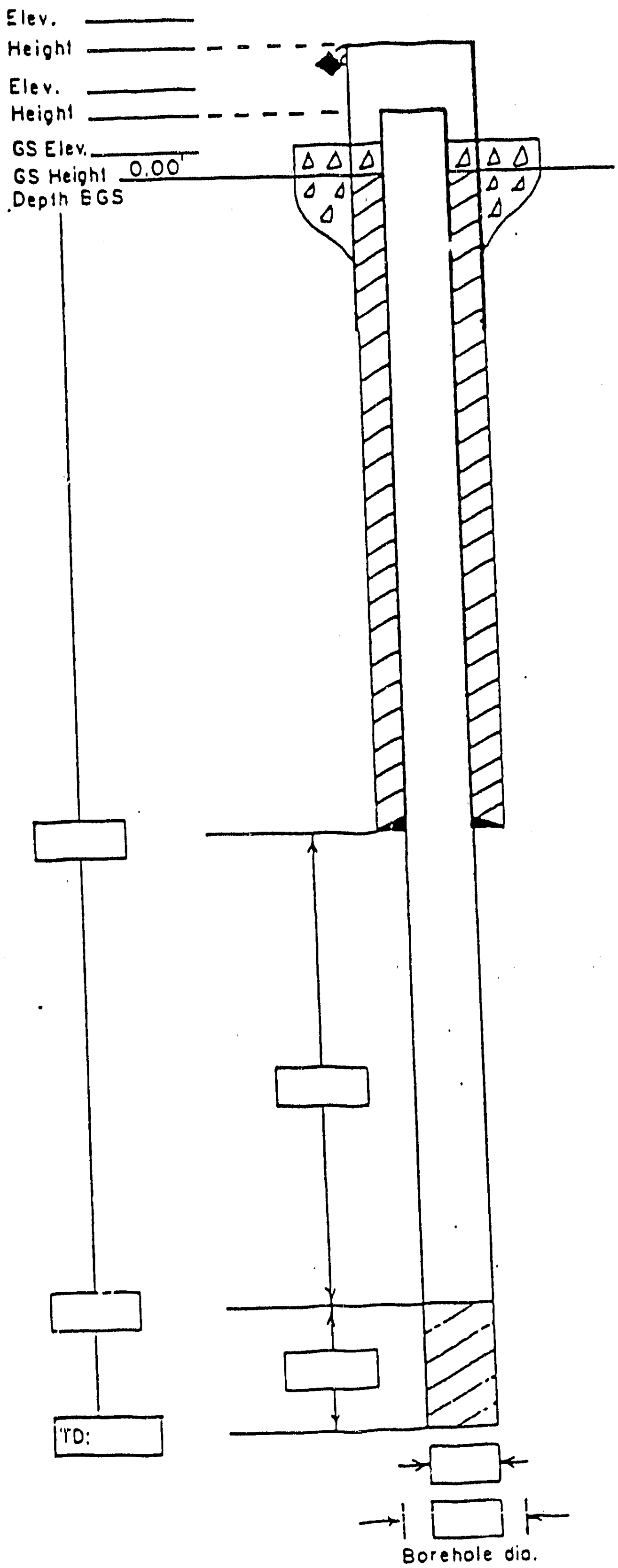
SUMP (Y/N)
Interval BGS ______ Length ______
Bottom Cap (Y/N)

BACKFILL PLUG
Material ______
Setup/Hydration Time ______
Tremied (Y/N)

REV. DATE: JAN 1989

MONITORING WELL CONSTRUCTION LOG – Open Hole

WELL NO.:	Installation:	Site:
Project No.:	Client/Project:	
HAZWRAP Contractor:	Drlg Contractor:	
Comp. Start: (: __m)	Comp. End: (: __m)	
Built By:	Well Coord.:	



PROTECTIVE CSG
Material/Type
Diameter
Depth BGS ______ Weep Hole (Y/N)

GUARD POSTS (Y/N)
No. ______ Type

SURFACE PAD
Composition & Size

RISER PIPE
Type
Diameter
Total Length (TOC to TOS)

GROUT
Composition & Proportions

Tremied (Y/N)
Interval BGS

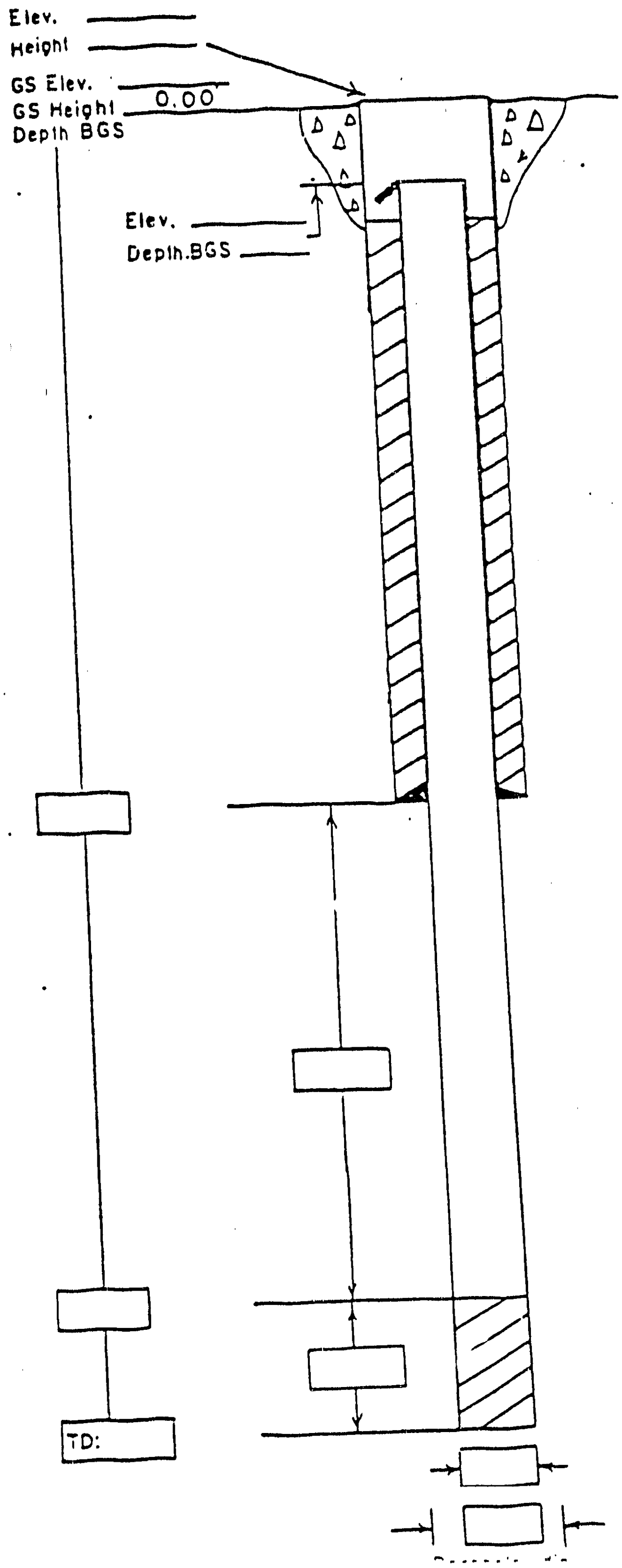
CENTRALIZERS (Y/N)
Depth(s)

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

REV. DATE: JAN 1989

MONITORING WELL CONSTRUCTION LOG - Open Hole Flush Mount

Site:		
WELL NO.:	Installation:	
Project No.:	Client/Project:	
HAZWRAP Contractor:		Drlg Contractor:
Comp. Start: (: m)		Comp. End: (: m)
Built By:		Well Coord.:



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

SURFACE PAD
Composition & Size

RISER PIPE
Type
Diameter
Total Length(TOC to TOS)

GROUT
Composition & Proportions

Tremied (Y/N)
Interval

CENTRALIZERS (Y/N)
Depth(s)

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

AMENDMENTS TO:

FIELD PROCEDURE FP 5-2
MONITORING WELL CONSTRUCTION

The following is a list of specific amendments to the referenced SOP. The amended portions of the SOP are marked and correspond to the numbered items listed below.

1. All wells installed will be 2-inch ID.

2. Threaded, flush-joint casing will be required for the completed 2-inch monitoring well and screen; however, the secondary casing may be joined by welding.

3. Wells constructed in 100-year flood plain will be flood-protected by sealing the top cap of the well.

4. The quantity of sand placed in the annular space shall not extend more than two feet above the top of the screen.

5. The bentonite seal for all wells will be installed as a slurry using a tremie pipe.

6. For wells that are completed above the ground surface, the finish casing should extend approximately 2 feet above the land surface with a protective steel riser pipe equipped with a hinged, lockable cover. A tight fitting cap will be installed on wells in the 100-year flood plain to prevent groundwater contamination by surface water. Modifications to attachment Figures 9.1, 9.2, and 9.4 will also reflect this change.

7. The general well construction details are:

    - 8-inch or 10-inch casing will be driven 2 to 3 feet into the clay confining layer during drilling.
    - 6-inch secondary casing will be driven 3 to 5 feet into the clay confining layer.
    - Grout will be tremied between 8-inch and 6-inch casings as 8-inch casing is pulled.
    - Grout will be allowed to cure for 12 hours (there will be no grout inside the 6-inch secondary casing).
    - A 4-inch casing will be driven during drilling through the confining layer. There should be minimal vibration of the 6-inch casing during drilling with the 4-inch casing.
    - Following installation of the monitoring well, grout will be tremied into the 4-inch borehole and extend back to land surface.

FIELD PROCEDURE FP 5-4

WELL DEVELOPMENT

Subject	Procedure No.	Rev.	
WELL DEVELOPMENT	FP 5-4	0	Page 1 of 5
	Issue Date 05/25/90		Effective Date 07/02/90
	Supersedes Procedure Number 630 FP 12	Rev. 0	Date
Acceptance - Program QA	Approval - Program Manager		

1.0 PURPOSE

The purpose of this procedure is to define the requirements for developing monitoring wells to increase permeability and ensure a representative sample of ground water obtained from the aquifer.

2.0 SCOPE

This procedure applies to development of wells by either the bailing or pumping technique.

3.0 REQUIREMENTS

The purpose of well development is to stabilize and increase the permeability of the gravel pack around the well screen, and to restore the permeability of the formation which may have been reduced by drilling operations. The selection of the well development method shall be made by a hydrogeologist and is based on the drilling methods, well construction and installation details, and the characteristics of the formation in which the well is screened. Any equipment introduced into the well during development shall be decontaminated in accordance with FP 3-1.

Each monitoring well will be developed by bailing or pumping. Centrifugal pumps will generally be used to develop shallow wells with high yield. Submersible pumps will generally be used to develop deep wells of low to high yield. Equipment availability or other circumstances may occasion the use of a submersible pump to develop a shallow high-yield well or hand pumps and bailers to develop any well. Physical and chemical parameters including temperature, pH, specific conductance and turbidity of the water will be measured during well development.

The development water will be stored in appropriate containers, analyzed and handled in accordance with project-specific Work Plan.

Bailers used for development must be decontaminated in accordance with appropriate decontamination procedures.

4.0 REFERENCES

4.1 Driscoll, F.G., 1986, *Groundwater and Wells*: Johnson Division, St. Paul, Minnesota, 1108 p.

4.2 HAZWRAP, February 1989, *Quality Control Requirements for Field Methods*, DOE/HWP-69.

5.0 DEFINITIONS

Swabbing - Swabbing is a process in which a plunger-type device called a surge plunger or surge block, is moved up and down within the well screen to force ground water to alternately flow in and out through the sand pack. This back and forth movement of water facilitates removal of fines from the formation immediately adjacent to the well, while preventing bridging (wedging) of sand grains.

6.0 RESPONSIBILITIES

6.1 Field Operations Leader

The Field Operations Leader is responsible for proper implementation of this procedure.

6.2 Field Geologist

The Field Geologist is responsible for withdrawing sufficient water to clarify the well, and for performing physical measurements such as pH, temperature, specific conductance, and turbidity to ensure proper development. All data should be entered into the field logbook and on the Well Development Log (Attachment 9.1).

7.0 EQUIPMENT

7.1 Pumps.

7.2 Pump suction lines.

7.3 Swabbing equipment (as necessary).

7.4 Bailers.

7.5 Steel retractable engineer's measuring tape calibrated to 0.01 foot.

7.6 Water level indicators.

7.7 pH meter.

7.8 Specific conductance meter.

7.9 Nephelometer.

7.10 Mercury thermometer.

7.11 Drums to contain the development water. | (1)

7.12 Field logbook.

7.13 Well development log.

8.0 PROCEDURE

8.1 Development

- Open and check the condition of the well head. Check for organic vapors.
- Measure the water level in the well before development begins. Record the value to the nearest 0.01 foot in the field logbook.
- Prepare the equipment for developing the well. For screened intervals longer than 10 feet, develop the well in 2 to 3 foot intervals from bottom to top.
- Continue development until water appears to run clear. Collect a sample per Section 8.2.
- Sampling will be repeated until consistent measurements of pH, temperature and specific conductance are achieved in three consecutive samples.
- Development will be considered complete when the three consecutive measurements, each separated by five minutes, have pH values within ± 0.1 units, temperature within ± 1.0 degree Celsius and specific conductance within ± 10 micromhos per centimeter. The turbidity must be less than 5 NTU.
- If the NTU objective is not reached within 8 hours, a sample will be collected for analysis of the silt content by X-ray diffraction. If silt and clay are not present the well will be considered developed. (2)
- If silt and clay are present, the sample will be analyzed for Total Organic Carbon (TOC). If TOC is present, the well will be considered developed. (3)
- If TOC is not present, consideration will be given for further development or abandonment.

8.2 Ground-Water Sampling

A pump or bailer will then be lowered into the well. Water will be removed from the well at varying depths along the entire interval of the screen until the effluent begins to clear of suspended solids. A sample of the development water will be tested for clarity, pH, temperature and specific conductance.

1. Temperature Measurement: The temperature of the water will be measured to within one degree Celsius (°C) using a mercury thermometer. This measurement will also be used to calibrate the pH and conductivity meters.

2. pH Measurement: The pH of the water will be measured within 0.1 pH unit using a portable pH meter. The meter will be calibrated daily, per FP 7-4.

3. Specific Conductivity Measurement: The specific conductivity of the water will be measured with a portable specific conductivity meter. The instrument will be calibrated per FP 7-5.

4. Turbidity: Turbidity will be measured using a nephelometer with a range of 0 to 10 nephelometric turbidity units, an accuracy of ± 0.2 NTU and a resolution of 0.1 NTU. This instrument will be calibrated daily with a 5.0 NTU standard solution cell. (4)

8.3 Development Methods, Restrictions, and Limitations

Overpumping and Backwashing

- This method develops the well by drawing the water level down at a given rate and then reversing the flow direction so water is passing from the well into the formation.
- The acceptable method of backwashing is accomplished by starting and stopping the pump intermittently.

Surging with a Surge Plunger

- A surge plunger (also called a surge block or swab) is approximately the same diameter as the well casing and is used to agitate the water.
- In formations with a high yield, a solid plunger is the most effective.
- In formations with a high yield, a valved surge plunger may be preferred, as they are designed to create greater inflow than outflow during surging.

High-Velocity Jetting

- Water used in high-velocity jetting shall be of known quality (i.e., a sampled source).
- The amount of water added shall be recorded in the field logbook.
- Jetting should be used only if other methods ar ineffective.
- The jetting tool should be rotated and slowly raised and lowered along the length of the screen to insure complete development.

Compressed Air

- For the closed-well method (i.e., increase air pressure in a sealed well forcing water out, then releasing pressure and allowing water to flow back in), care shall be taken not to lower the water level below the top of the screen. (5)
- A no time in the open-well method shall air be injected directly into the screened interval.

9.0 ATTACHMENTS

9.1 Well Development Log.

REV. DATE: JAN 1989

WELL DEVELOPMENT LOG	WELL NO.:	Page ____ of ____
Installation:		Site:
Project No.:	Client/Project:	
HAZWRAP Contractor:	Dev. Contractor:	
Dev. Start: (: __m)	Dev. End: (: __m)	Csg Dia.:
Developed by:		Dev. Rig (Y/N)

Dev. Method ____

Equipment ____

Pre-Dev. SWL ____________ Maximum drawdown during pumping ________ ft at ________ gpm
Range and Average discharge rate ____________________ gpm
Total quantity of material bailed ____________________
Total quantity of water discharged by pumping ____________________
Disposition of discharge water ____

Time	Volume Removed (gal)	Water Level ft.BTOC	Turbidity	Clarity/ Color	Temp. °C	pH	Conductivity	Remarks

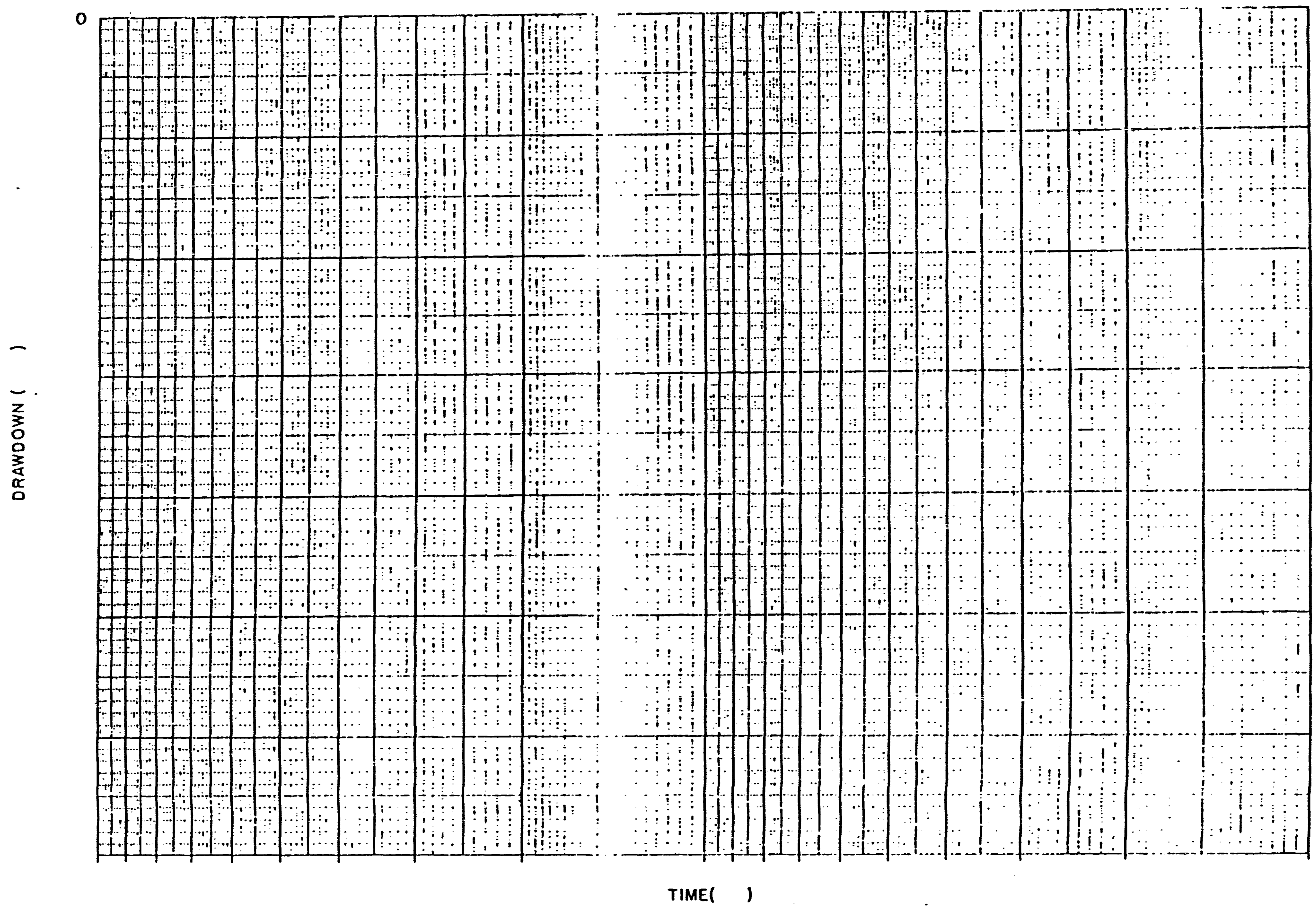
POST DEVELOPMENT WATER LEVEL RECOVERY GRAPH

REV. DATE: JAN 1989

Well Recording Instrument ____________________

Start Recovery: ________ (: __m) End Recovery: ________ (: __m) Total Recovery Time ________

Beginning WL ____________ Final SWL ____________



AMENDMENTS TO:

FIELD PROCEDURE FP 5-4
WELL DEVELOPMENT

The following are specific amendments to the referenced SOP. The amended portions of the SOP are marked and correspond to the comments listed below.

1. Tanks or drums to contain development water.

2. Amendment not implemented.

3. Amendment not implemented.

4. The Nephelometer will be calibrated as directed by the manufacturer.

5. Delete.

FIELD PROCEDURE FP 5-5

WELL PURGING - BAILING METHOD

Subject	Procedure No. FP 5-5	Rev. 0	Page 1 of 5
WELL PURGING - BAILING METHOD	Issue Date 05/25/90		Effective Date 07/02/90
	Supersedes Procedure Number 630 FP 13	Rev.	Date
Acceptance - Program QA	Approval - Program Manager		

1.0 PURPOSE

The purpose of this procedure is to provide general reference information on well purging by the bailing method prior to the sampling of ground water wells. The methods and equipment described are for the purging of water samples from the saturated zone of the subsurface.

2.0 SCOPE

This procedure applies to purging water from relatively low volume wells, or from very deep wells. Reference Procedure FP 5-6 Well Purging - Pumping Method for wells too voluminous for purging by the bailing method.

3.0 REQUIREMENTS

Methods for purging 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 ground water 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 ground water due to normal flow patterns, but the well water above the screened section will remain isolated and become stagnant.

4.0 REFERENCES

4.1 United States Environmental Protection Agency, 1987. *Ground Water Handbook*: EPA/625/6-87/016.

5.0 DEFINITIONS

Bailer - A cylindrical section of PVC, stainless steel, or Teflon closed at the top, and with a floating ball check-valve at the bottom. The bailer is submerged, the ball floats, and water enters from the bottom. As the bailer is raised, the ball settles on the bottom creating a seal, allowing retrieval of a quantity of trapped water.

6.0 RESPONSIBILITIES

6.1 Project Manager

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

6.2 Site Hydrogeologist or Geochemist

Responsible for selecting and detailing the specific well purging techniques and equipment to be used, documenting these in the project-specific work plan, and properly briefing the site sampling personnel.

6.3 Site Geologist

The Site Geologist is primarily responsible for the proper well purging techniques. When appropriate, such responsibilities may be performed by other qualified personnel (engineers, field technicians). The Geologist will be responsible for purging of wells, performing necessary physical measurements and observations, and containment of purged water. He must record pertinent information including amount of water purged, pH, specific conductivity of emperature, and turbidity in the Field Log Book and on the Ground Water Sampling Form, Attachment 9.1. (1)

7.0 EQUIPMENT

7.1 Bailers.

7.2 One-quarter inch nylon rope.

7.3 Steel retractable engineer's measuring tape (Calibrated to 0.01 foot).

7.4 Water level indicators.

7.5 Swabbing equipment (as necessary).

7.6 pH meter.

7.7 Specific conductance meter.

7.8 Nephelometer.

7.9 Mercury thermometer.

7.10 HNu photoionization detector.

7.11 Drums to contain the development water.

7.12 Ground water sampling form, Attachment 9.1.

7.13 Field log book.

8.0 PROCEDURE

8.1 General

- The amount of flushing a well should receive prior to sample collection will depend on the intent of the monitoring program and the hydrogeologic conditions.

- For the volumetric method, generally three to five well volumes are considered effective for purging a well.
- An alternative method of purging a well is to purge continuously (using a low volume low flow pump) while monitoring specific conductance, pH, and water temperature until the values stabilize.
- The site hydrogeologist, geochemist, and risk assessment personnel shall define the objective of the groundwater sampling program in the Work Plan.

8.2 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 determine the volume of standing water in the well pipe and the volume of water in the filter pack below the well seal. The volume can be easily calculated by the following method. Calculations shall be entered in the field logbook:

1. Obtain all available information on well construction (location, casing, screens, etc.).
2. Determine well or casing and borehole diameter.
3. Measure and record static water level (Depth below ground level or top of casing reference point), using one of the methods described in FP 7-2.
4. Determine depth of well (if known from past records) by sounding using a clean, decontaminated weighted tape measure.
5. Calculate number of linear feet of static water (total depth or length of well pipe minus the depth to static water level).
6. Calculate the volume of water in the casing and the volume of water in the filter pack.

$$Vc = \pi \, (di/2)^2 \, (TD-H)$$

$$Vf = \pi \, \frac{dH^2}{2} - \frac{do^2}{2}$$

TD - (S or H) (P)

If S > H use S, if S < H use H

$$Vt = (Vc + Vf)\,(7.48)$$

Where:

Vc = Volume of water in casing, ft^3
Vf = Volume of water in filter pack, ft^3

Vt	=	Total volume, gal
di	=	inside diameter of casing, ft
do	=	outside of diameter of casing, ft
dH	=	diameter of borehole, ft
TD	=	total depth of well, ft
H	=	depth to water, ft, from ground surface
S	=	depth to base of seal, ft, from ground surface
P	=	estimated porosity of filter pack (for most Ottawa, Morie #1 sand or glass beads this value is estimated at a range of 30 to 35%)

7. Determine the minimum number of volumes to be evacuated before sampling.

8.3 Well Purging by Bailing

- Remove protective foil from the top of the bailer.
- To prevent bailer from getting stuck in the well, the loose end of the rope will be cut short enough not to extend beyond the sloping portion of the bailer barrel.
- The bailer will be slowly lowered into the well to the desired level. NOTE: If resistance is encountered when lowering into the well, THE BAILER WILL BE WITHDRAWN FROM THE WELL, and the Field Operations Leader informed.
- The rope will be secured to the protective casing of the well or to the Geologists wrist.
- To prevent the introduction of foreign contaminants into the well, the bailing rope will not be allowed to contact the ground.
- The bailer will be withdrawn from the well and the purge water poured into the receptor drum.
- The bailer will be lowered and balesful of water withdrawn repeatedly until the required minimum of three well volumes have been purged.
- Record total volume of water removed on the Ground Water Sampling Form (Attachment 9.1) and in the field log book.
- Monitor purge water for physical parameters including pH, conductivity, temperature, and turbidity and record these values on the Ground Water Sampling Form (Attachment 9.1) and the Field Log Book. (2)
- Purging will continue until the required volume of water has been removed and the physical parameters have stabilized so that pH is ± 0.1 su, conductivity ± 10 umhos and temperature is ± 1 °C, within three successive intervals.
- Whenever the receptor drum has become filled, the water shall be stored,

analyzed and disposed of in accordance with the project-specific Work Plan.

- Decontaminate the bailers per FP 3-1.

8.4 Restrictions and Limitations

- Bailers are the simplest evacuation devices and offer several advantages:
  - few limitations on size and materials;
  - no external power source needed;
  - bailers are inexpensive and can be dedicated to the well to reduce cross-contamination;
  - minimal outgassing of volatiles;
  - easy to contaminate.
- Limitations on the use of bailers include:
  - time consuming to remove stagnant water column;
  - transfer of sample may cause aeration; and
  - use of bailers is physically demanding, especially in warm temperatures at protection levels above Level D.

9.0 ATTACHMENTS

9.1 Ground-Water Sampling Form

ATTACHMENT 9.1
FP 5-5
2 PAGES

GROUND WATER SAMPLING FORM

3. GROUNDWATER SAMPLING FORM

1. Date/Time ________________ Sample No. ________________
2. Location ________________________________
3. Well No. ________________ Sketch on Back [Y or N] ________
4. Total Depth ________________ Number of Screened Interval(s) ______
5. Depth to Screen/Length(s) ________________________
6. [Y or N] Well Secure? Comments ________________________
   ____
7. Sampler ________________ Other present ________________
8. Organic Vapor Detector FEL No. __________, Reading __________
9. Weather: Wind ______, Precipitation ______, Air Temperature ______
10. Water Level Measurement: FEL No. ________________
    [Y or N] Well Labeled ______, Elev. Ref. For Water Level ______
    Comments ________________________________
    Odor ________________________________

11. Depth to Product / Depth to Interface/Water / Thickness

	Depth to Product	Depth to Interface/Water	Thickness
1st	______	______	______

12. Casing Type __________, I.D. __________, Gal/Ft. __________
    (Show derivation for gal/ft of casing)

13. Total Depth __________ - Depth to Water __________ = Ht. __________
14. Well Volume __________ = Ht. __________ * Gal/Ft. __________
15. Required Purge Volume __________, Actual Purge __________

16. FEL No.'s Cond. ______ pH ______ Temp. ______ Redox ______

17.

Cond.	µmhos/cm	pH	Temp.	Redox mv
Initial	______	______	______	______
(Purged	______	______	______	______
cycle)	______	______	______	______
	______	______	______	______
Sample	______	______	______	______

Sample Type and FEL No. ________________________

18. [Y or N] Turbid __________, Purge Water Containerized __________
19. Sample Filtered __________, Filter Size __________
20. Reviewed By ________________ Date/Time __________
    Form Complete? [Y or N] ________
    Decon Complete? [Y or N] ________

③

AMENDMENTS TO:

FIELD PROCEDURE FP 5-5
WELL PURGING - BAILING METHOD

The following are specific amendments to the referenced SOP. The amended portions of the SOP are marked and correspond to the numbered comments below.

1. Amendment not implemented.

2. Amendment not implemented.

3. Purging method ________________________________.

FIELD PROCEDURE FP 5-6

WELL PURGING - PUMPING METHOD

Subject	Procedure No. FP 5-6	Rev. 0	Page 1 of 6
WELL PURGING - PUMPING METHOD	Issue Date 05/25/90		Effective Date 07/02/90
	Supersedes Procedure Number 630 FP 14	Rev. 0	Date
Acceptance - Program QA	Approval - Program Manager		

1.0 PURPOSE

The purpose of this procedure is to provide general reference information on well purging by the pumping method prior to the sampling of ground-water wells. The methods and equipment described are for the purging of water samples from the saturated zone of the substrata.

2.0 SCOPE

This procedure applies to purging relatively large volumes of water in shallow to medium depth wells.

3.0 REQUIREMENTS

Methods for purging 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 ground water 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 ground water due to normal flow patterns, but the well water above the screened section will remain isolated and become stagnant.

4.0 REFERENCES

4.1 United States Environmental Protection Agency, 1987. *Ground Water Handbook*: EPA/625/6-87/016.

4.2 HAZWRAP, February 1989. *Quality Control Requirements for Field Methods*, DOE/HWP-69.

5.0 DEFINITIONS

None.

6.0 RESPONSIBILITIES

6.1 Project Manager

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

6.2 Site Hydrogeologist or Geochemist

The site Hydrogeologist or geochemist is responsible for selecting and detailing the specific well purging techniques and equipment to be used, documenting these in the project-specific work plan, and properly briefing the site sampling personnel.

6.3 Site Geologist

The Site Geologist is primarily responsible for the proper well purging techniques. When appropriate, such responsibilities may be performed by other qualified personnel (engineers, field technicians). The Geologist will be responsible for purging of wells, performing necessary physical measurements and observations, and containment of purged water. He must record pertinent information including amount of water purged, pH, specific conductivity, temperature, and turbidity in the Field Log Book and on the Ground-Water Sampling Form, Attachment 9.1. (1)

7.0 EQUIPMENT

7.1 Gasoline or electric purge pump.

7.2 Power source.

7.3 Steel retractable engineer's measuring tape (Calibrated to 0.01 foot).

7.4 Water level indicators.

7.5 Swabbing equipment (as necessary).

7.6 pH meter.

7.7 Specific conductance meter.

7.8 Nephelometer.

7.9 Mercury thermometer.

7.10 HNu photoionization detector.

7.11 Drums to contain the development water.

7.12 Ground-water sampling form, Attachment 9.1.

7.13 Field log book.

8.0 PROCEDURE

8.1 General

- The amount of flushing a well should receive prior to sample collection will depend on the intent of the monitoring program and the hydrogeologic conditions.
- For the volumetric method, generally three to five well volumes are considered effective for purging a well.
- An alternative method of purging a well is to purge continuously (using a low volume low flow pump) while monitoring specific conductance, pH, and water temperature until the values stabilize.
- The site hydrogeologist, geochemist, and risk assessment personnel shall define the objective of the ground-water sampling program in the Work Plan.

8.2 Calculations of Well Volume

To ensure that the proper volume of water has been removed from the well prior to sampling, it is first necessary to determine the volume of standing water in the well pipe and the volume of water in the filter pack below the well seal. The volume can be easily calculated by the following method. Calculations shall be entered in the field logbook:

1. Obtain all available information on well construction (location, casing, screens, etc.).
2. Determine well or casing and borehole diameter.
3. Measure and record static water level (Depth below ground level or top of casing reference point), using one of the methods described in FP 7-2.
4. Determine depth of well (if not known from past records) by sounding, using a clean, decontaminated weighted tape measure.
5. Calculate number of linear feet of static water (total depth or length of well pipe minus the depth to static water level).
6. Calculate the volume of water in the casing and the volume of water in the filter pack.

$$Vc = \pi \ (di/2)^2 (TD-H)$$

$$VF = \pi \ [(dH/2)^2 - do/2)^2]$$

$$TD - (S \text{ or } H) (P)$$

If S > H use S, if S < H use H

$$Vt = (Vc + Vf) (7.48)$$

Where:

Vc	=	Volume of water in casing, ft^3
Vf	=	Volume of water in filter pack, ft^3
Vt	=	Total volume, gal
di	=	inside diameter of casing, ft
do	=	outside of diameter of casing, ft
dH	=	diameter of borehole, ft
TD	=	total depth of well, ft
H	=	depth to water, ft, from ground surface
S	=	depth to base of seal, ft, from ground surface
P	=	estimated porosity of filter pack (for most Ottawa, Morie #1 sand or glass beads this value is estimated at a range of 30 to 35%)

7. Determine the minimum number of volumes to be evacuated before sampling.

8.3 Specific Procedure

- To prevent cross contamination of wells, upgradient and background wells should be purged and sampled first. ②

- Open the well casing cover, remove the well cap and sample the well head space for gaseous contaminants using the HNu photoionization detector (see HNu instruction manual). If the organic vapor concentration is equal to or greater than 1000 ppm, immediately recap the well and inform the Field Operations Leader.

- Measure the "depth to water" in the well in accordance with the water level measurement procedure and using well construction data (FP 7-2).

- Calculate the volume of water in the well. Record this data in the purge notebook and calculate the volume of water in the well. Record this data in the purge notebook and calculate the volume of water required to be purged. Normally, the well will be purged of three to five volumes of water or until the temperature, pH and conductivity have stabilized.

- Lower the purge pump into the well until it is submerged. NOTE:!!! If resistance is encountered when lowering the pump into the well, WITHDRAW THE PUMP FROM THE WELL and inform the Field Operations Leader.

- Direct the pump discharge hose into the receptor bucket and start the pump in accordance with the pump's operation manual. Record the total volume of water purged from the well. Collect a minimum of three samples during purging and note the clarity of the sample, pH, conductivity, and temperature measurements of the sample in the purge notebook.

- Whenever the receptor bucket is filled, dispose of the purge water in accordance with the project-specific work plan.

- Continue purging the well until the required volume of water has been purged and physical parameters have stabilized.
- Carefully withdraw the purge pump from the well and decontaminate the pump and hose in accordance with FP 3-1.
- Dispose of all contaminated waste items in accordance with the project-specific work plan.

8.4 Well Purging by Pumping

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 volume created by these pumps can cause significant loss of dissolved gases and volatile organics.
- The complex internal components of these pumps may be difficult to decontaminate.

Submersible Pumps - Submersible pumps take in water and push the sample up a sample tube to the surface. The power sources of 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-in diameter wells and larger. These pumps can lift water from considerable depths (several hundred feet).

Limitations of this class of pumps include:

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

9.0 ATTACHMENTS

9.1 Ground-Water Sampling Form

ATTACHMENT 9.1
FP 5-5
2 PAGES

GROUND-WATER SAMPLING FORM

3. GROUNDWATER SAMPLING FORM

1. Date/Time ____________ Sample No. ____________
2. Location ____________
3. Well No. ____________ Sketch on Back [Y or N] ______
4. Total Depth ____________ Number of Screened Interval(s) ______
5. Depth to Screen/Length(s) ____________
6. [Y or N] Well Secure? Comments ____________
7. Sampler ____________ Other present ____________
8. Organic Vapor Detector FEL No. ________, Reading ________
9. Weather: Wind ______, Precipitation ______, Air Temperature ______
10. Water Level Measurement: FEL No. ____________
    [Y or N] Well Labeled ______, Elev. Ref. For Water Level ______
    Comments ____________
    Odor ____________

11.

	Depth to Product	Depth to Interface/Water	Thickness
1st	________	________	________

12. Casing Type ________, I.D. ________, Gal/Ft. ________
    (Show derivation for gal/ft of casing)

13. Total Depth ________ - Depth to Water ________ = Ht. ________
14. Well Volume ________ = Ht. ________ * Gal/Ft. ________
15. Required Purge Volume ________, Actual Purge ________

16. FEL No.'s Cond. ______ pH ______ Temp. ______ Redox ______

17.

Cond.	μmhos/cm	pH	Temp.	Redox mv
Initial	______	______	______	______
(Purged	______	______	______	______
cycle)	______	______	______	______
	______	______	______	______
Sample	______	______	______	______

Sample Type and FEL No. ____________

18. [Y or N] Turbid ________, Purge Water Containerized ________
19. Sample Filtered ________, Filter Size ________
20. Reviewed By ____________ Date/Time ________
    Form Complete? [Y or N] ______
    Decon Complete? [Y or N] ______

AMENDMENTS TO:

FIELD PROCEDURE FP 5-6
WELL PURGING - PUMPING METHOD

The following are amendments to the referenced SOP. The amended portions of the SOP are marked and correspond to the numbered comments below.

1. Amendment not implemented.

2. The monitoring wells will be sampled in a manner which is logistically convenient.

3. Purging method ______________________________.

FIELD PROCEDURE FP 5-7

MONITORING WELL AND BOREHOLE ABANDONMENT

Subject	Procedure No. FP 5-7 / Rev. 0 / Page 1 of 2
	Issue Date: 05/25/90 / Effective Date: 07/02/90
MONITORING WELL AND BOREHOLE ABANDONMENT	Supersedes Procedure Number / Rev. / Date: 630 FP 33
Acceptance - Program QA	Approval - Program Manager

1.0 PURPOSE

The purpose of this procedure is to describe, in general terms, the principles and methods of securing a monitoring well borehole from external contaminants after testing is completed.

2.0 SCOPE

This procedure applies specifically to abandonment of test holes and wells in the State of Ohio and generally to other locations with the understanding that federal, state or local regulations may modify these requirements. A specific plan for abandonment should be presented as an integral part of the monitoring well or borehole approval process.

3.0 REQUIREMENTS

The potential for entrance of contaminants into ground-water through monitoring wells or boreholes that are not properly maintained after testing is complete or simply abandoned, is enormous.

For this reason, an effective method for preventing the entrance of contaminants into ground water must be developed and utilized.

4.0 REFERENCES

4.1 Ohio Administrative Code (OAC) 3745-9-10, February 15, 1975, *Abandonment of Test Holes and Wells*.

5.0 DEFINITIONS

Contaminant - Any substance, which if introduced, would degrade the quality of ground water.

Grout - A slurry of cement, clay or other material impervious to and capable of preventing movement of water. Typically a neat cement grout containing three to five percent bentonite powder by weight.

6.0 RESPONSIBILITIES

The Field Operations Leader is responsible for assuring that monitoring wells and boreholes are abandoned in accordance with this procedure.

7.0 EQUIPMENT

7.1 Drilling Rig equipped with appropriate drilling tools and crew.

7.2 Cement, sand, bentonite powder, bentonite pellets or commercial hole-sealing products.

8.0 PROCEDURE

8.1 The client and regulatory agency shall determine if a monitoring well or borehole is damaged to the point of being useless or is no longer necessary for field investigations. (1)

8.2 When abandoning a well containing walls, the well shall be filled with grout from the base of the well to the land surface by tremie pipe.

8.3 Test holes, dug with a backhoe to a relatively shallow depth to test the water level, shall ordinarily be filled with the material that was removed from the hole and compacted.

8.4 Wells with damaged casings shall be re-drilled to remove the casing and grouted. In this way, the integrity of the seal in the annular space; that is, between the side of the excavation and the casing, is assured. This method is also recommended in areas of potentially high contamination levels or where weather, especially frost heaving causes a void between the well apron and well casing.

9.0 ATTACHMENTS

None.

AMENDMENTS TO:

FIELD PROCEDURE FP 5-7
MONITORING WELL AND BOREHOLE ABANDONMENT

The following are specific amendments to the referenced SOP. The amended portions of the SOP are marked and correspond to the numbered comments below.

1. Amendment not implemented.

FIELD PROCEDURE FP 6-5

GROUND-WATER SAMPLING

Subject	Procedure No. FP 6-5	Rev. 0	Page 1 of 13
GROUND-WATER SAMPLING	Issue Date 05/25/90		Effective Date 07/02/90
	Supersedes Procedure Number 630 FP 9	Rev. 0	Date
Acceptance - Program QA	Approval - Program Manager		

1.0 PURPOSE

The purpose of this procedure is to obtain ground-water samples that are representative of the source from which they are taken, and minimize sampler exposure to ground-water contaminants. The methods and equipment described are for the collection of water samples from the saturated zone of the substrata.

2.0 SCOPE

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

3.0 REQUIREMENTS

Generally, wells should be sampled within three hours of purging. However, wells with poor recharge should be sampled within 24 hours of purging. Poor recharge wells are those that cannot recharge 80% of the original volume within 8 hours.

Applicable preservatives must be added to the sample containers before receiving the samples. All sampling equipment must be decontaminated in accordance with Field Procedure FP 3-1, Decontamination of Sampling Equipment, before commencement of sampling.

4.0 REFERENCES

4.1 ASTM, 1986. *Annual Book of ASTM Standards*, Section 11. Volume 11.04, D4448-85A.

4.2 Barcelona, M.J., J.P. Gibb and R.A. Miller, 1983. *A Guide to the Selection of Materials for Monitoring Well Construction and Groundwater Sampling*, ISWS Contract Report 327, Illinois State Water Survey, Champaign, IL.

4.3 Johnson Division, UOP, Inc. 1975. *Ground Water and Wells, A Reference Book for the Water Well Industry*. Johnson Division, UOP, Inc., Saint Paul, MN.

4.4 Nielson, D.M. and G.L. Yeates, 1985. *A Comparison of Sampling Mechanisms Available for Small-Diameter Ground Water Monitoring Wells.* Ground Water Monitoring Review 5:38-98.

4.5 Scalf, M.R., J.F. McNabb, W.J. Dunlapp, R.L. Crosby and J. Fryberger, 1981. *Manual of Ground Water Sampling Procedures.* R.S. Kerr Environmental Research Laboratory, Office of Research and Development, USEPA, Ada, OK.

4.6 USDOE/HWP-69, 1989. *Quality Control Requirements for Field Methods.*

4.7 USEPA, 1980. *Procedures Manual for Ground Water Monitoring at Solid Waste Disposal Facilities.* Office of Solid Waste, United States Environmental Protection Agency, Washington, D.C.

4.8 USEPA, 1986. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, EPA SW-846.

4.9 USEPA, 1987. *Ground Water Handbook*, EPA/625/6-87/016.

4.10 USEPA, 1987. *A Compendium of Superfund Field Operations Methods*, EPA/540/P-87/001.

5.0 DEFINITIONS

None.

6.0 RESPONSIBILITIES

6.1 Project Manager

Responsible for reviewing the sampling procedures used by the field crew and for performing in-field spot checks for proper sampling procedures.

6.2 Site Hydrogeologist or Geochemist

Responsible for selecting and detailing the specific ground-water sampling techniques and equipment to be used, documenting these in the project-specific Work Plan, and properly briefing the site personnel.

6.3 Site Geologist

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

7.0 EQUIPMENT

Sample containers shall conform with EPA regulations for preservation of appropriate contaminants (see Procedure FP 6-7).

Ideally, sample withdrawal equipment should be completely inert, economical, easily decontaminated, easily sterilized, reusable, able to operate at remote sites in the absence of power sources, and capable of delivering variable rates for well flushing and sample collection. The sample withdrawal equipment (evacuation devices) most commonly used are discussed in Section 8.3.2 of this procedure.

7.1 Sample Packing and Shipping Equipment.

7.2 Coolers for sample shipping and cooling.

7.3 Chemical preservatives.

7.4 Appropriate packing cartons and filler.

7.5 Labels.

7.6 Chain-of-custody documents.

7.7 Thermometer.

7.8 pH meter/paper.

7.9 Dissolved oxygen meter.

7.10 Portable HNu or OVA photoionization detector.

7.11 Specific-conductivity meter.

7.12 Camera and film.

7.13 Appropriate keys (for locked wells).

7.14 Tape measure.

7.15 Pipe wrenches.

7.16 Water-level indicator.

7.17 Flow meter.

7.18 Sample gloves.

7.19 Field sampling log books.

7.20 Knife.

7.21 Sample table and plastic cover.

7.22 Plastic trash bags.

7.23 Indelible pen.

7.24 Pen, black, permanent ink.

7.25 Shallow-well pumps: centrifugal, pitcher, suction, or peristaltic pumps with droplines, air-lift apparatus (compressor and tubing) where applicable

7.26 Deep-well pumps: submersible pump and electrical power generating unit, bladder pump with compressed air source, or air-lift apparatus where applicable

7.27 Sample tubing such as Teflon, polyethylene, polypropylene, or PVC. Tubing type shall be selected based on specific site requirements and must be chemically inert to ground water being sampled

7.28 Teflon, PVC, or stainless steel:

- Teflon-coated wire, stainless steel single strand wire, polypropylene monofilament line, or one-quarter inch nylon rope
- tripod-pulley assemble (if necessary)

7.29 Pails:

- Plastic, graduated

7.30 Decontamination Solutions:

- Distilled water, Alconox or Liquinox, methanol, acetone, or isopropyl alcohol

(1)

8.0 PROCEDURE

8.1 General

To be useful and accurate, a ground-water sample must be representative of the particular saturated zone of the substrata 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.

The ground-water sampling program should be developed with reference to ASTM D4448-85A, Standard Guide for Sampling Ground Water Monitoring Wells. The ASTM guide is not intended as a monitoring plan or procedure for a specific application, but rather is a review of methods. Specific methods must be stated in the project-specific Work Plan.

Methods for withdrawing samples from completed wells include the use of pumps, compressed air, and various types of samplers such as bailers. The primary considerations in obtaining a representative sample of the ground water 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. Stratification may occur. The well water in the screened section will mix with the ground water 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 should be followed during sample withdrawal:

1. All monitoring wells shall be pumped or bailed prior to withdrawing a sample. Evacuation of three to five volumes is recommended for a representative sample. In a high-yielding ground-water 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 pumped or bailed to dryness with the sampling equipment being used, the wells should be evacuated and allowed to recover prior to sample withdrawal. If the recovery rate is fairly rapid and time allows, 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. The inlet line of the sampling pump should be placed just below the surface of the well water and three to five casing volumes of water pumped from the well at a rate equal to the well's recovery rate. This provides reasonable assurance that all stagnant water has been evacuated. The sample can then be collected directly from the pump discharge line, or a bailer can be used to collect the sample.

   b. The inlet line of the sampling pump (or the submersible pump itself) should be placed near the bottom of the screened section. Approximately one casing volume of water should be pumped from the well at a rate equal to the well's recovery rate. The sample should then be collected directly from the discharge line.

Stratification of contaminants may exist in the aquifer formation, either in terms of concentration gradients as a result of mixing and dispersion processes in a homogeneous layer, or due to 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. This can result in the collection of a non-representative sample. Water produced during purging shall be collected, stored or treated and discharged as allowed. Disposition of purge water is usually project-specific and must be addressed in the project-specific Work Plan.

8.2 Calculations of Well Volume

To ensure that the proper volume of water has been removed from the well prior to sampling, it is first necessary to determine the volume of standing water in the well casing and the volume of water in the filter pack below the well seal. The volume can be easily calculated by the following method. Calculations should be entered into the field logbook:

1. Obtain all available information on well construction (location, casing, screens, etc.).

2. Determine well or casing and borehole diameter.

3. Measure and record static water level (depth below ground level or top of casing reference point), using one of the methods described in Field Procedure FP 7-2, Water Level Measurement.

4. Determine depth of well (if not known from past records) by sounding, using a clean, decontaminated, weighted tape measure.

5. Calculate number of linear feet of static water (total depth or length of well casing minus the depth to static water level).

6. Calculate the volume of water in the casing and the volume of water in the filter pack.

$$Vc = (\pi)(di/2)^2(TD-H)$$

$$Vf = (\pi)[(dH/2)^2-(do/2)^2](TD-[S \text{ or } H])(P)$$

If $S > H$ use S, if $S < H$ use H

$$Vt = (Vc+Vf)(7.48 \text{ gal/ft}^3)$$

Where,

Vc	=	Volume of water in casing, ft^3
Vf	=	Volume of water in filter pack, ft^3
Vt	=	Total volume, gal
di	=	inside diameter of casing, ft
do	=	outside of diameter of casing, ft
dH	=	diameter of borehole, ft
TD	=	total depth of well, ft
H	=	depth to water, ft, from ground surface
S	=	depth to base of seal, ft, from ground surface
P	=	estimated porosity of filter pack (for most Ottawa, Morie #1 sand or glass beads this value is estimated at a range of 30 to 35%)
π	=	pi, a constant = 3.14

7. Determine the minimum number of volumes to be evacuated before sampling.

8.3 Evacuation of Static Water (Purging)

8.3.1 General

The amount of flushing a well should 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 extended pumping periods to obtain

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 sufficiently to remove the stagnant water but not long enough to induce significant ground-water

An alternative method of purging a well is to pump continuously (usually using a low-volume, low-flow pump) while monitoring specific conductance, pH, and water temperature until the values stabilize.

The site hydrogeologist, geochemist and risk assessment personnel must define the objectives of the ground-water sampling program in the project-specific Work Plan, and provide appropriate criteria and guidance to the sampling personnel on the proper methods and volumes of well purging. Procedures for well purging are documented in Field Procedures FP 5-5, Well Purging - Bailing Method, and FP 5-6 Well Purging - Pumping Method.

8.3.2 Evacuation Devices

The following discussion is limited to those devices which are commonly used for sampling at hazardous waste sites.

Bailers are the most simple evacuation devices used and have many advantages. They generally consist of a length of pipe with either a ball check-valve at the bottom (most preferred), or the bucket-type bailer, which has a sealed bottom. An inert line (e.g., Teflon-coated) 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 (secured in the well between sample collections) to reduce the chances of cross-contamination
- There is minimal outgassing of volatile organics while the sample is in bailer
- Bailers are relatively easy to decontaminate

Limitations on the use of bailers include the following:

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

Suction Pumps - There are many different types if inexpensive suction pumps including: centrifugal, diaphragm, peristaltic, and pitcher pumps. Centrifugal and diaphragm pumps may be used for well evacuation at both a fast pumping rate and low pumping rate. The peristaltic pump is a low volume pump (therefore not suitable for well purging) that creates a suction by using rollers to squeeze a flexible tubing. 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 ft of the ground surface. Another 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.

Gas-Lift Samplers

This group of samplers use gas pressure either in the annulus of the well or in a venturi to force the water through a sampling tube. The pumps are also relatively inexpensive. Gas lift pumps 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. An inert gas such as nitrogen is generally used.

Submersible Pumps

The operating principles of submersible pumps vary widely. The displacement of the sample may be achieved by an inflatable bladder, sliding piston, gas bubble, or impeller. The power sources of these pumps maybe compressed gas or electricity. 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:

- They may have low delivery rates
- Many models are expensive
- Compressed gas or electric power is required
- Sediment in water may cause clogging of the valves or abrading of the impellers
- Decontamination of internal components is difficult and time-consuming

8.4 Sampling

The sampling approach consisting of the following, should be developed as part of the project-specific Work Plan prior to the field work:

1. Background and objectives of sampling.
2. Brief description of area and waste characterization.
3. Identification of sampling locations, with map or sketch, and applicable well construction data (well size, depth, screened interval, reference elevation).
4. Sampling equipment to be used.
5. Assigned 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 should be sampled last to reduce the risk of cross-contamination between wells as a result of the sampling procedures.
6. Sample preservation requirements.
7. Working schedule.
8. List of team members.
9. List of observers and contacts.
10. Other information, such as the necessity for a warrant or permission of entry, requirement for split samples, access problems, location of keys, etc.

8.4.2 Sampling Methods

The collection of a ground-water sample is made up of the following steps. ②

1. Set up the sample table adjacent to the well and cover the table top with clear sheet plastic to minimize contamination of the table. Tape the plastic onto the table and record the sample location, site, anticipated sample time, and field sample number onto the plastic using a indelible pen. Fill out sample labels for each of the required sample containers and place labels onto the appropriate sample containers. Labels must be waterproof to prevent water damage. The following information must be included on the sample label:

   - site name;
   - field identification or sample station number;
   - date and time of sample collection;

- designation of the sample as grab or composite;
- type of sample (matrix) and a brief description of the sampling location;
- printed full name of the sampler;
- sample preservative used; and
- types of analyses to be performed.

If a sample is split with another party, sample labels with identical information should be attached to each of the sample containers.

2. Position the labeled sample containers and required trip blanks, on the sample table so that the sampling information on the plastic is legible and take a photograph of the sampling setup.

3. Health and Safety Officer or designee will open the well cap and use volatile organic detection equipment (HNU or OVA) to monitor the escaping gases at the well head to determine the need for respiratory protection.

4. When proper respiratory protection has been selected and outfitted, sound the well for total depth and water level (using decontaminated equipment) and record these data in the field notebook. Calculate the fluid volume in the well according to Section 8.2.

5. Calculate depth from the casing top to the midpoint of the screen or well section open to the aquifer. Any dry wells encountered must be noted. (3)

6. Select appropriate purging equipment. If an electric submersible pump with packer is chosen, go to Step 11.

7. Lower purging equipment or intake into the well to a short distance below the water level and begin water removal. If resistance is encountered when lowering the device into the well, **withdraw the device from the well** and inform the Field Operations Leader or use a smaller diameter device. Purge the well following the appropriate procedure (Field Procedures FP 5-5 Well Purging - Bailing Method, and FP 5-6 Well Purging - Pumping Method).

8. If sample is taken 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 a bailer other than the "bucket-type"). Purged water should be collected in a designated container and disposed of in an acceptable manner according to the project-specific Work Plan.

9. (For pump and packer assemble 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 should always be tested in a casing section above ground to determine proper inflation pressures for adequate sealing.

10. In the event that recovery time of the well is very slow (e.g., 24 hours), sample collection may 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.

11. To ensure that ground-water samples are representative of actual conditions, samplers must work efficiently to minimize the loss of ground-water contaminants and the introduction of foreign contaminants. To prevent contamination of samples, the sample bottles should be opened only when receiving sample preservatives or ground-water samples and closed immediately afterwards. To prevent introduction of foreign contaminants into the well, sample bottles should be held away from the well opening when receiving samples and the bailing rope should not be allowed to touch the ground, or other potentially contaminating objects.

    The sampler should quickly add the sample into the sample containers, while minimizing aeration and loss of volatile contaminants. Samples collected for analysis of volatile constituents will be collected first, followed by samples collected for analysis of total organic carbon (TOC), total organic halogens (TOX), and those constituents which require field filtration or field determination after collection of volatile organics. Water from each bailer extraction from the well will be divided among the remaining sample bottles. For analysis that requires filtered samples, it is preferred that the samples be allowed to settle in a separate sample container, followed by decanting and then filtration. Consult the specific analytical procedure for details. Large volume samples for extractable organic compounds, total metals, etc., should be collected last.

    When a sample bottle is filled, the bottle must be tightly capped as soon as possible.

12. Efficiency and care must be utilized to obtain representative samples for volatile organic analysis. Unnecessary delays or poor sampling technique will lead to loss of the volatile constituents from the sample.

    Add the required preservatives to the sample containers within 12 hours of collecting the sample, label all containers and stage the collection setup before collecting the sample to minimize sampling time. If possible, collect samples using either a Teflon or stainless steel bottom filling bailer in accordance with Section 8.3.2. Prevent unnecessary stripping of volatile constituents from the sample by minimizing turbulence and aeration when filling the sample container. Quickly fill the sample container until a positive meniscus is achieved above the rim of the container and cap the container immediately. Gently tap the sample container to dislodge any air bubbles and verify that no bubbles are present. If bubbles are detected, immediately uncap the sample, add additional sample from the bailer until a positive meniscus is re-established, immediately recap the sample and check the sample for bubbles. Repeat this step until the sample contains no bubbles and all required samples are obtained.

13. After sampling, replace the well cap.

14. As soon as all samples are collected, promptly prepare the samples for shipment in accordance with Field Procedure FP 6-7, Packaging and Shipment of Field Samples, and store the samples collected for volatile organic analysis in a cooler with prepackaged ice. Attach a custody seal to the shipping package as described in Field Procedure FP 6-7. Make sure that traffic reports and chain-of-custody forms are properly filled out and enclosed or attached (see Field Procedure FP 6-7).

15. Record all sampling information in the Field Sampling Log Book.

16. Decontaminate all equipment.

8.4.3 Sample Containers

For most samples and analytical parameters, either glass or plastic containers are satisfactory. Field Procedure FP 6-7, Packaging and Shipment of Field Samples, describes the required sampling containers for various analytes at various concentrations.

8.4.4 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. Field Procedure FP 6-7 describes the sample preservation and volume requirements for most of the chemicals that will be encountered during hazardous waste site investigations.

8.4.5 Field Filtration

In general, preparation and preservation of water samples include some form of filtration. All filtration must occur in the field immediately upon collection. The recommended method is through the use of a disposable in-line filtration module (0.45 micron filter) using the pressure provided by the pumping device for its operation. Filters must be prerinsed with organic-free water.

Samples for organic analyses must never be filtered.

8.4.6 Handling and Transporting Samples

After collection, samples should 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 natural ice is used, it should be bagged and steps taken to ensure that the melted ice does not cause sample containers to be submerged and thus the possibility of cross-contaminated. All sample containers should be enclosed in plastic bags or cans to prevent cross-contamination (see Field Procedure FP 6-7). Samples should be secured in the ice chest to prevent movement of sample containers and possible breakage. Sample packing and transportation requirements are described in Field Procedure FP 6-7.

8.4.7 Sample Holding Times

Holding times (i.e., allowed time between sample collection and analysis for routine samples are given in Field Procedure FP 6-7.

8.5 Records

Records will be maintained for each sample that is taken. The ground-water sampling form (Attachment 9.1) 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.
- Field observations and measurements (appearance; volatile screening; field chemistry; sampling method).
- Sample disposition (analyses to be run; number and size of bottles; preservatives added).
- Additional remarks - (e.g., sampled in conjunction with state, county, local regulatory authorities; samples for specific conductance value only; sampled for key indicator; etc.).

8.6 Chain-of-Custody

Proper chain-of-custody procedures play a crucial role in data gathering. Field Procedure FP 6-7 describes the requirements for a correct chain-of-custody.

9.0 ATTACHMENTS

9.1 - Ground-Water Sampling Form

ATTACHMENT 9.1
FP 6-5
2 Pages

GROUND-WATER SAMPLING FORM

3. GROUNDWATER SAMPLING FORM

1. Date/Time ____________ Sample No. ____________
2. Location ________________________________
3. Well No. ____________ Sketch on Back [Y or N] ______
4. Total Depth ____________ Number of Screened Interval(s) ______
5. Depth to Screen/Length(s) ________________________
6. [Y or N] Well Secure? Comments ________________________

____
7. Sampler ____________ Other present ____________
8. Organic Vapor Detector FEL No. ______, Reading ______
9. Weather: Wind ______, Precipitation ______, Air Temperature ______
10. Water Level Measurement: FEL No. ____________
   [Y or N] Well Labeled ______, Elev. Ref. For Water Level ______
   Comments ________________________
   Odor ________________________

11. Depth to Product ____ Depth to Interface/Water ____ Thickness ____
   1st ____________ ____________ ______

12. Casing Type ______, I.D. ______, Gal/Ft. ______
   (Show derivation for gal/ft of casing)

13. Total Depth ______ - Depth to Water ______ = Ht. ______
14. Well Volume ______ = Ht. ______ * Gal/Ft. ______
15. Required Purge Volume ______, Actual Purge ______

16. FEL No.'s Cond. ______ pH ______ Temp. ______ Redox ______

17.

	Cond. µmhos/cm	pH	Temp.	Redox mv
Initial	______	______	______	______
(Purged	______	______	______	______
cycle)	______	______	______	______
	______	______	______	______
Sample	______	______	______	______

   Sample Type and FEL No. ________________________

18. [Y or N] Turbid ______, Purge Water Containerized ______
19. Sample Filtered ______, Filter Size ______
20. Reviewed By ____________ Date/Time ______
   Form Complete? [Y or N] ______
   Decon Complete? [Y or N] ______

AMENDMENTS TO:

FIELD PROCEDURE FP 6-5
GROUNDWATER SAMPLING

The following are amendments to the referenced SOP. The amended portions of the SOP are marked and correspond to the comments listed below.

1. Deionized water, Alconox, hydrochloric acid, nitric acid, hexane, and methanol.

2. Set up the sampling equipment on plastic sheeting or tarpaulin to prevent direct contact of sampling equipment with the ground. Label the sample containers with the following information:

3. Determine the presence of any floating nonaqueous phase liquid (NAPL) by removing one clear bailer of liquid from the top of the well. Visually inspect the liquid and screen it with a PID or FID to determine whether free product is present. If free product is visibly detected, measure and record the volume of free product present and decant the NAPL into a 40-mL VOA vial for analysis. The EMO Program Director will be notified immediately if this situation occurs during the course of the field investigation.

4. Well Purging Method ________________________________.

FIELD PROCEDURE FP 6-7

PACKAGING AND SHIPMENT OF FIELD SAMPLES

GENERAL COMMENT

Subject	Procedure No. / Rev.	
	FP 6-7 / 0	Page 1 of 19
PACKAGING AND SHIPMENT OF FIELD SAMPLES	Issue Date: 05/25/90	Effective Date: 07/02/90
	Supersedes Procedure Number: 630 FP 10	Rev. / Date
Acceptance - Program QA	Approval - Program Manager	

1.0 PURPOSE

The purpose of this procedure is to define the requirements necessary for sample packaging, and information on chain-of-custody records used in sample transfer.

2.0 SCOPE

This procedure applies to the packaging, shipping, and documentation of samples being transferred from the field to the laboratory for analysis. Specifically, this document outlines shipping and sample documentation procedures that are in accord with the U.S. Department of Transportation (DOT) and HAZWRAP. This procedure is applicable to all samples taken from uncontrolled hazardous substance sites for analysis at laboratories away from the site; however, this procedure does not take precedence over region-specific or site-specific requirements for chain-of-custody.

3.0 REQUIREMENTS

Careful packaging, shipping, and documentation are necessary to insure that all samples received are undamaged and authentic.

4.0 REFERENCES

4.1 HAZWRAP, February 1989. *Quality Control Requirements for Field Methods*, DOE/HWP-69, Rev. 0.

4.2 HAZWRAP, July 1988. *Requirements for Quality Assurance of Analytical Data*, DOE/HWP-65, Rev. 0, July 1988.

4.3 U.S. Department of Transportation, 1983. *Hazardous Materials Regulations*, 49 CFR 171-177.

4.4 USEPA, 1984. *User's Guide to the Contract Laboratory Program*, Office of Emergency and Remedial Response, Washington, D.C.

5.0 DEFINITIONS

Carrier - A person or firm engaged in the transportation of passengers of property.

Chain-of-Custody Record Form - A Chain-of-Custody Record Form is a printed two-part form that accompanies a sample or group of samples as custody of the sample(s) is transferred from one custodian to the subsequent custodian. Attachment 9.7 shows a typical Chain-of-Custody Record. Chain-of-Custody Record Form is a controlled document. One copy of the form must be retained in the project file.

Custodian - The person responsible for the custody of samples at a particular time, until custody is transferred to another person (and so documented), who then becomes custodian. A sample is under your custody if:

- You possess the sample.
- It is in your view, after being in your physical possession.
- It was in your physical possession and then you locked it up to prevent tampering.
- You have designated and identified a secure area to store the sample.

Hazardous Material - A substance or material in a quantity and form which may pose an unreasonable risk to health and safety or property when transported in commerce ("commerce" here to include any traffic or transportation). Defined and regulated by DOT (49 CFR 173.2) and listed in Attachment 9.1.

Hazardous Waste - Any substance listed in 40 CFR Subpart D (261.30 et seq) or 40 CFR otherwise characterized as ignitable, corrosive, reactive, or EP toxic as specified under Subpart C (261.20 et seq) that would be subject to manifest requirements specified in 40 CFR 262. Defined and regulated by EPA.

Marking - Applying the descriptive name, instructions, cautions, weight, or specification marks or combination thereof required to be placed outside containers of hazardous materials.

n.o.i. - Not otherwise indicated.

n.o.s. - Not otherwise specified.

ORM - Other regulated material.

Packaging - The assembly of one or more containers and any other components necessary to assure compliance with the minimum packaging requirements of 49 CFR 172, including containers (other than freight containers or overpacks), portable tanks, cargo tanks, tank cars, and multi-unit tank car tanks.

Placard - Color-coded, pictorial sign depicting the hazard class symbol and name to be placed on all four sides of a vehicle transporting certain hazardous materials.

Reportable Quantity (RQ) - A parenthetical note of the form "(RQ-1000/454)" following an entry in the DOT Hazardous Materials table (49 CFR 172.101) indicates the reportable quantity of the substance in pounds and kilograms. If a spill of that amount or more of the substance occurs during transit or storage, a report must be filed with DOT according to 171.15-17 concerning hazardous materials incidents reports. If the material spilled is a hazardous *waste*, a report must always be filed, regardless of the amount, and must include a copy of the manifest. If the RQ notation appears, it must be shown either immediately before or after the proper shipping name on the shipping paper (or manifest). Most shipping papers and manifests will have a column designated "HM" which my be used for this purpose.

Sample - A sample is physical evidence collected from a facility or the environment, which is representative of conditions at the point and time that it was collected.

6.0 RESPONSIBILITIES

6.1 Field Operations Leader - Responsible for determining that samples are properly packaged and shipped, and for determining that the chain-of-custody procedures are implemented from the time the samples are collected to their release to the shippers.

6.2 Field Samplers - Responsible for implementing the packaging and shipping requirements and for initiating the chain-of-custody records until they are relinquished to another custodian, to the shipper, or to the carrier.

7.0 EQUIPMENT

7.1 Coders. | (1)

7.2 Teflon and nylon strapping tape.

7.4 Vermiculite or styrofoam packaging materials.

7.5 Bubble pack.

7.6 Sampling gloves.

7.7 Poly-net.

7.8 Reclosable plastic bags.

7.9 Permanent felt tip marker.

7.10 Pen, black permanent ink.

8.0 PROCEDURE

8.1 SAMPLE PACKAGING AND SHIPPING

Samples collected for shipment from a site should be classified as either environmental or hazardous material (or waste) samples. In general, environmental samples are collected off-site (for example, from streams, ponds, or wells) and are not expected to be grossly contaminated with high levels of hazardous materials. On-site samples (for example, soil, water, and materials from drums or bulk storage tanks, obviously contaminated ponds, lagoons, pools, and leachates from hazardous waste sites) are considered hazardous. A distinction must be made between the two types of samples in order to:

- Determine appropriate procedures for transportation of samples. If there is any doubt, a sample should be considered hazardous and shipped accordingly.
- Protect the health and safety of laboratory personnel receiving the samples. Special precautions are used at laboratories when samples other than environmental samples are received.

8.2 ENVIRONMENTAL SAMPLES

8.2.1 Packaging

Environmental samples may be packaged following the procedures outlined in Section 8.4 for samples classified as "flammable liquids" or "flammable solids". Requirements for marking, labeling, and shipping papers do not apply.

Environmental samples may also be packaged without being placed inside metal cans as required for flammable liquids or solids.

- Place sample container, properly identified and with a sealed lid, in a polyethylene bag and seal the bag.
- Place sample in a fiberboard container or metal picnic cooler which has been lined with a large polyethylene bag. | (2)
- Pack with enough nocombustible, absorbent, cushioning materials to minimize the possibility of the container breaking.
- Seal large bag.
- Seal or close outside container.

8.2.2 Marking/Labeling

Sample containers must have a completed sample identification tag and the outside container must be marked "Environmental Sample". The appropriated side of the container must be marked "This End Up" and arrows placed appropriately. No DOT markings or labeling are required.

8.2.3 Shipping Papers

No DOT shipping papers are required. However, the appropriate chain-of-custody forms must be included with the shipment.

8.2.4 Transportation

There are no DOT restrictions on mode of transportation.

8.3 Determination of Shipping Classification for Hazardous Material Samples

Samples not determined to be environmental samples, or samples known or expected to contain hazardous materials, must be considered hazardous material samples and transported according to the requirements listed below.

8.3.1 Known Substances

If the substance in the sample is known or can be identified, package, mark label, and ship according to the specific instructions for that material (if it is listed) in the DOT Hazardous Materials Table, 49 CFR 172.101.

Unz and Company have published the following steps to help in locating a proper shipping name from the Hazardous Materials Table, 48 CFR 172.101.

1. Look first for the chemical or technical name of the material, for example, ethyl alcohol. Note that many chemicals have more than one technical name; for example, perchloroethylene (not listed in 172.101) is also called tetrachloroethylene (listed in 172.101). It may be useful to consult a chemist for all possible technical names a material can have. If you material is not listed by its technical name, then....

2. Look for the chemical family name. For example, pentyl alcohol is not listed, but the chemical family name is alcohol, n.o.s. (not otherwise specified). If the chemical family name is not listed, then....

3. Look for a generic name based on end use. For example, Paint, n.o.s. or Fireworks, n.o.s. If a generic name based on end use is not listed, then....

4. Look for a generic family name based on end use. For example, Drugs, n.o.s. or Cosmetics, n.o.s. Finally if your material is not listed by a generic family name but you suspect or know the material is hazardous because is meets the definition of one or more hazard classes, then....

5. You will have to go to the general hazard class for a proper shipping name. For example, Flammable Liquid, n.o.s., or Oxidizer, n.o.s.

8.3.2 Unknown Substances

For samples of hazardous substances of Unknown content, select the appropriate transportation category according to the DOT Hazardous Materials Classification (Attachment 9.1), a priority system of transportation categories.

The correct shipping classification for an unknown sample is selected through a process of elimination, utilizing Attachment 9.1. Unless known or demonstrated otherwise (through the use of radiation survey instruments), the sample is considered radioactive and appropriate shipping regulations for "radioactive material" followed.

If radioactive material is eliminated, the sample is considered to contain "Poison A" materials (Attachment 9.2), the next classification on the list. DOT defines "Poison A" as extremely dangerous poisonous gases or liquids of such a nature that a very small amount of gas, or vapor of the liquid, mixed with air is dangerous to life. Most Poison A materials are gases or compressed gases and would not be found in drum-type containers. Liquid Poison A would be found only in closed containers; however, all samples taken from closed drums do not have to be shipped as Poison A, which provides for a "worst case" situation. Based upon information available, a judgement must be made whether a sample from a closed container is a Poison A.

If Poison A is eliminated as a shipment category, the next two classifications are "flammable" or "nonflammable" gases. Since very few gas samples are collected, "flammable liquid" would be the next applicable category. With the elimination of radioactive material, Poison A, flammable gas, and nonflammable gas, the sample can be classified as flammable liquid (or solid) and shipped accordingly. These procedures would also suffice for shipping any other samples classified below flammable liquids in the DOT classification table (Attachment 9.1). For samples containing unknown material, categories listed below flammable liquids/solids on Attachment 9.1 are generally not used because showing that these materials are not flammable liquids (or solids) requires flashpoint testing, which may be impractical and possibly dangerous at a site. Thus, unless the sample is known to consist of material listed as less hazardous than flammable liquid (or solid) on Attachment 9.1, it is considered a flammable liquid (or solid) and shipped as such.

For any hazardous material shipment , utilize the shipping checklist (Attachment 9.3) as a guideline to ensure that all sample-handling requirements are satisfied.

8.4 Packaging and Shipping of Samples Classified as Flammable Liquid (or Solid)

8.4.1 Packaging

Applying the word "flammable" to a sample does not imply that it is in fact flammable. The word prescribes the class of packaging according to DOT regulations.

1. Collect sample in the prescribed container with nonmetallic, Teflon-lined screw cap. To prevent leakage, fill container no more than 90% full. If an air space in the sample container would affect sample integrity, place that container within a second container to meet the 90% requirement.

2. Complete sample label and identification tag and attach securely to sample container.

3. Seal container and place in a 2-ml thick (or thicker) polyethylene bag, one sample per bag. Position identification tag so that it can be read through bag. Seal bag.

4. Place sealed bag inside metal can and cushion it with enough noncombustible, absorbent material (for example vermiculite or diatomaceous earth) between the bottom and sides of the can and bag to prevent breakage and absorb leakage. Pack one bag per can. Use clips, tape, or other positive means to hold can lid securely, tightly and permanently. Mark can as indicated in Paragraph 1 of Section 8.4.2, below.

5. Place one or more metal cans (or single 1-gallon bottle) into a strong outside container, such as a metal picnic cooler or a DOT-approved fiberboard box. Surround cans with noncombustible, absorbent cushioning material for stability during transport. Mark containers as indicated in Paragraph 2 of Section 8.4.2.

8.4.2 Marking/Labeling

1. Use abbreviations only where specified. Place the following information, either-hand printed or in label form, on the metal can (or 1-gallon bottle):

   - Laboratory name and address.
   - "Flammable Liquid, n.o.s. UN1993" or "Flammable Solid, n.o.s. UN1325".
   - Not otherwise specified (n.o.s.) is not used if the flammable liquid (or solid) is identified. Then the name of the specific material is listed before the category (for example, Acetone, Flammable Liquid), followed by its appropriate UN number found in the DOT hazardous materials table (49 CFR 172.101).

2. Place all information on outside shipping container as on can (or bottle), specifically:

   - Proper shipping name.
   - UN or NA number.
   - Proper label(s).
   - Addressee and sender.

Place the following labels on the outside container: "Cargo Aircraft Only" and "Flammable Liquid" (or "Flammable Solid"). "Dangerous When Wet" label should be used if the solid has not been exposed to a wet environment. "Laboratory Samples" and "THIS SIDE UP" or "THIS END UP" should also be marked on the top of the outside container, and upward-pointing arrows should be placed on all sides of the container.

8.4.3 Shipping Papers

1. Use abbreviations only where specified. Complete the carrier-provided

bill of lading and sign certification statement (if carrier does not provide, use standard industry form, see Attachment 9.4). Provide the following information in the order listed (one form may be used for more than one exterior container).

- "Flammable Liquid, n.o.s. UN1993" or "Flammable Solid, n.o.s. UN1325).
- "Limited Quantity" (or "Ltd. Qty.").
- "Cargo Aircraft Only".
- Net weight (wt) or net volume (vol), just before or just after "Flammable Liquid n.o.s." or "Flammable Solid, n.o.s.", by item, if more than one metal can is inside an exterior container.
- "Laboratory Samples" (if applicable).

2. Include Chain-of-Custody Record, properly executed in outside container.

3. "Limited Quantity" of "Flammable Liquid, n.o.s." is limited to one pint per inner container. For "Flammable Solid, n.o.s.", net weight of inner container plus sample should not exceed one pound; total package weight should not exceed 25 pounds.

8.4.4 Transportation

1. Transport Unknown hazardous substance samples classified as flammable liquids by rented or common carried truck, railroad, or express overnight package services. Do not transport by any passenger-carrying air transport system, even if they have cargo-only aircraft. DOT regulations permit passenger airline company cargo only aircraft, but difficulties with most suggest avoiding them. Instead, ship by airline carriers that only carry cargo.

2. For transport by government-owned vehicle, including aircraft, DOT regulations do not apply. However, procedures described above, with the exception of execution of the bill of lading with certification, should still be used.

8.5 Packaging and Shipping of Samples Classified as Poison "A"

This packaging, marking, labeling, and shipping method provides a worst-case procedure for materials classed as Poison A (49 CFR 173.328). In the absence of reliable data that exclude the possibility of the presence of Poison A chemicals or compounds (see Attachment 9.2), these procedures must be followed.

8.5.1 Packaging

Applying the word "poisonous" to a sample does not imply that it is, in fact, poisonous, or how poisonous. It describes the class of packaging according to DOT regulations.

1. Collect samples in a polyethylene or glass container with an outer diameter narrower than the valve hole on a DOT specification #3A1800 or #3AA1800 metal cylinder. To prevent leakage, fill container no more than 90% full. Seal sample container.

2. Complete sample label and identification tag and attach securely to sample container.

3. Attach string or flexible wire to neck of the sample container; lower it into metal cylinder partially filled with noncombustible, absorbent cushioning material (for example, diatomaceous earth or vermiculite). Place only one container in metal cylinder. Pack with enough absorbing material between the bottom and sides of the sample container and the metal cylinder to prevent breakage and absorb leakage. After the cushioning material is in place, drop the end of the string into the cylinder valve hole.

4. Replace valve, torque to 250 ft-lb (for 1-inch opening), and replace valve protector on metal cylinder, using Teflon tape.

5. Mark and label cylinder as described in Paragraph 1 of Section 5.5.2.

6. Place one or more cylinders in DOT-approved outside container.

7. Mark and label outside container and complete shipping papers as described below.

8.5.2 Marking/Labeling

1. Use abbreviations only where specified. Place the following information, either hand-printed or in label form, on the side of the cylinder or on a tag wired to the cylinder valve protector.

   - "Poisonous Liquid, n.o.s." or "Poisonous Gas, n.o.s. NA9035)".
   - Laboratory name and address.
   - DOT label "Poisonous Gas" (even if sample is liquid) on cylinder.

2. Put all information on metal cylinder on outside container. Print "Laboratory Sample" and "Inside Packages Comply With Prescribed Specifications" on top and/or front of outside container. Mark "THIS SIDE UP" on top of container and upward-pointing arrows on all four sides.

8.5.3 Shipping Papers

1. Use abbreviations only as specified. Complete carrier-provided bill of lading and sign certification statement (if carrier does not provide, use standard industry form, see Attachment 9.4). Provide the following

information in the order listed. One form may be used for more than one exterior container.)

- "Poisonous Liquid, n.o.s. NA9035)."
- "Limited Quantity" (or "Ltd. Qty.").
- Net weight (wt) or net volume (vol), just before of after "Poisonous Liquid, n.o.s.", of each cylinder, if more than one is inside the outer container.

2. Include a Chain-of-Custody Record, properly executed, in container or with cylinder.

3. Accompany shipping container to carrier and, if required, open outside container(s) for inspection.

8.5.4 Transportation

Transport Unknown hazardous substance samples classified as Poison A only by ground transport or Government-owned aircraft. Do not use air cargo, other common-carrier aircraft, or rented aircraft.

8.6 Transport of Investigation and Remediation Wastes

The packaging, marking, labeling, and other shipping requirements will depend on the particular waste to be transported. Examples of wastes which may be generated during the site investigations are decontamination or cleaning solutions, contaminated disposable items, test pit spoils, drilling cuttings or fluids and contaminated monitoring well discharges. Waste materials from remediation include excavation spoils, overpacked drums and discharges from drained lagoons or tanks.

In many cases, wastes generated during site investigations will be disposed of onsite. These relatively small volumes of waste will be dealt with as part of the waste to be cleaned up or isolated during remediation. This avenue should be pursued, if feasible, to avoid the inconvenience of transportation and disposal which are disproportionately expensive for small volumes. If such a solution is approved, materials should be properly bagged, drummed, covered, buried, or otherwise contained at the end of each day.

Those materials which must be transported for treatment, storage, or disposal should be packaged, labeled and marked in accordance with applicable regulations.

Many wastes generated during site investigation and remediation activities will probably be adequately handled under the classification "ORM-E" (i.e., other regulated materials, type E) Types of wastes which would normally fall under this classification are contaminated disposable protective clothing and sampling equipment, spent soapy decontamination solutions and rinses, contaminated drilling cuttings or fluids and contaminated soils excavated during site investigations or remediation.

Spent solvents used for decontamination of sampling equipment (e.g., acetone or methanol) should be referenced by the actual product name. Liquids from drums or tanks should be specified as accurately as possible based on results of lab analysis or reliable records. If the liquid is known to be a solvent, organic liquid, or spent distillation bottoms, it should be referenced by its actual or generic name from the Hazardous Materials Table. In cases requiring emergency actions where the identity of a substance is not accurately know, place the substance in one of the general hazard classes in 49 CFR 173.2. The choice of class should be conservative; that is, use the highest priority class based on available information as described in Section 8.3.2.

The following steps for preparing hazardous materials for shipment were extracted from the "Hazardous Materials Transportation Guide for Shippers" published by the U.S. DOT. References are to CFR Title 49.

1. **Determine the Proper Shipping Name**

   The shipper must determine the proper shipping name of the materials as listed in the Hazardous Materials Table, *172.101, Column (2).

2. **Determine the Hazard Class or Classes**

   a. Refer to the Table, *172.101, Column (3) and locate the hazard class of the material or follow the steps described in Section 8.3.2 of this Guideline.

   b. If more than one class is shown for the proper shipping name, determine the proper class by definition.

   c. If the material has more than one hazard, classify the material based on the order of hazards in *173.2.

3. **Select the Proper Identification Number**

   a. Refer to the Table, 172.101, Column (3a) and select the Identification Number (ID) that corresponds to the proper shipping name and hazard class.

   b. Enter the ID Number(s) on the shipping papers and display them, as required, on packaging, placards, and/or orange panels.

4. **Determine the Mode(s) of Transport to Ultimate Destination***

   a. As a shipper, you must assure yourself that the shipment complies with the various modal requirements.

b. The modal requirements may affect the following:

(1) Packaging

(2) Quantity per package

(3) Marking

(4) Labeling

(5) Shipping papers

(6) Certification

* For example, truck, rail or air.

5. Select the Proper Label(s) and apply as required

Required labels are based on the hazard class of the substance to be shipped. No placards are required on vehicles transporting ORM-E substances or limited quantities of any hazardous materials (e.g., hazardous samples as discussed in Section 8.4).

a. Refer to the Table, 172.101, Column (4) for required label(s).

b. For details in labeling refer to:

(1) Additional Labels, 172.402

(2) Location of Labels, 172.406

(3) Packaging (Mixed or Consolidated), 172.404(a) and (b)

(4) Packages Containing Samples, 172.402(h)

(5) Radioactive Materials, 172.403

(6) Authorized Label Modification, 172.405

6. Determine and Select the Proper Packaging

a. Refer to the Table, 172.101, Column (5a) for exceptions and Column (5b) for authorized Packaging. Consider the following when selecting an authorized container: Quantity per package; Cushioning material, if required; Proper closure and reinforcement; Proper pressure; Outage; etc, as required.

b. If packaged by a prior shipper, make sure the packaging is correct and in proper condition for transportation.

7. **Mark the Packaging (Including Overpacks)**

   a. Apply the required marking (172.300); Proper shipping name and ID number, when required (172.301); Name and address of Consignee and Consignor (172.306).

   b. For details and other required markings, see *172.300 through *172.338.

8. **Prepare Shipping Papers**

   a. The basic requirements for preparing shipping papers include: proper shipping name; hazard class; ID number; total quantity; shipper's certification.

   b. Make all entries on the shipping papers, using the information required, and in proper sequence (172.202).

   c. For additional requirements, see 172.200 through 172.205.

9. **Certification**

   a. Each shipper must certify, by printing (manually or mechanically) on the shipping papers, that the materials being offered for shipment are properly classified, described, packaged, marked, and labeled, and are in proper conditions for transportation according to the applicable DOT Regulations (172.204).

10 **Loading, Blocking, and Bracing**

When loading hazardous materials into the transport vehicle or freight container, each package must be loaded, blocked, and braced in accordance with the requirements for the mode of transport.

   a. If the shipper loads the freight container or transport vehicle, the shipper is responsible for the proper loading, blocking, and bracing of the materials. The packages must be properly labeled as to the right side up and samples must be packed to avoid damage in case of overturning.

   b. If carrier personnel do the loading, the carrier is responsible.

11. **Determine the Proper Placard(s)**

Each person who offers hazardous materials for transportation must determine that the placarding requirements have been met.

   a. For highway, unless the vehicle is already correctly placarded, the shipper must provide the required placard(s) and required identification number(s) (172.506).

b. For rail, if loaded by the shipper, the shipper must placard the rail car if placards are required. (172.508)

c. For air and water shipments, the shipper has the responsibility to apply the proper placards.

12. Hazardous Waste/Hazardous Substance

a. If the material is classed as a hazardous waste or hazardous substance, most of the above steps will be applicable.

b. Pertinent Environmental Protection Agency Regulations are found in the Code of Federal Regulations, Title 40, Part 262.

8.6 Chain-of-Custody Guidelines

The term "chain-of-custody" refers to procedures which ensure that evidence presented in a court of law is what it is represented to be. The chain-of-custody procedures track the evidence from the time and place it is first obtained to the courtroom. These procedures also provide an auditable trail for the evidence as it is moved and/or passes from the custody of one individual to another. In addition, procedures for consistent and detailed records facilitate the admission of evidence under Rule 803(b) of the Federal Rules of Evidence (P.L. 93-575).

Chain-of-custody procedures, record keeping, and documentation are an important part of the management control of samples in the HAZWRAP program. Regulatory agencies must be able to provide the chain of possession and custody of any samples that are offered for evidence, or that form the basis of analytical test results introduced as evidence. Written procedures must be available and followed whenever evidence samples are collected, transferred, stored, analyzed, or destroyed.

8.6.1 Sample Identification

The following information shall be written in the sample log book when in-situ measurements or samples for laboratory analysis are collected:

- project code;
- station number;
- location of station;
- date and time of measurement;
- samples used (if any);
- field observations (include date and time);
- level of personnel protection (if required);

- equipment used to make physical measurements and collect samples; and
- calibration data for equipment used.

Measurements and observations shall be recorded using black, waterproof ink.

8..6.2 Sample Label

Samples, other than in-situ measurements, are removed and transported from the sample location to a laboratory or other location for analysis. Before removal, however, a sample is often divided into portions, depending upon the analyses to be performed. Each portion is preserved in accordance with the Sampling Plan. Each sample container is identified by a sample label (see Attachment 9.5).

Sample labels are provided by the HAZWRAP Program Office. The sampler fills out the following information on the sample label: ③

Project	HAZWRAP Work Assignment Number
Sample Number	The unique sample number identifying this sample
Date	A six-digit number indicating the month, day, and year of sample collection; e.g., 12/21/85
Time	A four digit number indication the 24-hour time of collection (for example: 0954 is 9:54 a.m., and 1629 is 4:29 p.m.)
Medium	Water, Soil, Sediment, Sludge, Leachate, etc.
Sample Type	Grab or Composite
Preservation	Type, quantity, and concentration of preservative added
Analysis	Same as Analyses on Sample Identification Tag (see Section 8.6.3)
Sampled by	Name of the sampler
Lab #	The receiving laboratory assigns the lab# to the sample label (this number is not to be used for on-site analyses)
Remarks	If for Contract Lab analysis, include the Contract Lab case of SAS number, and Contract Lab sample number from the traffic report, SAS Packing List, or Dioxin Shipment Record. Also, pertinent observations of the sampler (e.g., sequence number for sequential samples).

8.6.3 Sample Identification Tag

A Sample Identification Tag (Attachment 9.6) must also be used for samples collected for Control Lab analysis. The Sample Identification Tag is a white, waterproof paper label, approximately 3-by-6 inches, with a reinforced eyelet, and string or wire for attachment to the neck of the sample bottle. The sample tag is a controlled document, and is provided by the regional EPA office. The field sampler completes the sample tag and attaches the sample tag to the field sample container. Following sample analysis, the sample tag is retained by the laboratory as evidence of sample receipt and analysis.

The following information is recorded on the tag:

Site Name/Project Code	HAZWRAP Work Assignment Number
Field Identification or Station Number	Same as Sample Number on Sample Label
Month/Day/Year	Same as Date on Sample Label
Time	Same as Time on Sample Label
Designate: Comp/Grab	Designate the sample as either grab or composite
Station Location	Site-specific station location designation defined in Site Operation Plan
Type of Sample	Type of Sample (matrix), and a brief description of the sampling location
Samplers	Same as Sampled By on Sample Label
Signature	The Sampler signs the sample tag
Preservative	Yes or No
Analyses	Check appropriate box(es)
Remarks	Same as Remarks on Sample Label (make sure Contract Lab Case No/SAS no. and Contract Lab sample numbers are recorded)
Lab Sample No.	Same as Lab# on Sample Label

The tag is then tied round the neck of the sample bottle.

If the sample is to be split, it is equally divided into two similar sample containers.

Identical information is completed on the label attached to each split and both of these are marked "Split" on the "Remarks" line.

Blank, duplicate, or field spike samples shall *not* be identified as such on the label, as this may compromise the quality control function.

8.6.4 Chain-of-Custody Procedures

After collection, separation, identification, and preservation, the sample is maintained under chain-of-custody procedures until it is in the custody of the analytical laboratory and has been stored or disposed.

Field Custody Procedures

1. Samples are collected as described in the project-specific Work Plan. Care must be taken to record precisely the sample location and to ensure that the sample number on the label exactly matches those numbers on the sample log sheet and the Chain-of-Custody Record.

2. The person undertaking the actual sampling in the field is responsible for the care and custody of the samples collected until they are properly transferred or dispatched.

3. When photographs are taken of the sampling as part of the documentation procedure, the name of the photographer, date, time, site location, and site description are entered sequentially in the site logbook as photos are taken. Once developed, the photographic prints shall be serially numbered, corresponding to the logbook descriptions.

4. Sample labels shall be completed for each sample, using waterproof ink unless prohibited by weather conditions, e.g., a logbook notation would explain that a pencil was used to fill out the sample label because a ballpoint pen would not function in freezing weather.

8.6.5 Transfer of Custody and Shipment

Samples are accompanied by a Chain-of-Custody Record Form (Attachment 9.7). The appropriate form should be obtained from the Office in which the work takes place. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the Record. This Record documents sample custody transfer from the sampler, often through another person, to the analyst in the laboratory. The Chain-of Custody Record is filled out as follows:

1. Enter header information (project number and name, Contract Lab case No. or SAS No.). For each station number, enter date, time, composite/grab, station location, number of containers, analytical parameters, Traffic Report/SAS Packing List/Dioxin Shipment Record, and Sample Identification Tag Number

2. Sign, date, and enter the time under "Relinquished by" entry.

3. Make sure that the person receiving the sample signs for the "Received by" entry, or enter the name of the carrier (e.g., UPS, Federal Express) under "Received by". Receiving laboratory will sign "Received for Laboratory by" on the lower line and enter the date and time.

4. Enter the bill-of-lading or Federal Express airbill number under "Remarks or Reason for Change of Custody", if appropriate.

5. Place the original (top, signed copy) of the Chain-of-Custody Recorded Form in the appropriate sample shipping package. Retain a copy with field records.

6. Shipping containers should be secured to ensure samples have not been disturbed during transport by using nylon strapping tape and EPA custody seals. The custody seals should be placed on the containers so that they cannot be opened without breaking the seal.

7. Complete other carrier-required shipping papers.

The custody record is completed using black waterproof ink. Any corrections are made by drawing a line through and initialing and dating the change, then entering the correct informations. Erasures are not permitted.

Common carriers will usually not accept responsibility for handling Chain-of-Custody Record Forms; this necessitates packing the record in the sample container (enclosed with the other documentation is a plastic zip-lock bag). As long as custody forms are sealed inside the sample container and the custody seals are intact, commercial carriers are not required to sign off on the custody form.

The laboratory representative who accepts the incoming sample shipment signs and dates the Chain-of-Custody Record, completing the sample transfer process. It is then the laboratory's responsibility to maintain internal log books and custody records throughout sample preparation and analysis.

8.6.6 Receipt for Samples Form

Whenever samples are split with a private party or government agency, a separate Receipt for Samples Record Form (see Attachment 9.9) is prepared for those samples and marked to indicate with whom the samples are being split. The person relinquishing the samples to the party of agency shall require the signature of a representative of the appropriate party acknowledging receipt of the samples. If a representative is unavailable or refuses to sign, this is noted in the "Received by " space. When appropriate, as in the case were the representative is unavailable, the custody record should contain a statement that the samples were delivered to the designated location at the designated time. This form must be completed and a copy given to the owner, operator, or agent-in-charge even if the offer for split samples is declined. The original is retained by the Field Operations Leader.

9.0 ATTACHMENTS

9.1 DOT Hazardous Materials Classification (49 CFR 173.2).

9.2 DOT List of Class "A" Poison (49 CFR 172.101).

9.3 Hazardous Material Shipping Checklist.

9.4 Standard Industry Certification Form.

9.5 Sample Label. | ④

9.6 Sample Identification Tag.

9.7 Chain-of-Custody Record Form. | ⑤

9.8 Chain-of-Custody Seal. | ⑥

9.9 Receipt For Samples Form. | ⑦

DOT HAZARDOUS MATERIAL CLASSIFICATION (49 CFR 173.2)

1. Radioactive material (except a limited quantity)
2. Poison A
3. Flammable gas
4. Nonflammable gas
5. Flammable liquid
6. Oxidizer
7. Flammable solid
8. Corrosive material (liquid)
9. Poison B
10. Corrosive material (solid)
11. Irritating material
12. Combustible liquid (in containers have capacities of 110 gallons [415 liters])
13. ORM-B
14. ORM-A
15. Combustible liquid (in containers having capacities of 110 gallons [416 liters] or less)
16. ORM-E

DOT LIST OF CLASS "A" POISON (49 CFR 172.101)

MATERIAL TEMPERATURE	PHYSICAL STATE AT STANDARD TEMPERATURE
Arsine	Gas
Bromoacetone	Liquid
Chloropicrin and methyl chloride mixture	Gas
Chloropicrin and nonflammable, nonliquified compressed gas mixture	Gas
Cyanogen chloride	Gas(>13.1°C)
Cyanogen gas	Gas
Gelatin dynamite (H. E. Germaine)	---
Grenade (with Poison "A" gas charge)	---
Hexaethyl tetraphosphate/compressed gas mixture	Gas
Hydrocynic (prussic) acid solution	Liquid
Hydrocyanic acid, liquefiedLiquid	
Insecticide (liquefied) gas containing Poison "A" or Poison "B" material	Gas
Methyldichloroarsine	Liquid
Nitric oxide	Gas
Nitrogen peroxide	Gas
Nitrogen tetroxide	Gas
Nitrogen dioxide, liquid	Gas
Parathion/compressed gas mixture	Gas
Phosgene (diphosgene)	Liquid

HAZARDOUS MATERIALS SHIPPING CHECKLIST

Packaging

1. Check DOT 172.500 table for appropriate type of package for hazardous substance.
2. Check for container integrity, especially the closure.
3. Check for sufficient absorbent material in package.
4. Check for sample tags and log sheets for each sample, and chain-of-custody record.

Shipping Papers

1. Check that entries contain only approved DOT abbreviations.
2. Check that entries are in English.
3. Check that hazardous material entries are specially marked to differentiate them from any nonhazardous materials being set using same shipping paper.
4. Be careful that all hazardous classes are shown for multiclass materials.
5. Check total amounts by weight, quantity, or other measures used.
6. Check that any limited-quantity exemptions are so designated on the shipping paper.
7. Offer driver proper placards for transporting vehicle.
8. Check that certification is signed by shipper.
9. Make certain that driver signs for shipment.

RCRA Manifest

1. Check that approved state/federal manifests are prepared.
2. Check that transporter has the following: valid EPA identification number, valid driver's license, valid vehicle registration, insurance protection, and proper DOT labels for materials being shipped.
3. Check that destination address is correct.
4. Check that driver knows where shipment is going.
5. Check that the driver is aware of emergency procedures for spills and accidents.
6. Make certain driver signs for shipment.
7. Make certain one copy of executed manifest and shipping document is retained by shipper.

ATTACHMENT 9.4
FP 6-7

STANDARD INDUSTRY CERTIFICATION/FORM

NO PCS	SIZE	GROSS WEIGHT	HM	D.O.T. PROPER SHIPPING NAME	HAZARD CLASS	CODE	[illegible]	CONTAINER NUMBERS	PKG	BULK
1	55 gal	200 lbs.	X	Nitric Acid, Fuming	Oxidizer	55-DM	C	1	✓	
1	55 gal	450 lbs	X	Flammable Liquid, n.o.s.	Flammable Liquid	55-AW	—	2		✓
1	55 gal	250 lbs	X	Flammable Liquid, n.o.s.	Flammable Liquid	55-DM	D	3	✓	
1	15-A	12 lbs.	X	Bromine	Corrosive Material	55-DM	C	4	✓	

SHIPPER'S CERTIFICATION

This is to certify that the above named materials are properly classified, described, packaged, marked and labeled and are in proper condition for transportation according to the applicable regulations of the Department of Transportation.

Shipper's Signature

Placards Req'd

Shipment Date

Manifest No

Disposal Work Order

Service Order No

Rev. 1-79

SAMPLE LABEL

PROJECT: ____________________

SAMPLE NO. ____________________

DATE: __/__/__ TIME: __________ HRS

MEDIUM: ____________________

TYPE: *GRAB* ☐ *COMPOSITE* ☐

PRESERVATION: ____________________

ANALYSIS: ____________________

SAMPLED BY: ____________________

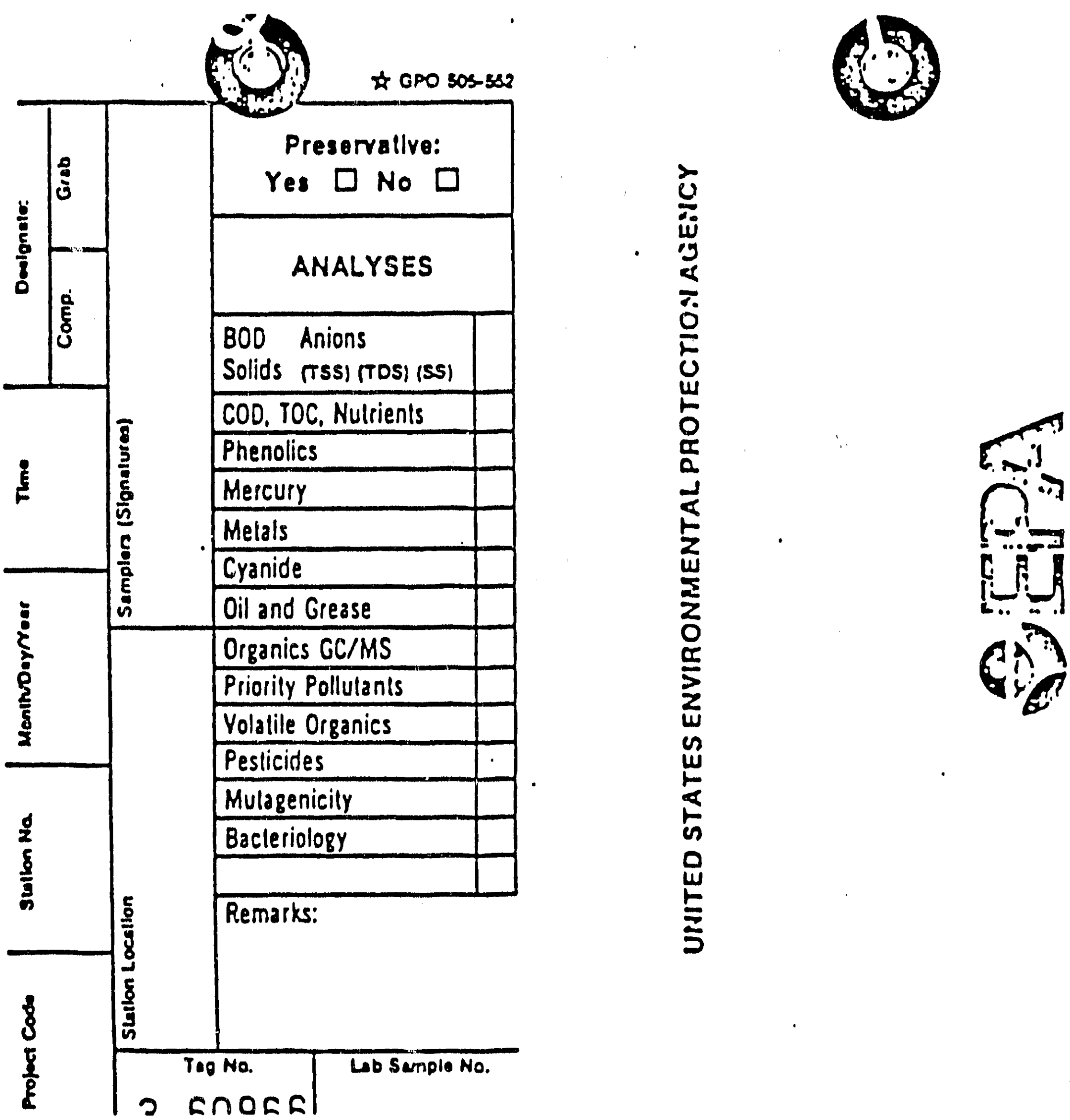
LAB NO.: ____________________

REMARKS: ____________________

4

ATTACHMENT 9.6
FP 6-7

SAMPLE IDENTIFICATION TAG



ATTACHMENT 9.7
FP 6-7

CHAIN-OF-CUSTODY FORM

CHAIN-OF-CUSTODY RECORD

ES JOB NO.	PROJECT NAME/LOCATION		SHIP TO:
SAMPLER(S): (Signature)			

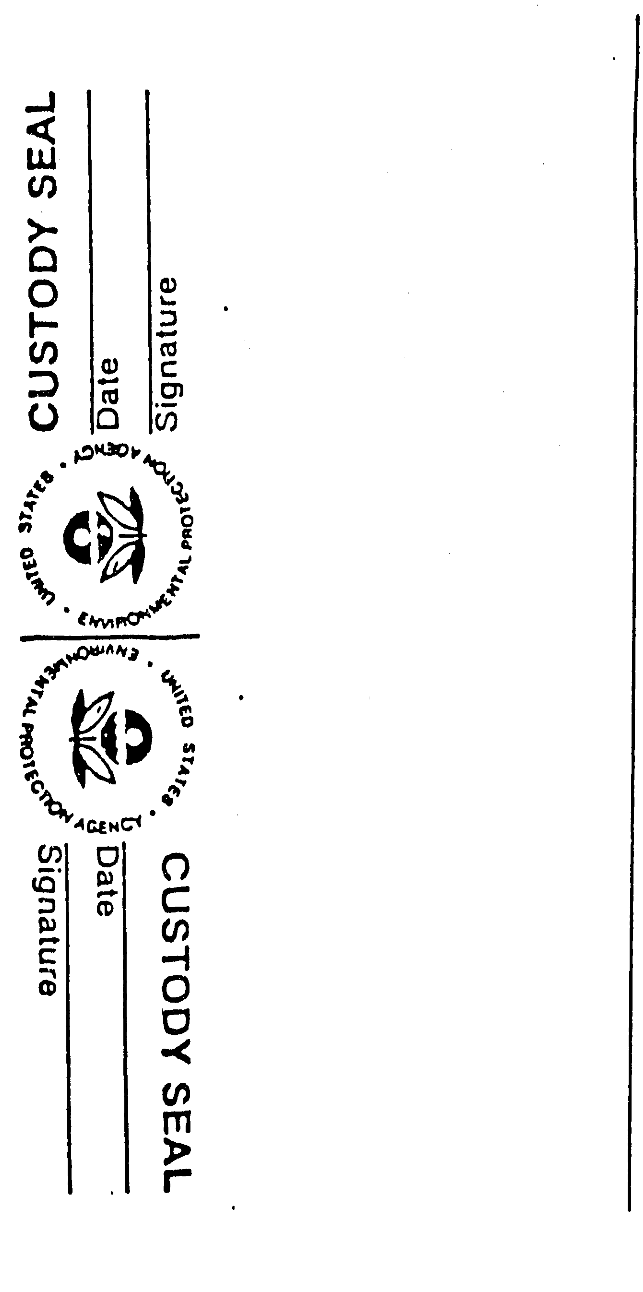
DATE	TIME	SAMPLE DESCRIPTION	NO. OF CON-TAINERS	WATER ANALYSES REQUIRED								REMARKS

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Relinquished by: (Signature)	Date/Time	Received for Laboratory by: (Signature)	Date/Time	Remarks	

Distribution: Original Accompanies Shipment, Copy to Coordinator Field Files

5

CHAIN-OF-CUSTODY SEAL



6

ATTACHMENT 9.9
FP 6-7

RECEIPT FOR SAMPLES FORM

7

RECEIPT FOR SAMPLES
EPA WORK ASSIGNMENT NUMBER ______

ES WORK CHARGE NO. 4238.	PROJECT NAME	Name of Facility
SAMPLERS: (Signature)		Facility Location
Split Samples Offered ( ) Accepted ( ) Declined		

STA. NO.	DATE	TIME	COMP.	GRAB	SPLIT SAMPLES	TAG NUMBERS	STATION DESCRIPTION	NO. OF CON-TAINERS	REMARKS

Transferred by: (Signature)		Received by: (Signature)		Telephone
Date	Time	Title	Date	Time

AMENDMENTS TO:

FIELD PROCEDURE FP 6-7
PACKAGING AND SHIPMENT OF SAMPLES

The following are specific amendments to the referenced SOP. The amended portions of the SOP are marked and correspond to the numbered comments listed below.

GENERAL COMMENT

All samples to be collected during this investigation shall be "non-hazardous environmental samples". Several of the DOT requirements listed in the SOP will not apply. The SOP will be followed if "hazardous materials" are sampled.

1. Subsection 7.1 "Coders" is assumed to be "Coolers".

2. Place the sample in a polyethlyene cooler provided by the analytical laboratory.

3. Sample labels are provided by IT Analytical Services.

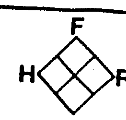
4. Attachment 9.5 "Sample Label" will be replaced with the Attached Sample Label provided by IT Analytical Services.

5. Attachment 9.7 "Chain-of-Custody Form" will be replaced with Chain-of-Custody and Request for Analysis forms provided by IT Analytical Services. These forms are attached.

6. Attachment 9.8 "Chain-of-Custody Seal" will be replaced with the IT Analytical Services "Custody Seal". An example of the seal is attached.

7. Delete Attachment 9.9.

INTERNATIONAL
TECHNOLOGY
CORPORATION



Project Name ______________________

Project No. ______________________

Sample No. ______________________

Collection Date/Time ______________________

Collector's Name ______________________

Sample Location ______________________

Sample Type/Depth/Description ______________________

Analyze For ____________ Preservative ____________

Bottle ______ of ______ ______ Filtered ______ Nonfiltered

23-8-85

INTERNATIONAL TECHNOLOGY CORPORATION

CHAIN-OF-CUSTODY RECORD

R/A Control No. ____________

C/C Control No. 213635

PROJECT NAME/NUMBER ____________ LAB DESTINATION ____________

SAMPLE TEAM MEMBERS ____________ CARRIER/WAYBILL NO. ____________

Sample Number	Sample Location and Description	Date and Time Collected	Sample Type	Container Type	Condition on Receipt (Name and Date)	Disposal Record No.

Special Instructions: ____________

Possible Sample Hazards: ____________

SIGNATURES: (Name, Company, Date and Time)

1. Relinquished By: ____________
   Received By: ____________
2. Relinquished By: ____________
   Received By: ____________
3. Relinquished By: ____________
   Received by: ____________
4. Relinquished By: ____________
   Received By: ____________

WHITE - To accompany samples
YELLOW - Field copy

CORPORATION

REQUEST FOR ANALYSIS

C/C Control No. ____________

PROJECT NAME ____________

PROJECT NUMBER ____________

PROJECT MANAGER ____________

BILL TO ____________

PURCHASE ORDER NO. ____________

DATE SAMPLES SHIPPED ____________

LAB DESTINATION ____________

LABORATORY CONTACT ____________

SEND LAB REPORT TO ____________

DATE REPORT REQUIRED ____________

PROJECT CONTACT ____________

PROJECT CONTACT PHONE NO. ____________

Sample No.	Sample Type	Sample Volume	Preservative	Requested Testing Program	Special Instructions

TURNAROUND TIME REQUIRED: (Rush must be approved by the Project Manager.)

Normal ______ **Rush** ______ (Subject to rush surcharge)

POSSIBLE HAZARD IDENTIFICATION: (Please indicate if sample(s) are hazardous materials and/or suspected to contain high levels of hazardous substances)

Nonhazard ______ **Flammable** ______ **Skin Irritant** ______ **Highly Toxic** ______ **Other** ______ ***(Please Specify)***

SAMPLE DISPOSAL: (Please indicate disposition of sample following analysis. Lab will charge for packing, shipping, and disposal.)

Return to Client ______ **Disposal by Lab** ______

FOR LAB USE ONLY

Received By ____________ **Date/Time** ____________

WHITE - Original, to accompany samples
YELLOW - Field copy

IT SAMPLES
INTERNATIONAL TECHNOLOGY
ANALYTICAL SERVICES

IT SAMPLES
INTERNATIONAL TECHNOLOGY
ANALYTICAL SERVICES

IT

FIELD PROCEDURE FP 7-2

WATER LEVEL MEASUREMENT

Subject	Procedure No.	Rev.	
	FP 7-2	0	Page 1 of 5
WATER LEVEL MEASUREMENT	Issue Date 05/25/90		Effective Date 07/02/90
	Supersedes Procedure Number 630 FP 4	Rev. 0	Date
Acceptance - Program QA	Approval - Program Manager		

1.0 PURPOSE

The purpose of this procedure is to provide general reference information and technical guidance on the measurement of piezometric head levels and the determination of the direction of ground-water flow, using contour maps of the water table or potentiometric surface of a confined aquifer.

2.0 SCOPE

This procedure gives overall technical guidance for obtaining piezometric head measurements in wells (frequently conducted in conjunction with ground-water sampling) and preparation of ground-water contour maps. The specific methods utilized could be modified by requirements of project-specific work plans.

3.0 REQUIREMENTS

Ground-water level measurements can be made in monitoring wells, private or public water wells, piezometers, open boreholes, or test pits (after stabilization). Ground-water measurements should generally not be made in boreholes with drilling rods or auger flights present. If ground-water sampling activities are to occur, ground-water level measurements shall take place prior to well evacuation or sampling.

4.0 REFERENCES

4.1 HAZWRAP, February 1989. *Quality Control Requirements for Field Methods*, DOE/HWP-69.

4.2 Freeze, R.A. and J.A. Cherry, 1979. Groundwater, Prentice-Hall, Englewood Cliffs, NJ. 604 pp.

5.0 DEFINITIONS

Artesian Conditions - A common condition in a confined aquifer in which the water level in a well completed within the aquifer rises above the top of the aquifer.

Confined Aquifer - An aquifer confined between two low permeability layers (aquitards).

Equipotential Line - A contour line on the potentiometric surface or water table showing uniform piezometric head levels. Equipotential lines on the water table are also called water-table contour lines.

Flow Line - A line indicating the direction of ground-water movement within the saturated zone. Flow lines are drawn perpendicular to equipotential lines.

Flow Net - A diagram of ground-water flow, showing flow lines and equipotential lines.

Piezometric Head - The height to which water will rise in a cased well.

Potentiometric Surface - A surface which is defined by the levels to which water will rise in cased wells which are screened in a specified zone of an unconfined aquifer or in a confined aquifer.

Unconfined (water table) aquifer - An aquifer in which the water table forms the upper boundary.

Water Table - A surface in an aquifer where ground-water pressure is equal to atmospheric pressure (i.e., the pressure head is zero) and below which all strata are saturated with water.

6.0 RESPONSIBILITIES

6.1 Field Operations Leader/Project Hydrogeologist - has overall responsibility for obtaining water level measurements and developing ground-water contour maps. The hydrogeologist shall specify the reference point from which water levels are measured (usually a specific point on the upper edge of the inner well casing), the number of data points needed and which wells shall be used for a contour map, and how many complete sets of water levels are required to adequately define ground-water flow directions (e.g., if there are seasonal variations).

6.2 Field Personnel - must have a basic familiarity with the equipment and procedures involved in obtaining water levels, and must be aware of any project-specific requirements.

7.0 EQUIPMENT

The equipment used to make water level measurements consists of the following:

7.1. Steel retractable engineer's measuring tape calibrated to 0.01 foot.

7.2. Electronic water level indicator with the probe tape calibrated at minimum of 1.0 foot increments.

7.3 Portable HNu photoionization detector.

7.4 Methanol and deionized water for decontamination of the water level indicator.

7.5 Ground-water Sampling Form.

8.0 PROCEDURE

8.1 General

(1)

- Initial monitoring of the well headspace and breathing zone concentrations using a PID (HNU) or FID (OVA) and combustible gas meters shall be evaluated by the health and safety officer to determine required levels of protection.

- All ground-water level measurements shall be made to the nearest 0.01 foot, and recorded in a logbook or Ground-water Sampling Form (Attachment 9.1). In measuring ground-water levels, there shall be a clearly-established reference point of known altitude, which is normally identified by a painted mark at one point on the upper edge of the inner well casing. The field notes recorded must clearly describe the reference used. To be useful, the reference point should be tied in with an established USGS benchmark or other properly surveyed altitude datum. Typically, altitude reference data are tied to mean sea level, as determined by the 1929 General Adjustment. An arbitrary datum could be used for an isolated group of wells if necessary.

- After a monitoring or ground-water observation well has been installed and the ground-water level has stabilized, the initial depth to the water shall be measured and recorded. The date and time of the reading must be recorded. Information related to precipitation should be included in the data. The total depth of the well shall be measured and recorded.

- Cascading water within a borehole can cause false readings with some types of sounding devices (chalked line, electrical). Oil layers may also cause problems in determining the true water level in a well.

- Water level readings shall be taken regularly, as required by the site hydrogeologist. All water level measurements at a site used to develop a ground-water contour map must be made in the shortest time practical, and at least during the same day.

8.2 Water Level Measuring Techniques

There are several methods for determining standing or changing water levels in boreholes and monitoring wells. Certain methods have particular advantages and disadvantages depending upon well conditions. A general description of these methods is presented, along with a listing of various advantages and disadvantages of each technique. An effective technique shall be selected for the particular site conditions by the onsite hydrogeologist.

Water levels can be measured by several different techniques, but the same steps shall be followed in each case. The proper sequence is as follows:

1. Check operation of recording equipment above ground. Prior to opening the well, don personal protective equipment as required. Wells that have

been completed with a water-tight cap should be opened at least 24 hours prior to measurement to allow the water level to stabilize.

2. All ground-water level measurement devices must be decontaminated before and after each use to prevent cross contamination of wells.

3. Record all information specified below on a Ground-water Sampling Form (Attachment 9.1) or in field notebook if the form is not available.

4. Record well number, top of casing altitude and surface altitude if available. Well diameter and total depth should be recorded. Water levels shall be taken from the surveyed reference mark on the top edge of the inner well casing.

5. Record water level to the nearest 0.01 foot (0.3 cm).

6. Record the time and day of the measurement.

7. Many water level measuring devices have marked metal or plastic bands clamped at intervals along the measuring line used for reference points to obtain depth measurements. The spacing and accuracy of these bands shall be checked frequently as they may loosen and slide up or down the line, resulting in inaccurate reference points.

8.3 Water Level Measuring Devices

Electric Water Level Indicators

These devices consist of a spool of small-diameter cable and a weighted probe attached to the end. When the probe comes in contact with the water, an electrical circuit is closed and a meter, light, and/or buzzer attached to the spool will signal the contract.

There are a number of commercial electric sounders available, none of which is entirely reliable under all conditions likely to occur in a contaminated monitoring well. In conditions where there is oil on the water, ground-water with high specific conductance, water cascading into the well, or a turbulent water surface in the well, measuring with an electric sounder may be difficult.

For accurate readings, the probe shall be lowered slowly into the well. The electric tape is marked at the measuring point where contact with the water surface was indicated. The distance from the mark to the nearest tape band is measured using an engineer's folding ruler or steel tape and added or subtracted to the nearest band reading to obtain the depth to water. Band spacing shall be checked periodically.

Chalked Steel Tape

Water level is measured by chalking a weighted steel tape and lowering it a known distance (to any convenient whole foot mark) into the well or borehole. Water level is determined by subtracting the wetted chalked mark from the total length lowered into the hole. The tape shall be withdrawn quickly from the well because water has a tendency to rise up the chalk due to capillary action.

Disadvantages to this method include the following: Depths are limited by the inconvenience of using heavier weights to properly tension longer tape lengths (typically, 100 foot tapes require a 10 to 12 pound weight to tension adequately); ineffective if borehole/well wall is wet or inflow is occurring above the static water level; chalking the tape is time consuming; difficult to use during periods of precipitation.

Popper or Bell Sound

A bell or cup shaped weight that is hollow on the bottom is attached to a measuring tape and lowered into the well. A "plopping" or "popping" sound is made when the weight strikes the surface of the water. An accurate reading can be determined by lifting and lowering the weight in short strokes, and reading the tape when the weight streaks the water. This method is not sufficiently accurate to obtain water levels to 0.01 feet, and thus is more appropriate for obtaining only approximate water levels quickly.

Float Recorder

A float or an electromechanically actuated water-seeking probe may be used to detect vertical changes of the water surface in the hole. A paper-covered recording chart drum is rotated by the up and down motion of the float via a pulley and reduction gear mechanism, while a clock drive moves a recording pen horizontally across the chart. To ensure continuous records, the recorder shall be inspected, maintained, and adjusted periodically.

9.0 ATTACHMENTS

9.1 Ground-water Sampling Form.

ATTACHMENT 9.1
FP 7-2
2 Pages

GROUND-WATER SAMPLING FORM

3. GROUNDWATER SAMPLING FORM

1. Date/Time ____________ Sample No. ____________
2. Location ____________
3. Well No. ____________ Sketch on Back [Y or N] ______
4. Total Depth ____________ Number of Screened Interval(s) ______
5. Depth to Screen/Length(s) ____________
6. [Y or N] Well Secure? Comments ____________

7. Sampler ____________ Other present ____________
8. Organic Vapor Detector FEL No. ________, Reading ________
9. Weather: Wind ______, Precipitation ______, Air Temperature ______
10. Water Level Measurement: FEL No. ____________
    [Y or N] Well Labeled ______, Elev. Ref. For Water Level ______
    Comments ____________
    Odor ____________

11. Depth to Product / Depth to Interface/Water / Thickness
    1st ________ ________ ________

12. Casing Type ________, I.D. ________, Gal/Ft. ________
    (Show derivation for gal/ft of casing)

13. Total Depth ________ - Depth to Water ________ = Ht. ________
14. Well Volume ________ = Ht. ________ * Gal/Ft. ________
15. Required Purge Volume ________, Actual Purge ________

16. FEL No.'s Cond. ______ pH ______ Temp. ______ Redox ______

17.

Cond.	µmhos/cm	pH	Temp.	Redox mv
Initial	______	______	______	______
(Purged	______	______	______	______
cycle)	______	______	______	______
	______	______	______	______
Sample	______	______	______	______

Sample Type and FEL No. ____________

18. [Y or N] Turbid ________, Purge Water Containerized ________
19. Sample Filtered ________, Filter Size ________
20. Reviewed By ____________ Date/Time ________
    Form Complete? [Y or N] ______
    Decon Complete? [Y or N] ______

1 (2)

AMENDMENTS TO:

FIELD PROCEDURE FP 7-2
WATER LEVEL MEASUREMENT

The following are specific amendments to the referenced SOP. The amended portions of the SOP are marked and correspond to the numbered comments listed below.

1. The ground-water levels in sealed wells will be permitted to equilibrate after opening and before ground-water levels are measured. The water level will be measured immediately after the well is unsealed. Another measurement will be made 5 minutes later and compared with the first measurement. When two successive level mearsurements at 5-minute intervals agree within ± 0.001 foot, the ground-water level will be considered to be in equilibrium.

2. 21. Purging method ______________________________

FIELD PROCEDURE FP 7-3

BORHOLE LOGGING

1

Subject	Procedure No. FP 7-3	Rev. 0	Page 1 of 6
BOREHOLE LOGGING | (1)	Issue Date 05/25/90		Effective Date 07/02/90
	Supersedes Procedure Number 630 FP 24	Rev. 0	Date
Acceptance - Program QA	Approval - Program Manager		

1.0 PURPOSE

The purpose of this procedure is to define the requirements necessary for borehole and sample logging. Consequently, the major objectives of this plan are to provide a uniform set of guidelines that will aid in developing consistency among sample descriptions and sample techniques. The importance of accurate, complete, clear, and concise logs cannot be overemphasized.

2.0 SCOPE

This procedure applies to descriptions of the standard techniques used for logging boreholes and logging soil/rock samples.

3.0 REQUIREMENTS

Careful field documentation and sample description is necessary to ensure that logging is done in a consistent manner.

4.0 REFERENCES

4.1 Compton, R. R., 1962. *Manual of Field Geology*, John Wiley and Sons, Inc., New York

4.2 Folk, R. L., 1968. *Petrology of Sedimentary Rocks*, Hemphills Bookstore, Austin, Texas, p. 170.

4.3 HAZWRAP, February 1989, *Quality Control Requirements for Field Methods*, DOE/HWP-69.

4.4 U.S. Army Corps of Engineers, 1953. *The Unified Soil Classification System*, Technical Memorandum No. 3-357 (Vol. 1), Waterways Experimental Station Usage, Vicksburg, MS.

4.5 Lewis, D.W., 1984. *Practical Sedimentology*, Van Nostrand Reinhold Company, Inc., NY, NY.

4.6 Pettijohn, F.J., 1975. *Sedimentary Rocks*, Harper & Row, New York.

5.0 DEFINITIONS

This section provide information that is commonly used in borehole sample descriptions (also see Section 9.0 Attachments).

Bedding - Term signifying the existence of beds or layers (strata), laminae, or other tabular and essentially horizontal units.

Cohesive - Having the capacity to stick or adhere together. In effect, the cohesion of soil is that part of its shear strength which does not depend on interparticle friction.

Color - Color should be described using a Munsell color chart, and only colors listed in that chart should be used. If the colors in the sample are variable, adjectives such as "mottled" or "banded" may be used as appropriate (available from USGS, see Attachment 9.1).

Conchoidal - Shell-like surface form produced by fracture of a brittle material.

Consistency - Consistency is the density or strength of the soil, and is a primary factor in engineering investigations (see Attachment 9.2).

Fabric - The orientation of the particles composing a soil or rock.

Friable - Easily crumbled.

Grading - Degree of mixing of size classes in a sedimentary material. Well graded implies more or less uniform distribution from coarse to fine; poorly graded implies uniformity in size or lack of a continuous distribution (also see sorting).

Grain Size - The size of particles within a rock or a soil sample (see Attachment 9.3).

Moisture - The degree of wetness of a soil, i.e. dry, damp, moist, and wet.

Plasticity - The property of a material which enables it to undergo permanent deformation without appreciable volume change or elastic rebound, and without rupture.

Slickensides - Polished and striated (scratched) surface that results from friction along a fault plane. Apparent slickensides can sometimes be created during the drilling process.

Soil Classification - see Attachment 9.7

Sphericity & Roundness - See Attachment 9.6.

Texture - Geometric aspects of the component particles of a soil or rock, including size, shape and arrangement.

6.0 RESPONSIBILITIES

6.1 Field Operations Leader

The Field Operations Leader is responsible for ensuring that field personnel have been trained in the use of this procedure, for verifying that monitoring well installation activities are performed in compliance with this procedure, and to ensure consistency in logging between Field Geologists.

6.2 Field Geologist and/or Field Technician

The Field Geologist is responsible for on-site monitoring of drilling and soil sampling operations, for recording (logging) pertinent information regarding the geologic materials penetrated during the operations, and that the well and sample numbering system follows that described in the Quality Assurance Project Plan (QAPP).

7.0 EQUIPMENT

The following is a list of required and optional equipment necessary for borehole logging.

7.1 Required Equipment

1. Clipboard
2. Drilling record forms
3. Portable organic vapor detector
4. Field book, straight edge and black permanent ink
5. 100 foot engineer's tape (weighted)
6. Folding rule or tape measure
7. Sand gauge
8. Color chart
9. Acid bottle
10. Water level indicator
11. Site map
12. Copy of drilling contract
13. Copy of Statement of Work and/or Project Work Plan
14. Waterproof marking pen
15. Sample jars or bags

7.2 Optional Equipment

1. Hand lens
2. Brunton compass
3. Pocket penetrometer
4. Equipment pouch
5. Flagging tape
6. Cooler and water bottles

7. Flashlight

8. Rock hammer

8.0 PROCEDURE

8.1 Recording Data

Borehole information is recommended in the field logbook (See FP 1-2). ②

In addition to the field logbook it is required that soil logging data be recorded on a pre-printed boring log (Attachment 9.8). This activity is usually accomplished in the field office and is done to provide a clear and concise record of borehole lithology. Secondly, this method allows a rapid means in which data can be discussed and interpreted.

8.2 Information to be Gathered During Borehole Logging

Soil sampling is performed using a method such as split spoon or continuous coring. The obtained soil sample is immediately scanned with a portable organic vapor detector and the reading recorded on the log form. Selection of soil sampling intervals for chemical analysis may be based on the results of the scan with the portable organic vapor detector or by visual confirmation of contamination such as discolorization. The sampling intervals should be noted on the log form.

The percent recovery of core is noted and recorded on the log form. This number is the ratio of the actual core recovered over the interval in which the sample was taken. For instance, if a continuous core barrel goes down five feet but only four feet are retained by the core barrel, then there was an 80 percent core recovery.

The most important information on the form is the description of each sample or geologic unit. Any obvious features related to contamination should also be noted such as odor or staining. The description of lithologic samples should include color, consistency, texture, mineralogy, and moisture of the sample or unit. These characteristics should be described according to guidelines given in the attachments.

8.3 Logging Guidelines ③

For accuracy and consistency, boring log descriptions should generally be completed in the following order. Refer to the listed attachments for guidance.

1. Material type - Attachment 9.1, Attachment 9.4.

2. Color. Color should be described using a Munsell color chart, and the colors listed in that chart only. If the colors in the sample are variable, adjectives such as "mottled" or "banded" may be used as appropriate (Attachment 9.2).

3. Consistency. Consistency is the density or strength of the soil, and is a primary factor in engineering investigations. It is also an important part

of geologic and hydrogeologic investigations (Attachment 9.3)

4. Texture. Texture describes the size and shape of soil grains and is often the most important characteristic of a soil. The first step in describing texture is to determine whether the soil consists primarily of sand and gravel (particle size greater than 63 micrometers) or fines (particle size less than 63 micrometers). In the written description, the major soil component should be given first and be capitalized or underlined. The portions of sand, gravel and fines should be described using only the following semi-quantitative adjectives:

Adjective	Estimated Percent of Total Sample
Trace	0-5
Little	5-12
Some	12-30
And	30-50

For example - SAND, some clay. NOT Sand, lots of clay or Clayey sand. Reference Attachment 9.4

5. Description of mineralogy should be as simple as possible and above all, accurate. Relatively common mineralogic descriptions may be used as adjectives:

   Arkosic
   Calcareous
   Feldspathic
   Glauconitic
   Micaceous

   More complicated descriptions should generally be enclosed in parentheses.

6. Moisture Content. If the drilling method permits, the moisture content of the sample (dry, moist or wet) should be noted.

7. Geologic Interpretation. If the logger is familiar with the site geology and confident of the interpretation, a brief interpretation of the soil (i.e. "saprolite", "beach sand", "loess", etc.) may be added in parentheses at the end of the description. This is, of course, no substitute for a complete soil description.

9.0 ATTACHMENTS

9.1 Grain Size.

9.2 Color.

9.3 Field Criteria Used in Determining Soil Consistency.

9.4 Lithology.

9.5 Sorting.

9.6 Sphericity and Roundness.

9.7 Soil Classification Abbreviations.

9.8 Sample HAZWRAP Boring Log Form.

GRAIN SIZE

Grain Size - For consistent descriptions of grain size, the grain size classification scheme of Wentworth (1922) should be used. It is also advantageous to carry a pocket grain size card to aid in quick grain size classification in the field.

Wentworth Grain Size Classification Scheme

Exact Size Limits (mm)	Approximate inch Equivalents (in.)	Sediment
256	<10	Boulder gravel
64 - 256	2.5 - 10	Cobble gravel
32 - 64	1.2 - 2.5	Very coarse pebble gravel
16 - 32	0.6 - 1.2	Coarse pebble gravel
8 - 16	0.3 - 0.6	Medium pebble gravel
4 - 8	0.15 - 0.3	Fine pebble gravel
2 - 4	0.08 - 0.15	Granule (or very fine pebble) gravel
1 - 2	0.04 - 0.08	Very coarse sand
0.5 - 1	0.02 - 0.04	Coarse sand
0.25 - 0.5	0.01 - 0.02	Medium sand
0.125 - 0.25	0.005 - 0.01	Fine sand
0.0625 - 0.125	0.002 - 0.005	Very fine sand
0.0039 - 0.0625	0.00015 - 0.002	Silt
Smaller than 0.0039	<0.00015	Clay (clay-size materials)

COLOR

Color - The definition of color is self-explanatory; however, the Field Geologist should be aware to note both the fresh and weathered color of a soil or rock sample. Note that soils should be wet before classifying the color. For consistent descriptions of color, the Munsell color charts should be used. These are distributed by:

The Geological Society of America
Post Office Box 9140
Boulder, CO 80401

For mixed lithologies within a common interval, provide relative percentages of the two or more lithologies within parentheses following the lithologic name. For example, SAND fine - medium (60%) brownish yellow (10YR6/6), and GRAVEL coarse (40%) - very pale brown (10YR7/3), etc. (HAZWRAP, 1989).

COMMONLY USED CRITERIA FIELD CRITERIA USED FOR DETERMINING SOIL CONSISTENCY

SOIL CONSISTENCY AS DETERMINED BY POCKET PENETROMETER

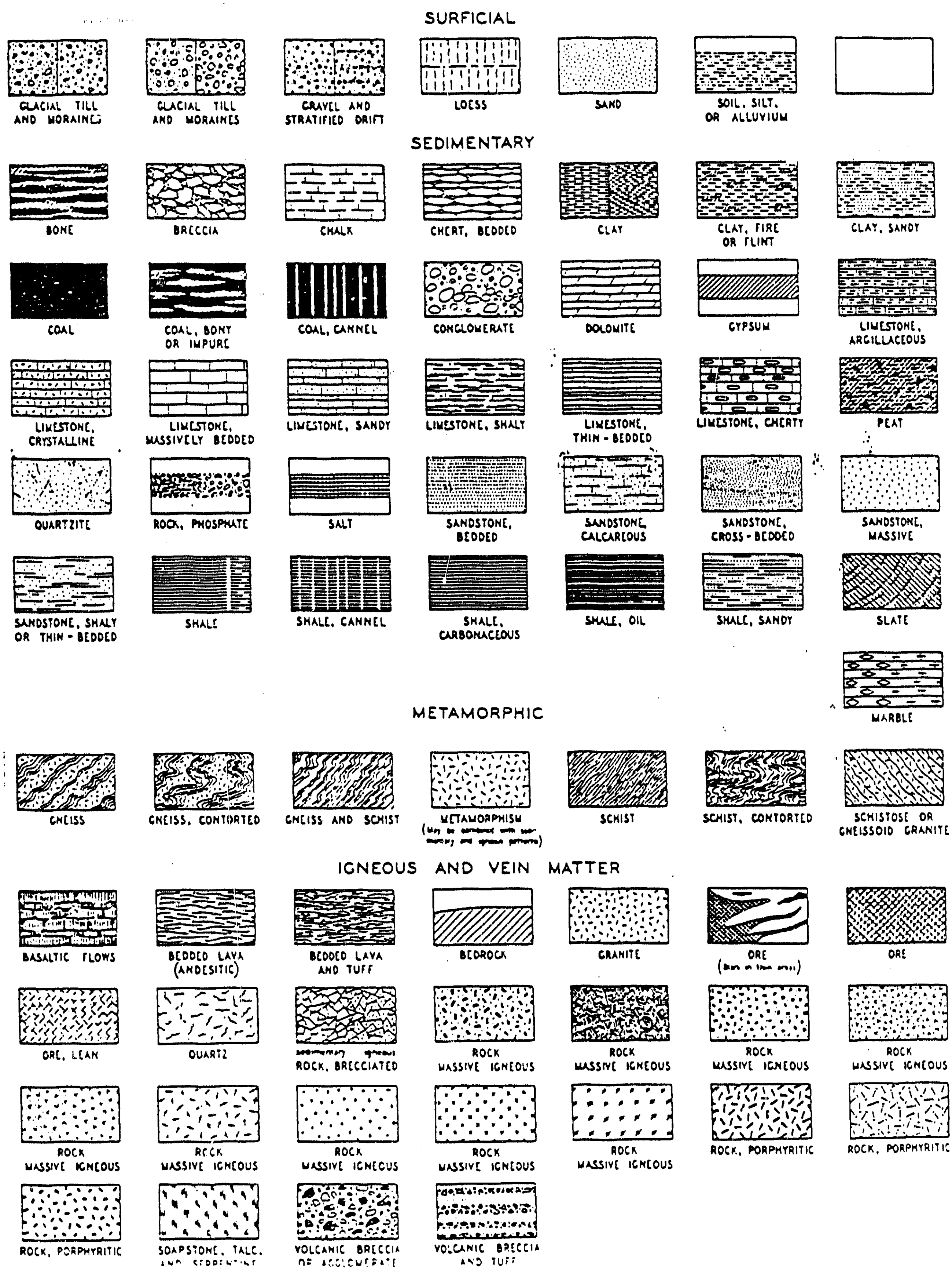
	Unconfined Compressive Strength of Fine Grained Soils (AFter Terzaghi and Peck)		Field Test (After Cooling, Skempton, and Glossip)
Term	Kips/ft^2	kN/m2	
Very soft	0-0.5	0-25	Squeezes between fingers when fist is closed.
Soft	0-5.1	25-50	Easily molded by fingers
Firm	1-2	50-100	Molded by strong pressure of fingers.
Stiff	2-3	100-150	Dented by strong pressure of fingers.
Very Stiff	3-4	150-200	Dented only slightly by finger pressure.
Hard	4+	200+	Dented only slightly by pencil point.

COMMONLY USED CRITERIA FIELD CRITERIA USED FOR DETERMINING SOIL CONSISTENCY (Continued)

Consistency of Fine Grained Soils - Standard Penetration Test (After Terzaghi and Peck)		Relative Density of Sand Standard Penetration Test (After Terzaghi and Peck)	
Blows 6-inch Penetration	Consistency	Blows 6-inch Penetration	Relative Density
0-1	Very soft	0-5	Very loose
2-4	Soft	5-10	Loose
5-8	Firm	11-20	Firm
9-15	Stiff	21-30	Very firm
16-30	Very Stiff	31-50	Dense
31+	Hard	51+	Very dense

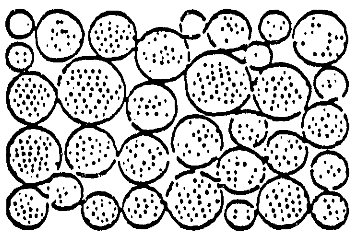
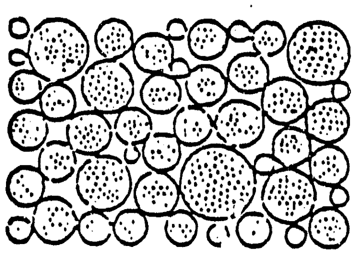
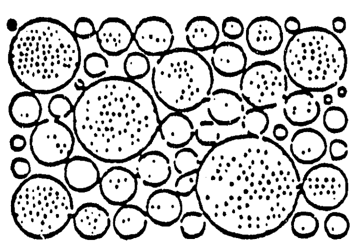
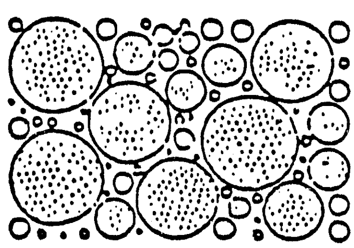
ATTACHMENT 9.4
FP 7-3

COMMON SYMBOLS USED IN THE LITHOLOGIC DESCRIPTION OF SOIL AND ROCK SAMPLES



SORTING

The generally accepted standard for describing the degree of sorting in a soil or rock sample is based on the Folk Classification Scheme, 1968.

Visual Standard	Phi standard deviation	Verbal
	0.35	
		0.35 - 0.50 well sorted
	0.50	
		0.50 - 1.0 moderately sorted
	1.00	
		1.0 - 2.0 poorly sorted
	2.00	
		>2.00 very poorly soorted

SPHERICITY AND ROUNDNESS

Sphericity is a mesure of how nearly equal the axial dimensions of a particle are. True sphericity is the surface area of a grain divided into the surface area of a sphere of the same volume.

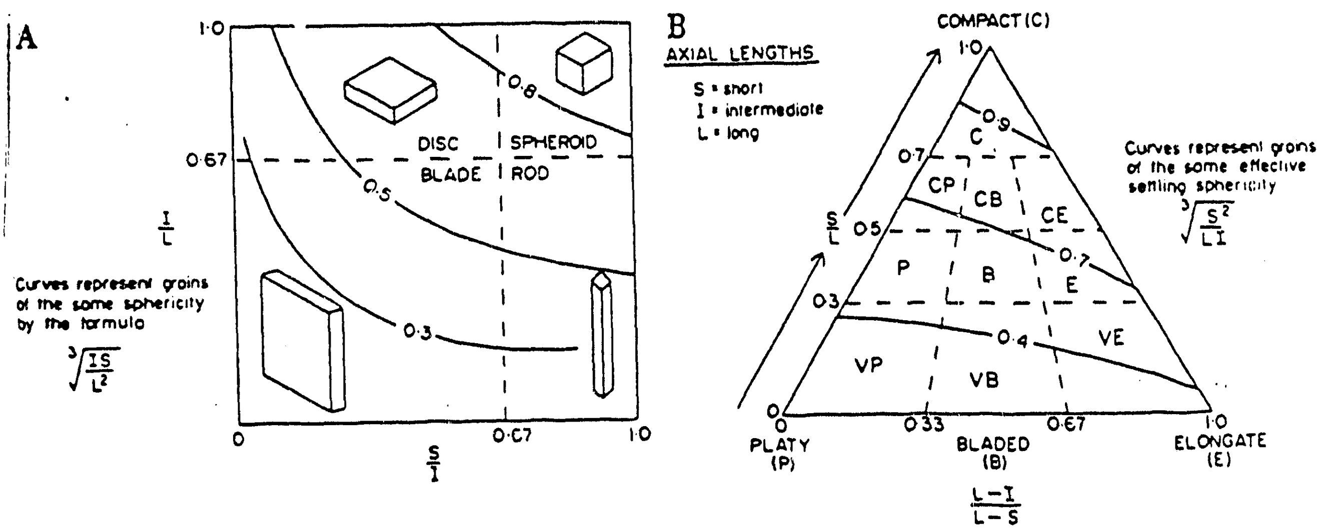
Operational sphericity is:

$$\sqrt[3]{\frac{Vp}{Vcs}}$$

where Vp = volume of particle and Vcw = volume of smallest sphere that would enclose the particle. Vcs is approximated by

$$\sqrt[3]{\frac{LIS}{L^3}} = \sqrt[3]{\frac{IS}{L^2}}$$

where I = intermediate axis, S = short axis, and L = long axis.



SPHERICITY AND ROUNDNESS (Continued)

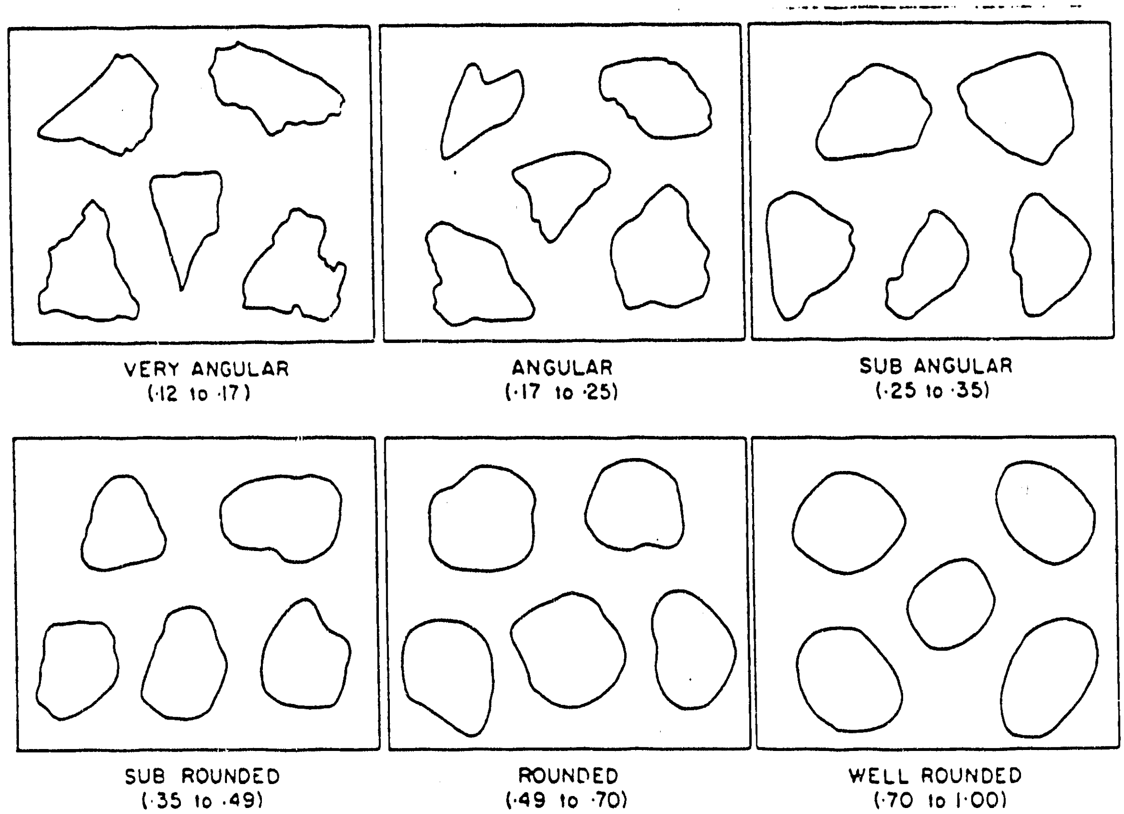
Roundness indicates the extent of abrasion the grains have undergone. Extent of abrasion reflects overall transport history but does not necessarily reflect the distance the grains have traveled from their source - rounded grains may have been derived locally from a sedimentary rock, or may have been extensively abraded in an environment near the source, such as a beach adjacent to a cliff.

Quantitatively, true roundness is generally expressed by the formula:

$$\Sigma \frac{r}{R} N$$

where r - radius of curvature of grain corners, R - radius of largest *inscribed* circle, and N - number of corners.

Unless highly detailed work is justified by the likely results, practical measures of roundness rely on visual comparison with standard silhouette charts.



Silhouette comparison diagram for sand grain roundness.

SOIL CLASSIFICATION ABBREVIATIONS

The following is a list of modifiers that are commonly used to characterize the gross lithology of a soil sample. The list if after the Unified Soil Classification System (USCS) scheme.

C -	Coarse	BR -	Broken
Med -	Medium	BL -	Blocky
F -	Fine	M -	Massive
V -	Very	Br -	Brown
Sl -	Slight	Gn -	Green
Sm -	Some	Gr -	Gray
Occ -	Occasional	Bk -	Black
Tr -	Trace	Yl -	Yellow
Lt -	Light	Or -	Orange
Dk -	Dark	Rd -	Red
		Bl -	Blue
		Tn -	Tan
		Wh -	White

SAMPLE HAZWRAP BORING LOG FORM

REV. DATE: JAN 1989

BORING LOG

BORING LOG	BORING/WELL NO.:	Page ___ of ___
Installation:		Site:
Project No.:	Client/Project:	
HAZWRAP Contractor:	Drlg Contractor:	Driller:
Drlg Started: (: __m)	Drlg Ended: (: __m)	Borehole dia(s):
Drlg Method/Rig Type:		
Logged by:	E-Log (Y/N) From ______ to ______	Protection Level:

Depth (ft)	Sample	Sample No.	Lab Anal. (Y/N)	( ) hdsp ( )	Recovery ( )	Lithologic Description	USCS	Blows/6 inch.	Graphic Log	Well data	Water depth & Remarks	Elev.

U = Thin wall tube

S = Split spoon (tube)

C = Cuttings

R = Rock coring ______

O = Other ______

Notes: ______

Field G/C (Make/Mod.) ______

G/C Oper.: ______

AMENDMENTS TO:

FIELD PROCEDURE FP 7-3
BOREHOLE LOGGING

The following are specific amendments to the referenced SOP. The amended portions of the SOP are marked and correspond to the numbered comments listed below.

1. Borehole Log Preparation.

2. Amendment not implemented.

3. Subsection 8.3 Logging Guidelines and associated attachments will be used as a guidance. Samples collected during the investigation will be classified using The Soil Classification Chart approved by the American Society for Testing and Materials, Part 19 (1978) p. 328. A copy of this chart is attached to these comments.

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE-GRAINED SOILS More than 50% retained on No. 200 sieve*	GRAVELS 50% or more of coarse fraction retained on No. 4 sieve	CLEAN GRAVELS	GW	Well-graded gravels and gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
		GRAVELS WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS More than 50% of coarse fraction passes No. 4 sieve	CLEAN SANDS	SW	Well-graded sands and gravelly sands, little or no fines
			SP	Poorly graded sands and gravelly sands, little or no fines
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS 50% or more passes No. 200 sieve*	SILTS AND CLAYS Liquid limit 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL	Organic silts and organic silty clays of low plasticity
	SILTS AND CLAYS Liquid limit greater than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity
Highly Organic Soils			PT	Peat, muck and other highly organic soils

* Based on the material passing the 3-in. (75-mm) sieve.

FIG. 1 Soil Classification Chart.

FIELD PROCEDURE FP 7-4

PH MEASUREMENTS

Subject	Procedure No. FP 7-4	Rev. 0	Page 1 of 3
pH MEASUREMENTS	Issue Date 05/25/90		Effective Date 07/02/90
	Supersedes Procedure Number 630 FP 30	Rev. 0	Date
Acceptance - Program QA	Approval - Program Manager		

1.0 PURPOSE

The purpose of this procedure is to define the necessary steps for conducting pH measurements during field activities.

2.0 SCOPE

2.1 This procedure applies to the calibration, operation and maintenance of the Omega Model PHH-60/80 hand-held pH meter and probe.

2.2 This procedure may also be used in conjunction with the manufacturer's instructions for other pH measuring devices. (1)

3.0 REQUIREMENTS

pH is an important environmental parameter that is routinely measured during waste management investigations to provide information on the extent of contamination at a site. In addition, pH measurements are taken on purge waters from monitoring wells to aid in assessing when sufficient water has been removed from the well to ensure that formation water samples will be collected.

4.0 REFERENCES

OMEGA Engineering, Inc., Model PHH 60/80 Hand Held pH Meter Instruction Manual, 1986.

5.0 DEFINITIONS

None.

6.0 RESPONSIBILITIES

The Field Operations Leader is responsible to ensure that the necessary equipment is available for the calibration, use and maintenance of measuring equipment. The Field Operations Leader is also responsible to ensure that the calibration and use methodology is consistent and that workers have been instructed in the proper use of equipment.

7.0 EQUIPMENT

7.1 OMEGA Model PHH 60/80 hand held pH meter and probe, or equivalent.

7.2 Calibration solutions, as required.

8.0 PROCEDURE

The procedure for calibration, operation and maintenance of the OMEGA Model PHH 60/80 hand held pH meter is outlined below. If a different instrument is used, the owner's manual should be consulted for instructions.

8.1 Calibration

The OMEGA Model PHH-60/80 pH meter is laboratory calibrated prior to shipment from the manufacturer. Calibration should be performed daily or more frequently if field personnel suspect that calibration may have been altered. For best results, calibrate pH with a fresh buffer solution that is within three pH units of the test sample. The following procedure describe the steps for calibration of the OMEGA Model PHH 60/80 pH meter: ②

1. Rinse the pH probe with ASTM Type II reagent-grade water.
2. Insert the pH probe into 300 mL of a fresh pH 7 buffer solution (Fisher Scientific, monobasic potassium phosphate and sodium hydroxide, 0.05 Molar).
3. Slide back the battery compartment cover of the instrument exposing the adjustment pots.
4. Adjust the CAL pot until the display reads 7:00.
5. Remove the probe from the solution, rinse with ASTM Type II reagent-grade water and insert in 300 mL of either a pH 4 or a pH 10 buffer solution. Use the appropriate solution that is in the expected pH range of sampler. (Recommended buffer solutions: Fisher Scientific, pH 4: potassium biphthalate, 0.05 Molar; pH 10: potassium carbonate, potassium borate and potassium hydroxide, 0.05 Molar.)
6. Adjust the SLOPE pot until the display reads the correct value.

8.2 Operation

1. Slide back electrode compartment to release pH electrode. Remove storage cap.
2. Extend electrode in either the 90° or 180° measurement position.
3. Energize instrument by depressing the ON/OFF switch once.
4. Rinse the electrode thoroughly with distilled water to prevent cross-contamination.
5. Immerse electrode in solution to be measured. For proper operation, immerse electrode to half its length, approximately 300 ml. Do not immerse electrode caps.

6. Select the desired parameter by depressing pH/PPM switch.

7. Agitate electrode briefly and observe reading.

8. Rinse electrode thoroughly with ASTM Type II reagent-grade water and replace pH storage cap; fill the cap with a small amount of pH 4 buffer or potable water to keep the bulb from drying out.

9. Remove the battery when the instrument will be stored for a long period.

8.3 Preventive Maintenance

The pH meter should be cleaned and inspected daily before and after use. Batteries shall be replaced, as necessary and the pH electrode shall be replaced when required.

The pH electrode can be maintained by cleaning after use with ASTM Type II reagent-grade water and filling the electrode's protective cap with a small amount of pH 4 buffer or potable water to keep the bulb from drying out.

9.0 ATTACHMENTS

None.

AMENDMENTS TO:

FIELD PROCEDURE FP 7-4
pH MEASUREMENT

The following are specific amendments to the referenced SOP. The amended portions of the SOP are marked and correspond to the numbered comments listed below.

1. This procedure may also be used in conjunction with manufacturer's instructions for other pH measuring devices. Different meters, however, will require some variations in the calibration procedures and reagents used. Therefore, subsection 8.1 will be used as guidance when calibrating other pH measuring devices.

2. The pH meter will be calibrated before each use.

FIELD PROCEDURE FP 7-5

SPECIFIC CONDUCTIVITY MEASUREMENTS

Subject	Procedure No.	Rev.	
SPECIFIC CONDUCTIVITY MEASUREMENTS	FP 7-5	0	Page 1 of 5
	Issue Date		Effective Date
	05/25/90		07/02/90
	Supersedes Procedure Number	Rev.	Date
	630 FP 31	0	
Acceptance - Program QA	Approval - Program Manager		

1.0 PURPOSE

The purpose of this procedure is to define the steps necessary for calibration, operation and maintenance of the Hach Model 44600 conductivity/TDS meter.

2.0 SCOPE

2.1 This procedure applies to the calibration, operation and maintenance of the Hach Model 44600 conductivity/TDS meter.

2.2 This procedure may also be used in conjunction with the manufacturer's instructions for other specific conductivity meters. (1)

3.0 REQUIREMENTS

Electrical conductance of a substance is its ability to conduct an electrical current. Chemically pure water has a low electrical conductance; while water that contains dissolved inorganic solids (chloride, phosphate, etc.) has a high electrical conductance. Consequently, the greater the amount of dissolve solids in ground water the greater the water's electrical conductivity.

4.0 REFERENCES

4.1 Driscoll, F. G., 1986. *Groundwater and Wells*. Johnson Division, St. Paul, Minn. pp. 92-94.

4.2 Hach Model 44600 Conductivity/TDS Meter Instruction Manuals.

5.0 DEFINITIONS

None.

6.0 RESPONSIBILITIES

The Field Operations Leader is responsible to ensure that the necessary equipment is available for the calibration, use, and maintenance of the sampling equipment. The Field Operations Leader is also responsible to ensure that the calibration and the method of operation is consistent and that workers have been instructed in the proper use of equipment.

7.0 EQUIPMENT

The following is a list of replacement parts, calibration standards and accessories associated with the operation of the Hach Model 44600 conductivity/TDS meter.

REPLACEMENT PARTS AND ACCESSORIES

Cat. No.	Description	Unit
19380-04	Battery, AA, alkaline	4/pkg
1C80-42	Beaker, poly, 100 mL	each
620-14	Bottle, wash, 120 mL	each
14423-26	Gallic Acid Solution, 59-Ml dropping bottle	each
44600-88	Instruction Manual	each
162-36	Phenolphthalein Indicator Solution	15 mL
44606-00	Probe, conductivity	each
44606-10*	Probe, conductivity, 10-ft cable (optional)	each
2105-14	Sodium Chloride Standard Solution, 100 mg/L (1990 ± 20 μS/cm, 995 ± 10 TDS)	118 mL
23075-14	Sodium Chloride Standard Solution, 85.47 mg/L (180 ± 00 μS/cm, 90 ± 10 TDS)	118 mL
14400-14	Sodium Chloride Standard Solution, 491 mg/L (1000 ± 10 μS/cm, 500 ± 5 TDS)	118 mL
23074-14	Sodium Chloride Standard Solution, 10246 mg/L (18000 ± 50 μS/cm, 9000 ± 25 TDS)	118 mL

*Refer to specifications for differences in accuracy and zero error.

8.0 PROCEDURE

The procedure for calibration, operation, and maintenance of the Hach Model 44600 conductivity/TDS meter is outlined below. If using a different instrument, the owner's manual should be consulted for instructions.

8.1 Calibration

Calibration will be needed periodically due to aging of the probe electrical components or when a new probe is installed. Calibration with a standard solution of known conductivity value near the typical temperature of the sample solution will improve accuracy. (2)

NOTE: Calibration on the 2 mS/cm range with the 100 mg/L NaCl (1.99 mS/cm) standard calibrates all three ranges accurately enough for most applications. However, slightly better accuracy will be gained by calibrating on the particular range to be used using the appropriate standard solution. *Refer to Replacement Parts and Accessories* for a list of available standards offered by Hach Company.

Calibrate as follows:

NOTE: Sodium Chloride standards are contaminated easily. Always clean the probe before calibration and use a clean, dry container for the standard solution.

1. Be sure the probe is clean.
2. Soak the probe in demineralized water for at least 30 minutes.
3. Remove the probe from the water and fling out drops clinging inside.
4. Immerse the probe to or beyond the vent holes in a beaker containing Sodium Chloride Standard Solution, 1000 mg/L. Agitate vertically to remove entrapped air.
5. Repeat Steps 3 and 4 at least once more.
6. Press the POWER I key and CND key. Verify that the LO BAT indication does not appear.
7. Press the 2 mS/cm range key.
8. Check the reading on the display. It should be 1.990 mS/cm. If adjustment is needed, use a small screwdriver to adjust the CAL control next to the display. Counterclockwise adjustment increases the reading.

8.2 Operation

Taking the Conductivity Measurement:

If the probe has been in storage, soaking may be necessary prior to use to ensure the probe is thoroughly wetted.

1. Press the POWER I key and CND key. Verify that the LO BAT indication does not appear.
2. Select the appropriate range. If the range in unknown, begin with the highest range.
3. Insert the probe into the sample solution. Immerse the tip to or beyond the vent holes and agitate the probe vertically to be sure air bubbles are not entrapped. Allow time for the reading to stabilize. If the reading falls within the lowest 10% of the range, select the next lower range and again allow the reading to stabilize before recording the measurement. An overrange condition cause a 1 display followed by blank digits.
4. Rinse the probe thoroughly with demineralized water after each measurement.

Taking the Total Dissolved Solids Measurement:

1. Press the POWER I key and CND key. Verify that the LO BAT indication does not appear.
2. Select the appropriate range. If the range in unknown, begin with the highest range.

3. Insert the probe into the sample solution. Immerse the tip to or beyond the vent holes and agitate the probe vertically to be sure air bubbles are not entrapped. Allow time for the reading to stabilize. If the reading falls within the lowest 10% of the range, select the next lower range and again allow the reading to stabilize before recording the measurement.

Taking the Temperature Measurement:

1. Press the POWER I key and °C key. Verify that the LO BAT indication does not appear.

2. Insert the probe into the sample solution. Immerse the tip to or beyond the vent holes and agitate the probe vertically if the sample is not flowing or being stirred to be sure air bubbles are not entrapped near the temperature sensor. Allow the reading to stabilize before recording the temperature measurement.

3. Rinse the probe thoroughly with demineralized water after each measurement.

8.3 Preventive Maintenance

Cleaning the Probe:

The probe should be rinsed thoroughly with deionized water between measurements during normal use. When this is done there will be little chance of interfering substances building up on the probe elements. Should the sample contain oils, greases or fats, however, the electrodes could become coated and affect accuracy of the readings. In this case, the probe should be cleaned with a strong detergent solution or dipped in a 1:1 hydrochloric acid solution and then rinsed thoroughly with deionized water.

Battery Replacement:

A low battery indication will appear in the upper left corner of the display when battery replacement is needed. Replace the complete set as described in the Battery Installation procedure in the Preparation for Use section.

Probe Replacement:

The replacement probe assembly listed in the replacement parts list comes with the cable and the 4-circuit connector installed and with the cable tie properly positioned four inches from the connector. Replace the probe assembly as follows:

1. Remove the batteries from the battery holder.

2. Remove the six screws securing the instrument in the case.

3. Carefully lift the instrument from the case.

4. Disconnect the probe cable connector from the circuit board jack.

5. Connect the replacement probe cable connector to the circuit board jack and install the instrument in its case. Be sure the cable tie installed on the probe cable is placed inside the compartment housing the circuit boards to provide a strain relief for the probe cable.

6. Secure the instrument in the case with the six screws removed in Step 2. Thread the screws until the heads contact the panel surface. Screws will not become tight with further rotation, but threads will not strip.

7. Replace the batteries. *Refer to Battery Installation.*

8. Perform calibration with the new probe. *Refer to the Calibration paragraph.*

9.0 ATTACHMENTS

9.1 Attachment 9.1 - Description and Location of Controls and Indicators.

DESCRIPTION AND LOCATION OF CONTROLS AND INDICATORS

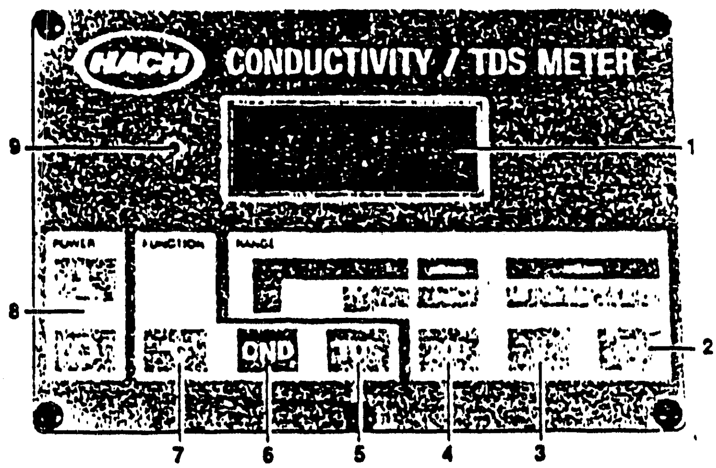


Table 1 Instrument Controls

tem	Name	Description
1	Liquid Crystal Display	A 3 1/2-digit display indicates value of measurement. Readout will be in millisiemens per centimeter, microsiemens per centimeter, grams per liter total dissolved solids, milligrams per liter total dissolved solids or degrees celsius, depending on the function and range switches selected. A low battery indication is incorporated, indicating LO BAT when battery replacement is required.
2	20 Range Key	Selects range 20 for mS/cm conductivity or g/L total dissolved solids.
3	20 Range Key	Selects range 2 for mS/cm conductivity or g/L total dissolved solids.
4	200 Range Key	Selects range 200 for μS/cm conductivity or mg/L total dissolved solids.
5	TDS Key	Selects total dissolved solids measurement mode.
6	CND Key	Selects conductivity measurment mode.
7	°C Key	Selects temperature measurement mode.
8	Power Keys	Turns operating power on and off. Press I for on, O for off.
9	CAL Control	Used to calibrate the cell constant setting to compensate for variations in probe electrical characteristics.

AMENDMENTS TO:

FIELD PROCEDURE FP 7-5
SPECIFIC CONDUCTIVITY MEASUREMENTS

The following are specific amendments to the referenced SOP. The amended portions of the SOP are marked and correspond to the numbered comments below.

1. This procedure may also be used in conjunction with manufacturer's instructions for other specific conductivity measuring devices. Different meters, however, will require some variations in the calibration procedures and reagents used. Therefore, subsection 8.1 will be used as guidance when calibrating other conductivity measuring devices.

2. Calibration will be performed daily and noted on the field activity log.

FP IT-1

HANDLING OF CUTTINGS AND WATER FROM DRILLING PROGRAM AND SAMPLING

August 10, 1990

1.0 Purpose

The purpose of this procedure is to detail the procedures for handling cuttings and development water from the drilling and ground-water sampling program.

2.0 Scope

This procedure applies to the following field activities:

1. Monitoring well installation using Hollow Stem Auger (HSA) techniques.
2. Monitoring well installation using Cable Tool drilling techniques.
3. Development of newly installed wells.
4. Purging of wells during ground-water sampling activities.

3.0 REQUIREMENTS

All cuttings and water resulting from the activities listed in Section 2.0 will be collected, screened, and containerized until proper disposal can be arranged. The procedure permits immediate field screening of drilling cuttings to determine disposal by two options, while water generated from these activities, will be containerized in bulk and disposed of after additional sampling and analytical efforts.

4.0 REFERENCES

IT Corporation, August 1990. Volume 2, Work Plan for Phase I, Task 4 Field Investigation. Prepared for Battelle Environmental Operations.

IT Corporation, August 1990. Volume3, Sampling and Analysis Plan (SAP) for Phase I, Task 4 Field Investigation. Prepared for Battelle Environmental Operations.

IT Corporation, August 1990. Volume 4, Health and Safety Plan (HSP) for Phase I, Task 4 Field Investigation. Prepared for Battelle Environmental Operations.

5.0 DEFINITIONS

Cable Tool Drilling - Refer to SOP FP5-1.

Hollow Stem Auger Drilling - Refer to SOP FP5-1.

Containers - Vessels for holding materials generated during the activities outlined in Section 2.0. The list of containers includes: drums, above-ground swimming pools, and fiberglass or polypropylene tanks.

Materials Handling Group - A crew of several individuals with the responsibility of screening, handling and general management of cuttings and water derived from well construction and purging.

6.0 RESPONSIBILITIES

The Project Manager is responsible for ensuring that the necessary equipment is available and in good working order. The Site Coordinator and the Material Handling Group Leader are responsible for implementing the procedure.

7.0 EQUIPMENT

7.1 Roll-off boxes
7.2 Above-ground swimming pools.
7.3 Pick-up truck mounted with a 500-gallon fiberglass or polypropylene tank.
7.4 Drums, 90-gallon over-packs or 55-gallon. Drums will be DOT approved steel open head type lids.
7.5 Wood pallets
7.6 Bobcat equipped with either a bucket or pallet forks.
7.7 Heavy gauge polyethlene plastic sheeting for liner membranes.
7.8 Various sizes of dimension lumber
7.9 Fencing
7.10 Personnel protection equipment as specified in the HEALTH AND SAFETY PLAN (Volume 4).
7.11 HNu or OVA.

8.0 PROCEDURE

GENERAL

This section is broken into three subsections dealing with the specific types of materials to be handled.

8.1 Handling of Drill Cuttings from the HSA drilling

Cuttings generated from the HSA drilling will be screened in the field and segregated into two catagories: clean cuttings or possibly contaminated cuttings. Cuttings deemed to be clean will be spread on the ground at the drilling area. Cuttings deemed to be possibly contaminated will be containerized in roll-off boxes for disposal at a proper location. Cuttings will be collected in ten-foot intervals from the HSA's for screening.

The following is a step-by-step procedure for screening HSA cuttings:

1. Collect the cuttings from each ten-foot interval of HSA drilling in a drum. The drum will only be used as a transfer container and will be reused after completing steps 2 and 3.

2. Screen the cuttings with an HNu or OVA to determine the presence of volatile organic compounds.

3. If the cuttings produce a 10 ppm value or greater on either the OVA or HNu, the cuttings will be deemed potentially contaminated and will be transfered to a 20 yard roll-off box for proper disposal. If the cuttings do not produce a 10 ppm value on either the OVA or the HNu, the cuttings will be deemed clean and spread evenly accross the ground at the drilling location.

4. Repeat steps 1 through 3 at each HSA borehole for every 10-foot interval of theboring.

8.2 Procedure for Handling Drill Cuttings and Fluids at Cable Tool Borings.

Cuttings and water will be generated as a slurry during cable tool drilling activities. The first operation when handling this material will be to separate the water from the cuttings. After the separation has been performed, the cuttings will be screened in the field and segregated into two catagories: clean cuttings or possibly contaminated cuttings. Cuttings deemed to be clean will be spread on the ground at the drilling area. Cuttings deemed to be possibly contaminated will be containerized in roll-off boxes for disposal. All water will

be collected and placed into a large vessel (above-ground swimming pool) for bulk disposal.
The following is a step-by-step procedure for screening cable tool generated drilling materials.

1. Separation of cuttings from water.

   a. A sand bailer which produces 10 to 15 gallons of water and cuttings slurry will be used to clean cuttings from the borehole during drilling at approximately 2 to 5 foot intervals. The bailer will be emptied into a drum. This procedure should produce a drum containing 50 to 70 gallons of a slurry of water and cuttings.

   b. In order to separate the cuttings from the water, the drum will be left undisturbed for 5 to 10 minutes to permit the cuttings to settle to the bottom of the drum. Since the drum must be left undisturbed for a period of time, 3 or 4 other drums will be needed to accept slurry material while the drilling procedure continues.

2. Handling of Cuttings and Water After Separation.

   a. When the cuttings have settled the water will be decanted from the drum to a polypropylene or fiberglass tank mounted on a pick-up truck using a low volume pump. When the tank on the truck is full, it will be transfered to a large vessel (an above-ground swimming pool) located at a strategic location with respect to the drilling operation in each area.

   b. The cuttings remaining in the drum will then be screened to determine proper disposal. If the cuttings produce a 10 ppm or greater value on either the OVA or HNu, the cuttings will be deemed potentially contaminated and transferred to a 20-yard roll-off box for proper disposal. If the cuttings do not produce a 10 ppm value on either the OVA or the HNu, the cuttings will be deemed clean and spread evenly across the ground at the drilling location.

3. Steps (1) through (2) will be repeated for each bailing event during the cable tool drilling procedure. Because of the time required for settling of cuttings, several (up to 5) drums will be needed at each cable tool operation to permit continuous drilling and cutting separation and disposal.

8.3 Disposal of Purge Water

Water will be generated from purging monitoring wells on and off site. At each location the water will be placed by the sampling crew in a labeled drum and left at the well for pick-up by the Materials Handling Group. The drums will be picked up from the location as soon as possible and transported to the bulk containers located a the central location. The drum will be opened and the contents will be transferred to the bulk containers. The drums can then be reused for other purging activities.

NOTE:
The swimming pools used for bulk water storage will rest on a polypropylene liner material and bermed with earth. The earthen berm and liner will provide secondary containment for the water held in the pool. The drums used to collect the cutting slurry at the cable tool rig will be placed in a depression lined with polyethylene sheeting to prevent possible releases from spillage.

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