Thuần

OVERVIEW OF FIELDTECHNIQUES:
SOIL AND GROUNDWATER ASSESSMENT

I. Drilling and Test Borings: The Primary Tool of Subsurface Investigation.

A. Background Information and Protocol

1. Objective: what is the goal of the drilling project.

    a. Regulatory Directives
    b. Assessment Parameters
    c. Results of Phase I Preliminary Investigation
    d. Known problems, hot spots and target areas
    e. Soil? Groundwater? or Both?

2. Preliminary Drilling Information

    a. Base map with engineering specs., boring/well locations
    b. Site Reconnaissance
    c. Property lines, ownership, authorization
    d. Preliminary surveying of reference points
    e. State and Local Drilling Permits?

3. Prescribed Health and Safety Protocol

    a. Potential Hazardous Situations to Personnel
    b. Personal Protective Equipment
        (1) coveralls, respirators, gloves, boots??

    c. Drilling Safety

        (1) Buried pipelines, waterlines, gaslines, electric
        (2) Overhead clearance, electrical wires
        (3) Buried tanks? Drums? Explosive Conditions?

II. Drilling Methods: Varies According to Goals and Geologic Conditions

A. Hollow Stem Auger

1. Penetration to 75-100 Ft depth
2. Excellent for unconsolidated materials
3. Sampling and Devices and Well Materials Lowered Through Drill Stem
4. Commonly used in environmental/engineering applications

B. Cable Tool (percussion Drilling)

1. Weighted Chisel Bit on End of Cable, Lift and fall drilling method
2. Percussion of bit during fall breaks rock apart

    a. rock or unconsolidated material may be drilled

   3. Cuttings removed from hole by bailer method
   4. Drill hole must be cased to prevent collapse

C. Hydraulic Rotary

   1. Rotary action of sharpened drill bit
   2. Drill cuttings removed from hole by circulating fluids
   3. Hydrostatic pressure of drill mud keeps hole from collapsing
   4. Commonly used in deeps wells of oil and gas industry

D. Air Rotary

   1. Rotary action of sharpened drill bit
   2. Cuttings removed from hole by circulation of compressed air down through drill string
   3. Fast and relatively cheap
   4. Casing need to keep unconsolidated materials open
   5. Drawback: in sensitive situations, traces of compressor oil may enter the system (checked by air filters)

E. Air Hammer-Percussion

   1. Jack-hammer type drilling method
   2. Air circulated to remove cuttings from hole
   3. Effective in very hard crystalline rock terrains

F. Combination Percussion-Hammer/Casing Advance System

   1. Simultaneous air-hammer drilling with steel casing advanced down borehole ("ODEX", "TUBEX")
   2. Drill cuttings removed via air and double walled casing system
   3. Good for difficult drilling conditions where hole stability is problem (e.g. Mine Spoil with sandstone boulders)

III. Other Types of "Holes in the Ground"

A. Backhoe Trenching

   1. With a large piece of equipment may extend to 25 Ft depth

B. Hand-dug Soil Pits

C. Hand Augering (down to 20 Ft if you're lucky)
D. Motorized Post-Hole Diggers ("Beaver Augers")
E. Direct-Push Drive Points
   1. New technology for environmental industry
   2. Replaces hole drilling, hammer hardened steel drive points directly into subsurface
   3. Casing allows sampling of groundwater
   4. Good for unconsolidated/shallow applications
   5. Limited diameter, to several inches

IV. Geological Sampling Techniques

A. Soil Sampling By Hollow-Stem Auger/Split Spoon Sampler

1. Spoon sampler lowered through hollow-stems
2. Allows unaltered sample to be taken prior to advancing drill stem (unconsolidated materials only)
3. Sampler generally 2 ft in length, driven into unconsolidated materials by hammer (140 # Wt. dropped 30 inches)
    - a. "Blow Counts": no. of hammer blows required to drive sampler 6 inches in depth
    - b. Gives thumbnail idea of material density/compaction
    - c. 50 blows with no penetration = "refusal"
4. Samples retrieved at prescribed depths for geologic description and/or chemical analysis, physical/engineering testing

B. Thin-walled Sampler ("Shelby Tubes")

1. Samples collected in tubes driven into unconsolidated sediments
2. Shelby tubes used for soils engineering testing
    - a. vertical permeability

C. Rotary Drill Cuttings (Air/Mud)

1. Rock/sediment cuttings retrieved and logged by geologist
    - a. depth, lithology, color, physical character
2. Samples may be bagged and archived for later examination

D. Coring

1. Coring device removes cylinder of rock for geologic description
2. Only good recovery technique for detailed geologic analysis

E. Field Screening of Soil and Sediment Samples for contamination

1. Rapid chemical field tests ("Hach Kits for PCB's, metals, pH)
2. Organic Vapor Detectors (hydrocarbon contamination)
3. Visual inspection/odors, anomalous color, chemical reactions

F. Sample collection, archiving, shipment to lab for analysis

1. Chain-of-Custody Protocol, EPA sampling technique protocol
2. Documentation of sample handling and analysis (legal ramification)

V. Precautions Against Cross-Contamination and "Induced Contamination"

A. Systematic Decontamination Procedures

1. Constant cleaning and washing of all sampling materials
2. Constant attention to sample handling (glove disposal, etc.)
3. Avoid moving "contaminated" equipment from location to location

B. Steam-Cleaning of Drill Equipment

1. "Steam-Genie": mobile pressurized steam washer (hot water shower)
2. Cleaning of drill rig, drill rods, samplers, bits, materials
3. Decon Pad: designated area for cleaning of materials and collection of wash waters

    a. Disposal Protocol for Wash Waters?

C. Induced Contamination Pathways during Drilling Process

1. Drilling Fluid Additives/Recirculated Fluids
2. Water Recirculated in Drill Hole to Clean Hole
3. Compressor Oil from Air-Rotary
4. Drilling Muds/Grout
5. Drilling Lubricants/Antifreeze

** constant attention to what is put in hole, and how might it cause a chemical overprint on the system... eliminate "false positives" ** Law Suits Prevail!

VI. Monitoring Well Construction

A. Considerations

1. Use of well (sampling only?, water depth measure? pumping/recovery?)
2. Depth of well (20 ft? 100's of feet?)

B. Well Components

1. "Slotted Screen" - porous slotted pipe that allows water to enter monitoring well
2. "Riser Pipe" - solid pipe of same diameter as screen, "rises" access hole to surface
3. Pipe Couplings
    a. No glues/adhesives used (deteiorate, potential contaminant)
    b. Threaded pipe joins, to join lengths of riser/screen
4. Outer Formation Casing- necessary to use casing to prevent hole collapse
5. "Sand Pack": coarse, clean porous material used to "pack" screen to serve as filter, prevent formation collapse on scree
6. "Bentonite Seal": impermeable clay sealant used to seal the annular space around riser, generally set above screen to seal off screened/ water-bearing horizon.
7. "Grout Seal": cement-bentonite mixture used to seal riser pipe to the surface, prevents upper level leakage into well.
8. Upper Protective Casing: steel cover for well assembly to prevent damage, locking to prevent unwanted access/environmental espionage.

See attached diagrams of typical monitoring well installation *

C. Types of Well Materials

1. selected dependent upon geologic/chemical conditions, depth of well

2. Types of materials

    a. PVC, stainless steel, teflon
        (1) Stainless and teflon are chemically non-reactive, but expensive
        (2) PVC is useful and cheapest, but may actually dissolve in cases of organic solvents, or melt under high temperatures (exothermic reactions)

    b. Sand Pack: clean silica sand, of variable grain-size depending on screen slot size

    c. Bentonite Seal: Powdered or pelletized bentonite, expands upon hydration to form impermeable barrier

    d. Cement Grout Mix: usually 5% Bentonite-95% cement slurry, bentonite used to temper cement, prevent fracture

D. Well Completion

    1. Well Development

        a. Initially well may be "clouded" with silt/drill cuttings
        b. Development involves pumping, bailing, removal of water from well to remove dirt and debris
        c. Well development also cleans sand pack and surrounding formation to enhance water production
        d. Development of well until water is clear and of constant pH/conductivity

    2. Special Problems

        a. Grout Contamination

            (1) Many problems if cement grout leaks into well
            (2) Make sure a good bentonite seal is on well
            (3) Very little grout/cement in well will cause water impacts (>pH (up to 12-13), K, Ca, Na, Ba, > conductivity)
            (4) Requires a lot of work to clean aquifer/well of grout impacts, may render well useless

    3. Other Development Techniques

        a. Overpumping, bail-surge techniques
        b. well surging: plunger method of causing turbulence to clean screen/sand pack

    4. Final Well Data

        a. Elevation control, surveying, map location, GIS entries
        b. Well completion diagram showing installation details

            (1) depths, problems, diameters, materials

        c. Well Development Report

VII. Sampling of Monitoring Well

A. Strict protocol according to EPA standards, extensive documentation of how and why well was sampled... Lawsuits Prevail!

B. Preliminary Details

    1. What wells to be sampled?, location maps, keys, equipment
    2. What are wells being sampled for?

a. Chemical Parameters to be Analyzed by Lab?
b. Field Parameters to be Checked by Field Personnel
c. Acquire Labe Sample Bottles According to Protocol
d. How many samples to be collected, sample volumes?

3. Establishment of Prescribed Sampling Plan

a. Sample protocol, special considerations/techniques?
b. Health and Safety Precautions: HASP
(1) personal protection equipment (gloves, coveralls, goggles, respirator, etc.)
(2) Access permits, authorization, dangerous conditions

c. Decon and cleanliness: How to keep samples and yourself from being cross-contaminated?

C. Preparing Well for Sampling

1. Opening well, removing well caps, allowing well to equilibrate with atmospheric pressures
2. Measuring of Static Water Level (M-scope, water level detector)
3. Sounding total depth of well (check for collapse/obstructions)
4. Purging of Well

a. removal of stagnant well water to encourage fresh aquifer flow into well
b. Generally: 3-5 well volumes extracted prior to sampling
c. Allow well to recover sufficiently to collect sample
d. Disposal of purged water?

D. Water Sampling Devices

1. Bailer (PVC, teflon, stainless steel: contaminant specific)
2. Pumps

a. submersibles, suction-lift, bladder pumps

E. Cleanliness/Cross-contamination

1. clean, clean, clean
2. begin with "clean" wells, end with "dirty"
3. wash everything all the time, dispose of all contaminated materials
4. Dedidicated sampling equipment (bailers, pumps left in well... can get expensive)

F. Sample Handling

1. Bottle/container management; Chain of custody
2. Preservatives for specific chemical parameters
a. refrigeration, acids, sodium hydroxide

G. Field Parameters

1. temperature, pH, dissolved oxygen, conductivity
2. Field gas chromatograph?
3. portable vapor analyzers?
4. Hack Kits: various metals, PCB's etc.

H. Quality Control: Samplers to Lab

1. Chain of Custody Records
2. Document everything done and said
3. Protocol checklist procedures
4. Lab Checks
    a. Trip blanks, spiked samples
5. Sampler Checks
    a. "field blanks" to check cleanliness/decon.

VIII. Overview of Health and Safety Procedures

A. Routine Safety

1. Drilling

    a. Trips, falls, stupid tricks
    b. Select a safe and knowledgable drilling contractor
    c. Preliminary site orientation
    d. Underground Utilities
    e. Buried Objects
    f. Overhead Lines
    g. Basic safety equipment: hard hat, goggles, steel toes
    h. Drill Rigs and Falling Objects

2. Basic Safe Lifting Techniques for Field "Grunts"
3. Excavations: anything >5 Ft deep requires retaining device

B. Procedures for Contaminated Sites

1. Eliminate Pathways of Contamination into Body

    a. Personal Protective Equipment

2. Know what you're walking into, chemistry, LD50's, toxicity

3. Keep eye out for toxic effects

    a. Local, acute
    b. Systemic acute
    c. Local Chronic
    d. Systemic chronic

4. NIOSH Guidelines to Chemical Hazards

    a. Substances/compound I.D.
    b. Permissible Exposure Limit (here's a good one)
    c. Health Hazards (MSDS sheets)
    d. Monitoring equipment (radiation badges, gas detectors, geiger counter)

5. Fire/explosive conditions

6. Confined space hazards (Oxygen-deficient conditions)

7. Personal Protective Equipment

    a. Respirators
    b. Supplied Air: SCBA's
    c. Protective, chemical resistant clothing/boots

8. USEPA Levels of Protection

    a. Level A: Encapsulating Suit, SCBA/supplied air
    b. Level B: Splash suit, SCBA/supplied air, gloves, boots
    c. Level C: Splach suit, gas mask, boots, gloves
    d. Level D: coveralls, boots

9. Dangerous Situations: "Just Say No" to drillers, clients and managers. If things look unsafe, they probably are.

C. Health and Safety Training

1. 40 OSHA training/certification
2. 8-hr OSHA refresher/update annually
3. Documentation kept with you to enter a site

D. Personal Decontamination

1. Dispose of all contaminated clothing and boots
2. never eat/drink on site
3. wash, scrub, clean ... decon. yourselt and equipment
4. Decon. Stations: from dirty to clean away from work site

E. Health Monitoring

1. Blood Tests
2. Radiation testing
3. Regular Check-ups

FIGURES.

DRILLING

PROCEDURES

vith phosphate-free detergent, including scrubbing ush, followed by a potable-water wash and then a :e. If the equipment has come into contact with then an initial solvent wash may be necessary.

f sampling equipment and the uncertainty introduced drogeologists to specify dedicated sampling equip-rs are also available that are less expensive than the eusable bailers.

of drilling that are appropriate for installation of n shallow unconsolidated formations, hollow-stem ell is to be drilled deeper than about 100 ft or into ay be appropriate. Cable-tool drilling is an excellent n both unconsolidated and consolidated formation, . Hollow-stem augers with a bit that contains carbide lurated rock.

uthoritative discussion of all aspects of drilling with 1 auger looks a little like a large, untapered screw nstructed around a hollow pipe. A drilling rig rotates e auger loosens the sediment, which is then brought uger flights. The cuttings accumulate at the surface he augers. Figure 8.10 pictures an auger drilling rig. ound as it is rotated. A plug on the end of a rod may be screwed into the bit to seal the end of the n coming up inside the hollow stem. Alternatively, a n the end of the bit. This plug is knocked out of the pth is reached and it is no longer needed. However, ction of soil and water samples during drilling.

h hollow-stem augers is that drilling fluids and mud ation of drilling fluids has the potential to spread hole. Drilling mud is a viscous liquid needed in mud-ehole and partially seal it. However, when drilling in e auger bit may smear clay from the cohesive layers avel layers at the perimeter of the borehole. Auger : 50 to 100 ft per day if samples are being taken. is of 5 ft. One flight is advanced into the ground and l and another flight is attached to the augers in the formation ahead of the auger bit may be taken. The removed before sampling can occur. The maximum lrilling can normally be used is 150 ft (Hackett 1987); eds 100 ft.

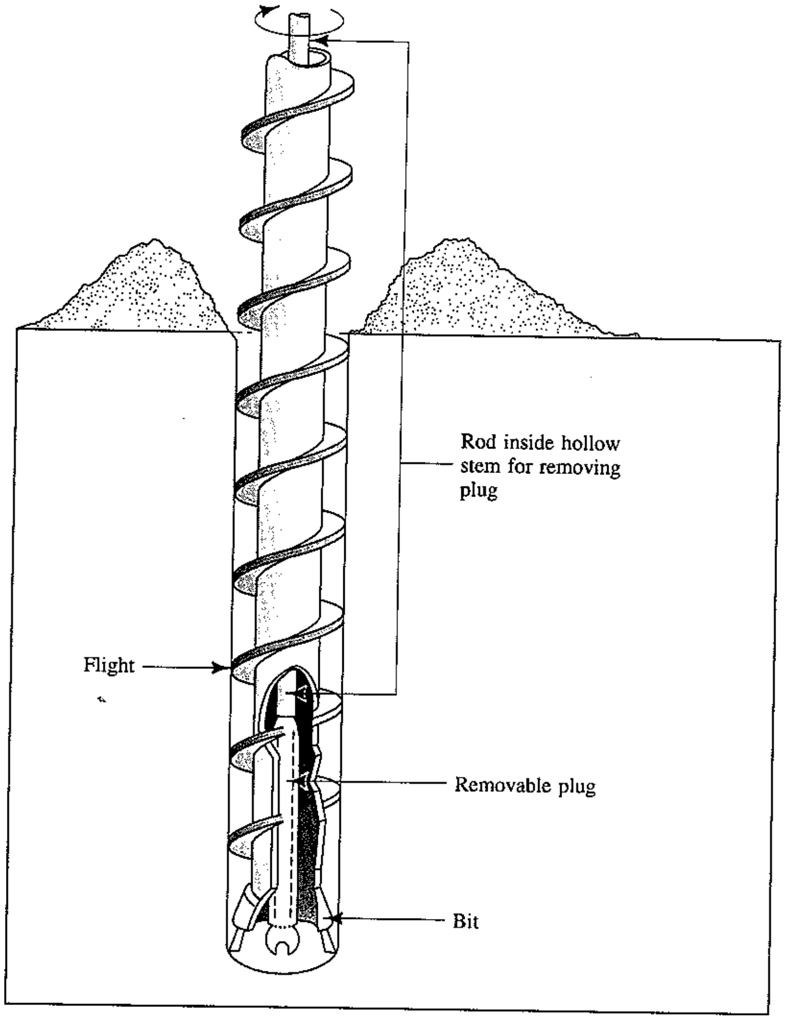


FIGURE 8.9 Hollow-stem auger drill rod and bit. *Source:* M. L. Scalf et al. *Manual of Ground Water Sampling Procedures,* 1981. National Water Well Association. Used with permission.

Some loosely consolidated sands, called heaving sands, can enter into the borehole when the plug is being removed. This problem can be avoided by keeping the hollow stem filled with potable water when the plug is removed. The potable water should not contain any contaminants that might be found in the ground water. If no formation sampling is planned, then a knock-out plug can be used to prevent the introduction of heaving sands into the hollow stem during drilling. The knock-out plug can be removed after the final depth is reached by pushing down with the well casing if it is stainless steel; otherwise it will be necessary to use a rod prior to the time that the well is installed.

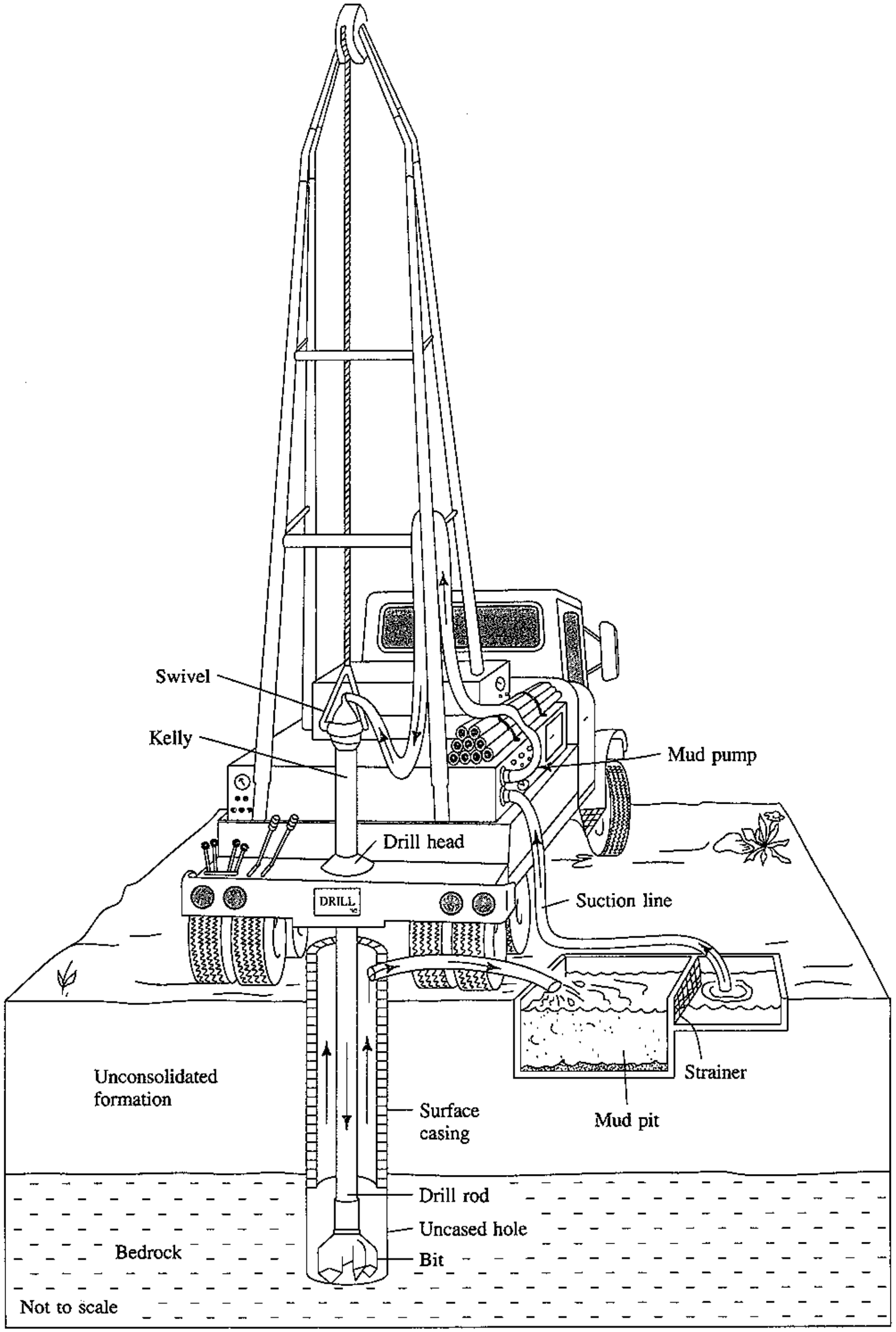


FIGURE 8.11 Circulation of drilling fluid in mud-rotary drilling.

compressors have air filters, which neec
lubricating oil and other contaminants r
compressed air. Percussion hammers use

Air-rotary drilling may introduce vc
as well as blowing contaminated dust ou

Reverse-Rotary Drilling

In reverse-rotary drilling the circulating d
then is pulled up the center of the drill s
Because the drilling fluid rises with a muc
rotary drilling, a much less viscous drillin
with the drill cuttings is all that is neces
advantage over mud-rotary drilling, since
there is no mud wall on the borehole tc
is more expensive than the mud-rotary
is 12 in.

Cable-Tool Drilling

Cable-tool drilling is one of the oldest d
the installation of water wells. Although
for some other methods, the drilling is sl
high labor costs.

In cable-tool drilling a heavy bit is l
a cable. The drill rig repeatedly lifts and dr
rock or loosens unconsolidated sedimer
behind the bit. When the bottom of the
tool string and bit are removed, and a
accumulated cuttings. Below the water
slurry. Above the water table, water must
can be used. Drive casing is needed on
formations the hole will stay open with
used for cable-tool drilling.

Advantages of cable-tool drilling in
and that nothing is circulated through the
problems. It is easy to collect representat
the casing. Well points can be driven ahe
for the collection of water quality sample
excess of 1000 ft.

8.3.3 Drilling in Contaminated Soil

When drilling at a contaminated site, the
be contaminated. Drilling personnel sho
if necessary, use breathing apparatus. A
in the work area, and the drill bit should
the plastic sheet.

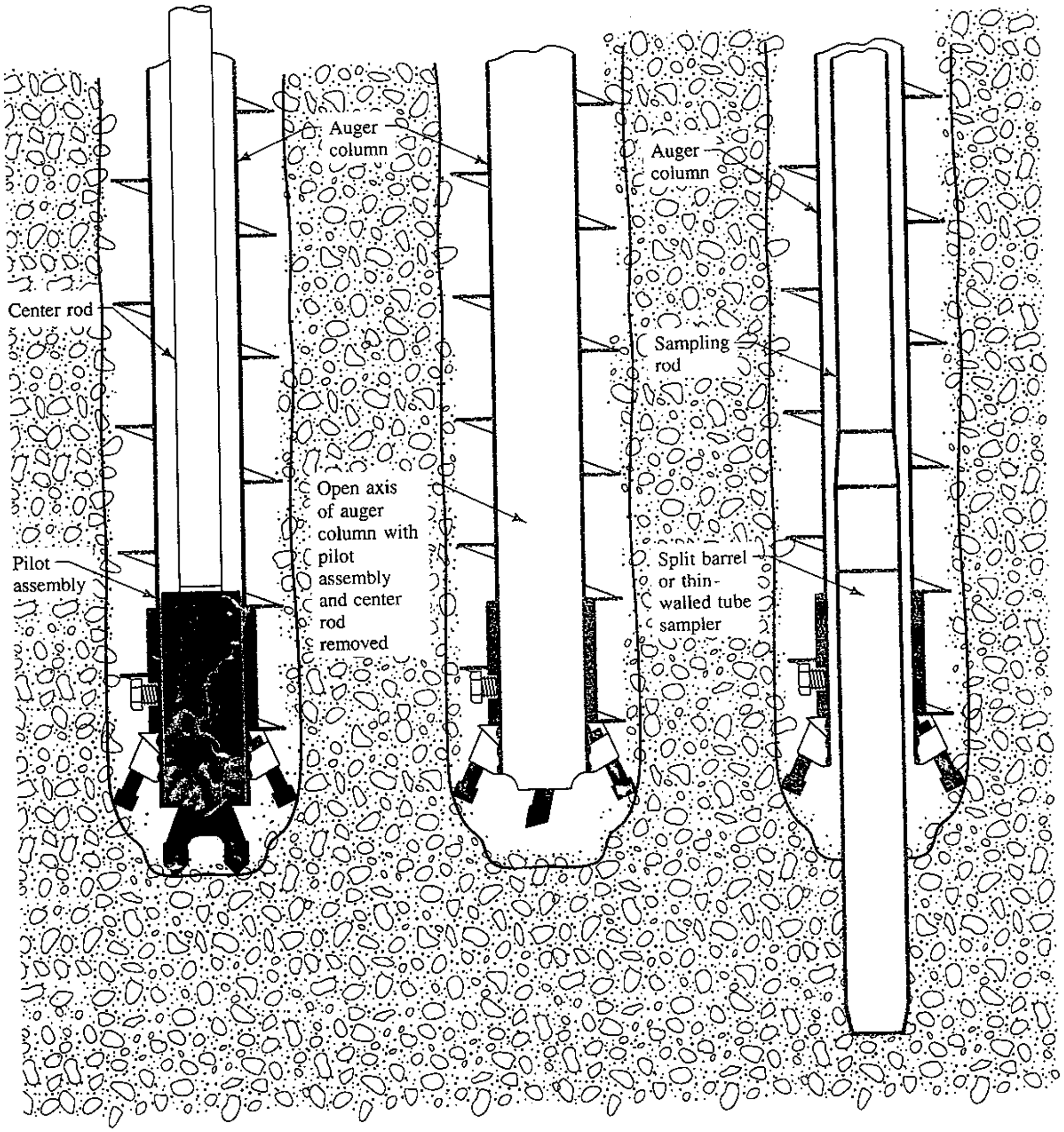
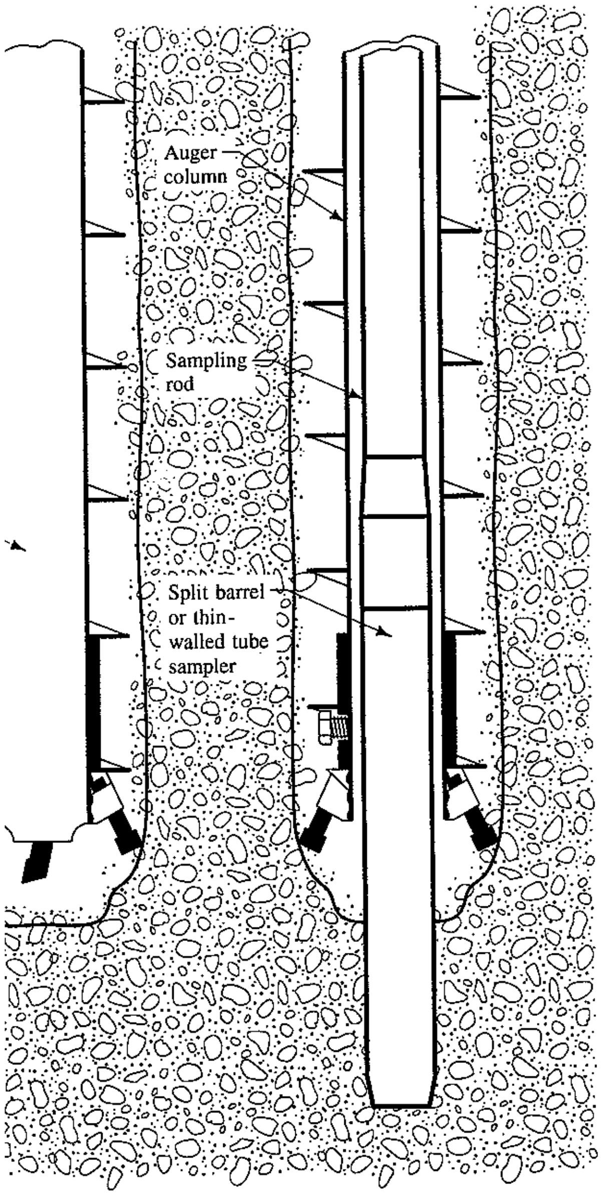


FIGURE 8.13 Sequential steps for the collection of a core sample through a hollow-stem auger. *Source:* Glen Hackett, *Ground Water Monitoring Review* 7, no. 4 (1987):51–62. Used with permission. Copyright © 1987 Water Well Journal Publishing Co.

FIGURE 8.14 Hydrogeologist describing

ahead of the previous core. Continu
soils by using a special core barrel t
auger as the auger is being advanc
followed by a 2.5-in split spoon fol
continuous sample core can be coll

In consolidated formation a ro
with a diamond-studded bit. The rota
an undisturbed center of rock that
behind the bit to keep the core fro
and bit are retrieved from the bore



'e sample through a hollow-stem auger. *Source:*
'1987):51–62. Used with permission. Copyright

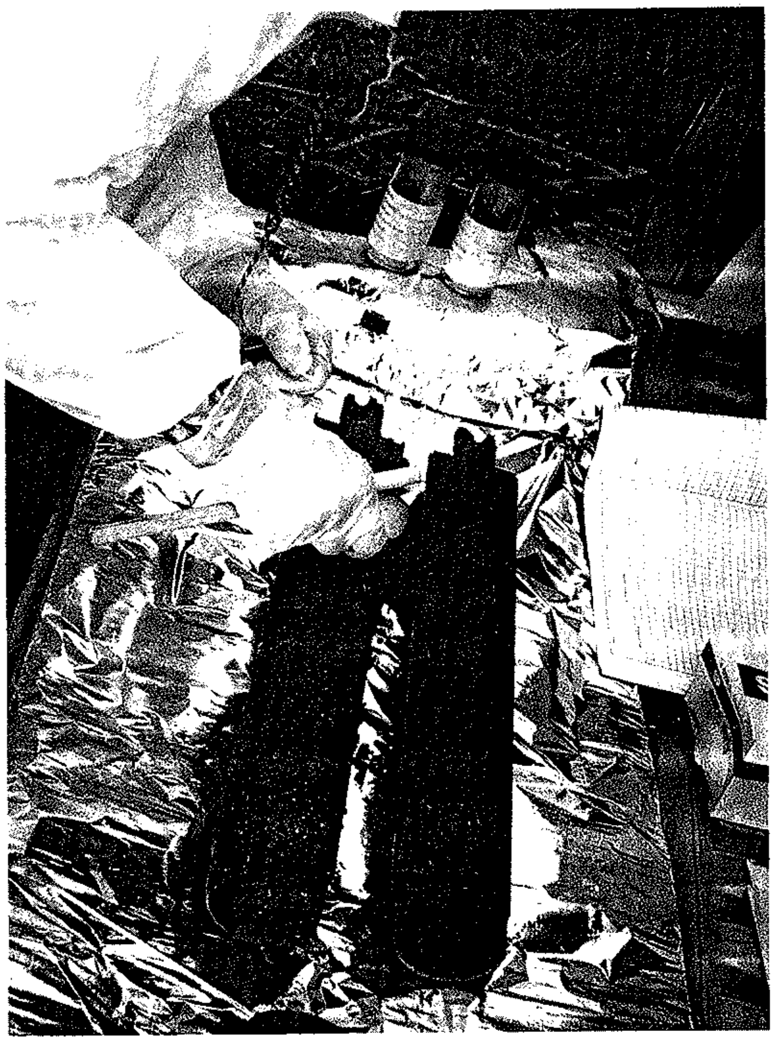


FIGURE 8.14 Hydrogeologist describing a split-spoon sample. *Photo credit:* C. W. Fetter.

ahead of the previous core. Continuous-core samples can also be collected in cohesive soils by using a special core barrel that collects a 5-ft-long sample inside a hollow-stem auger as the auger is being advanced. If a sequence consisting of a 3-in split spoon followed by a 2.5-in split spoon followed by a 2-in split spoon is used, 4.5 to 5 ft of continuous sample core can be collected before the augers need to be advanced.

In consolidated formation a rock-core sample is collected by use of a core barrel with a diamond-studded bit. The rotating bit grinds up rock in an annular pattern, leaving an undisturbed center of rock that enters the core barrel. There is a core lifter just behind the bit to keep the core from falling out of the core barrel when the drill rods and bit are retrieved from the borehole.

GERAGHTY & MILLER, INC.
Ground-Water Consultants

TABLE 1

UTILITIES AND STRUCTURES CHECKLIST

Project: Systems, Inc. **Prepared by:** O. Meinzer

Location: Stroudsburg, PA **Date:** November 7, 1987

Instructions. This checklist has to be completed by a G&M staff member as a safety measure to insure that all undergrou utility lines, other underground structures as well as above-ground power lines are clearly marked out in the area select for boring or excavation. **DRILLING OR EXCAVATION WORK MAY NOT PROCEED UNTIL LINES ARE MARKED A THIS CHECKLIST HAS BEEN COMPLETED.** Arrangements for underground utility markouts are best made at the time the preliminary site visit to allow client and/or utility company sufficient time. Keep completed checklist and maps ons send copy to Project Manager.

Assignment of Responsibility. Client is responsible for having underground utilities and structures located and mark Preferably, the utilities themselves should mark out the lines.

Drilling or Excavation Sites. Attach a map of the property showing the proposed drilling or excavation site (or if sites widely separated, several maps) clearly indicating the area(s) checked for underground utilities or underground structu and the location of above-ground power lines.

Utilities and Structures

Type	Not Present	Present	How Marked?1)
Petroleum products line	X		
Natural gas line		X	Yellow paint on road
Steam line	X		
Water line		X	Blue paint on sidewalk
Sewer line	X		
Storm drain	X		
Telephone cable		X	Overhead
Electric power line		X	Overhead
Product tank		X	Red flags
Septic tank/drain field	X		
Overhead power line	X		

1) Flags, paint on pavement, wooden stakes, etc.

Name and affiliation of person who marked out underground lines or structures.

NAME	ORGANIZATION	PHONE
V.T. Little	Systems, Inc.	307/427-8911 X32

Emergency Procedures

Persons at site or facility to contact in case of emergency

1. J.D. Mager Plant Manager Phone 307/427-8911 X10
2. F. Worth Safety Manager Phone 307/427-8911 X42

Fire Dept.: Phone 307/444-2222 Ambulance: Phone 307/777-1234

Utility: Phone Gas 307/444-5566 Utility: Phone Power 307/999-1122

Utility: Phone Water 307/444-1000 Utility: Phone

Directions to nearest hospital (describe or attach map).

Leaving plant right on Industry Road to Interstate 117; North 3 miles to Dayton Ave. exit; right on Main St. to Memorial Hospital. Distance is about 10 miles.

Table 2. Check List for Field Equipment

A. FOR DRILLING PROJECT

- Forms
  - Utilities and Structures Checklist
  - Location sketch forms
  - Daily logs
  - Sample/core logs
  - Well construction logs
  - Materials/cost logs
  - Water sampling forms
  - Extra lined paper
- Site maps
  - Topo map and/or aerial photo
- Clipboard (with clear plastic sheet or bag in case of rain)
- Pencils, pens, permanent marking pens (red and black)
- Watch
- Knife
- Electrical water-level measuring device
- Weighted steel tape (in hundredths of feet)
- Chalk
- Rags
- Thermometer
- Hand lens
- Sand Grain Size Folder
- Rock Color Chart
- Books (as needed):
  - Water well handbook, AGI data sheets, G&M manuals, Johnson, UOP: Ground Water and Wells
- Basic safety equipment
  - Hard hat
  - Safety glasses or goggles,
  - Site safety plan,
  - Steel-toed boots (where required)
- Optional Equipment (nice to have)
  - Rubber boots (disposable)
  - Foul weather gear
- Camera
- Folding chair
- Suntan lotion
- Insect repellent
- Flashlight
- Paint and small paint brushes or paint stick) to paint and number protective casing
- Paper towels
- Flagging and stakes
- Ziploc bags
- Duct tape
- Electric tape
- Ruler
- WD-40 oil (for locks)
- Plastic trash bags
- Drinking water
- Brunton compass
- HCl and rock dyes (for limestone/dolomite terrains)
- Teflon$^{\text{TM}}$ tape
- Nylon rope or twine
- Tools
  - Chain wrench/pipe wrench
  - Hacksaw
  - Screwdriver
  - Pliers or channel locks
  - Folding shovel
- For washing split spoons
  - Long-handled brushes
  - Micro$^{\text{TM}}$ solution (detergent)
  - Buckets
- Optional Safety Equipment (as needed)
  - Splash guards (for hard hats)
  - Half or full-face respirators and extra cartridges
  - Protective gloves and boots

B. FOR PUMPING TEST

- M-scope
- Weighted steel tape and chalk
- Pumping test forms
- Stopwatch
- Water-level recorders and all related equipment (clocks, F-1 or F-2 paper, pens, weights, floats, beaded cable, stamp and stamp pads)
- Locking recorder shelters (where needed)
- Tide gage
- Barometric recorder (where needed)
- Logarithmic and semilogarithmic paper
- Type curves
- Level
- Airhorn or walkie-talkie for signaling

Table 7: Sample Description Terminology

Standard grain size scale (modified Wentworth)

Inches	mm	
above		Boulders
10.1	256	
		Cobbles
2.52	64	
		Gravel, coarse
0.63	16	
		Gravel, medium
0.32	8	
		Gravel, fine
0.08	2	
		Sand, very coarse
-	1.0	
		Sand, coarse
-	0.50	
		Sand, medium
-	0.25	
		Sand, fine
-	0.125	
		Sand, very fine
	0.062	
below		Silt

Grain Size Determination

Use published sand size gauge; or refer to comparison charts on AGI Data Sheets 16.1 and 16.2.

Percentage Composition

Refer to comparison chart on AGI Data Sheets 15.1 and 15.2.

Angularity and Roundness

Four breakdowns are considered adequate: angular, subangular, subrounded, and rounded. Refer to comparison chart on AGI Data Sheet 18.1.

Table 7. (cont'd.)

Sorting

Three breakdowns are considered adequate: well sorted, moderately sorted, and poorly sorted, defined as follows:

Well sorted: 90% in 1 or 2 size classes
Moderately sorted: 90% in 3 or 4 size classes
Poorly sorted: 90% in 5 or more size classes

See also diagram in R.R. Compton's Manual of Field Geology, 1962, p. 214.

Density

Density	
Very Loose	5 blows/ft or less
Loose	6 to 10 blows/ft
Medium Dense	11 to 30 blows/ft
Dense	31 to 50 blows/ft
Very Dense	51 blows/ft or more

Relative Proportions

Descriptive Term	Percent
Trace	1-10
Little	11-20
Some	21-35
And	36-50

Color

Refer to Geological Society of America color chart. No need to supply color reference numbers.

Water/Fluid Content

Dry: No water or fluid

Moist: Slight wetness on hand when held

Saturated: Sample drips water or fluid

Table 8. Unified Soil Classification System

Field Identification			Group Symbols[a]	Typical Names
Coarse-grained soils More than half of material is larger than No. 200 sieve size[b]	Gravels More than half of coarse fraction is larger than No. 4 sieve size	Clean gravels	GW	Well graded gravels, gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines
		Gravels with fines	GM	Silty gravels, poorly graded gravel-sand-clay mixtures
			GC	Clayey gravels, poorly graded gravel-sand-clay mixtures
	Sand More than half of coarse fraction is smaller than No. 4 sieve size	Clean sands	SW	Well graded sands, gravelly sands little or no fines
			SP	Poorly graded sands, gravelly sands, little of no fines
		Sands with fines	SM	Silty sands, poorly graded sand-silt mixtures
			SC	Clayey sands, poorly graded sand clay mixtures
Fine-grained soils More than half of material is smaller than No. 200 sieve size	Silts and Clays		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL	Organic silts and organic silt clays of low plasticity
			MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
			CH	Inorganic clays of medium to high plasticity
			OH	Organic clays from medium to high plasticity
Highly Organic Soils			PT	Peat and other highly organic soils

From Wagner, 1957

[a] Boundary classifications. Soils possessing characteristics of two groups are designated by combinations of group symbols. For example GW-GC, well graded gravel-sand mixture with clay binder. [b] All sieve sizes on this chart are U.S. standard.

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DAILY LOG

Well(s) 2, 5 Project/No. EMANON, INC Page 1 of 1

Site Location Pleasantville, NJ

Prepared By M. Hubbert

Date/Time	Description of Activities
7/24/85 7:30	Arrived at site, met drillers. Moved rig to NE end of Parking Lot
	& Set up on well B-2
9:15	Began drilling WELL **B-2** using a MOBILE B-61 AUGER RIG
	- sampling every 5 feet with split-spoon sampler.
9:35	Water encountered on rods at approx. 8 FT.
10:50	At 18 FT, formation heaved into augers. Added approx
	50 GALS potable water to inside of augers to clean out
	sand. WATER SOURCE = plant fire hydrant (city water). H_2O Sample
	collected labeled # 2142, and put on ice for VOC analysis
11:10	Bottom of boring at 22 feet.
11:15	Began well construction at B-2 (see well diagram). Added screen + casing.
11:30	Pulled augers to 15 feet and let formation cave around
	screen. Completed well inside augers with 2 ft bentonite
	pellet seal and then pumped cement through tremie pipe
12:30	Well B-2 completed with protective cover & Lock
12:30 - 1:15 PM	Lunch & calls to office
1:30 - 2:00	Drillers steam clean drilling equipment (augers, rods & spoons)
2:00 - 2:30	Move to Well **B-5** location & set up rig.
2:40	Began drilling & sampling B-5
3:00 -	Plant Manager R.A. Freeze makes site visit with J. Cherrey
3:35	(State DEP). Discuss progress & access problems w/next hole
3:45	At depth of 11 feet, top head drive (universal) swivel breaks.
4:00	Drillers off site for parts. No more drilling today.

4:20 M. Hubbert off site

FIGURE

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SAMPLE/CORE LOG

Boring/Well B-3 Project/No. Emanon, PA Page 1 of 2

Site Location Pleasantville, NJ Drilling Started 11/8/85 11^{20} Drilling Completed 11/8/85 13^{30}

Total Depth Drilled 21.5 (feet)

Hole Diameter 9 7/8 (inches) Type of Sample/Coring Device Split-spoon sampler

Length and Diameter of Coring Device 1.5 ft / 2-in diam Sampling Interval every 5 feet

Drilling Fluid Used none Drilling Method Auger

Drilling Contractor ATEC Driller Tim Helper Rick

Prepared By Henry Darcy Hammer Weight 140 Hammer Drop 30 inches

Sample/Core Depth (feet below land surface)		Core Recovery (feet)	Time/Hydraulic Pressure or Blows per 6 Inches	Sample/Core Description
From	To			
0	0.5	–		No sample taken. Asphalt pavement
				and gravel foundation
0.5	2.0	1.5	2-[illegible]-9	SAND (90%), fine to medium,
				yellow, rounded; Silt (10%),
				tan to brown; moderately sorted,
				moist, loose to med. dense.
5.0	6.5	1.0	7-4-5	SILT (60%); sand (30%), fine,
				subrounded; clay (10%);
				dark brown to yellow brown,
				poorly sorted, moist, loose,
				slight chemical odor.
10.0	11.5	1.5	4-3-2	SAND (100%), med. to coarse
				(coarsens downward), brown
				at top to white at base, sub-
				rounded, wet, loose, mod.
				sorted. Note: rods wet at
				approx. 9.5 ft

FIGURE

GERAGHTY & MILLER, INC.
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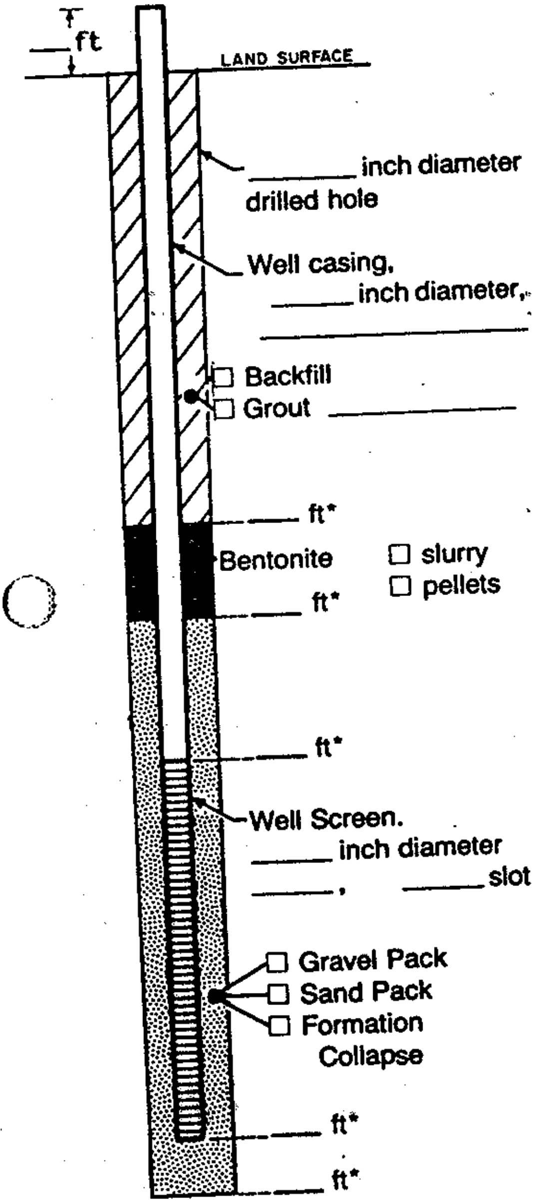
WELL CONSTRUCTION LOG



Measuring Point is Top of Well Casing Unless Otherwise Noted.

*Depth Below Land Surface

Project _____________________ Well _____________

Town/City _____________________________________

County _____________________ State _____________

Permit No. _____________________

Land-Surface Elevation

and Datum __________ feet ☐ surveyed

☐ estimated

____

Installation Dates(s) _____________________________

Drilling Method _________________________________

Drilling Contractor ______________________________

Drilling Fluid __________________________________

____

Development Techniques(s) and Date(s)

____

____

____

Fluid Loss During Drilling ____________________ gallons

Water Removed During Development ____________ gallons

Static Depth to Water ____________________ feet below M.P.

Pumping Depth to Water ___________________ feet below M.P.

Pumping Duration ____________ hours

Yield ____________ gpm Date __________

Specific Capacity ______________ gpm/ft

Well Purpose ___________________________________

____

____

Remarks _______________________________________

____

____

____

____

____

Prepared by ____________________________

GERAGHTY & MILLER, INC.
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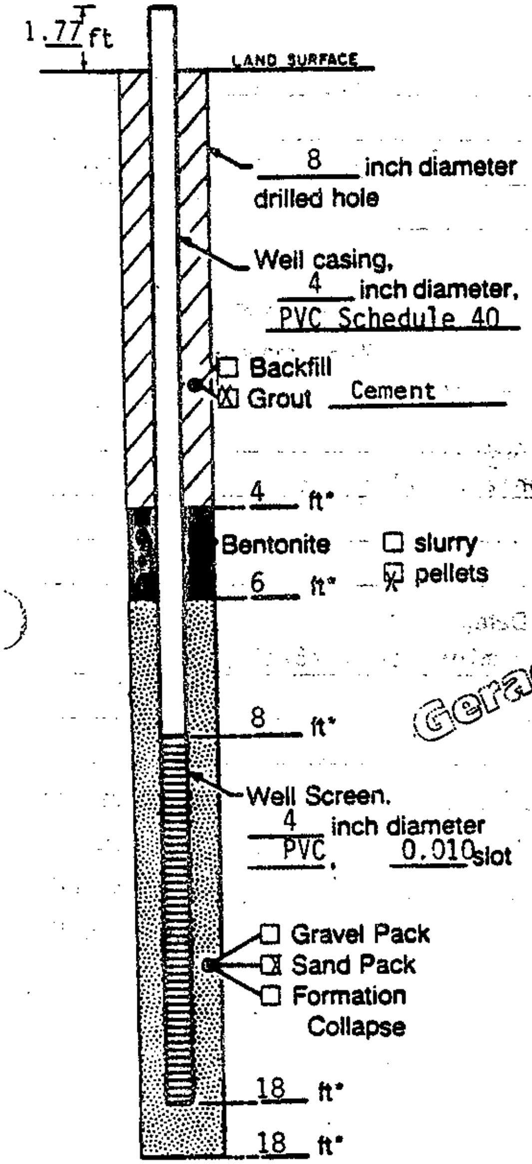
WELL CONSTRUCTION LOG



8 inch diameter drilled hole

Well casing, 4 inch diameter, PVC Schedule 40

☐ Backfill
☒ Grout Cement

4 ft*

Bentonite ☐ slurry ☒ pellets

6 ft*

8 ft*

Well Screen, 4 inch diameter PVC, 0.010 slot

☐ Gravel Pack
☒ Sand Pack
☐ Formation Collapse

18 ft*

18 ft*

Measuring Point is Top of Well Casing Unless Otherwise Noted.

*Depth Below Land Surface

Project Emanon, Inc. Well 10S
Town/City Paradise
County Lancaster State PA
Permit No. -
Land-Surface Elevation and Datum 296.62 feet ☒ surveyed
USGS Data Base ☐ estimated
Installation Date(s) 11/30/84
Drilling Method Acker down-hole hammer
Drilling Contractor Pennsylvania Drilling Company
Drilling Fluid None

Development Techniques(s) and Date(s)
12/1/84 Developed using compressed air for 60 minutes

Fluid Loss During Drilling NA gallons
Water Removed During Development 160 gallons
Static Depth to Water 13.69 feet below M.P.
Pumping Depth to Water ___ feet below M.P.
Pumping Duration ___ hours
Yield ___ gpm Date ___
Specific Capacity ___ gpm/ft
Well Purpose Ground-water monitoring well

Remarks DTW = 13.69 ft. below PVC on 12/2/84.

Prepared by O. Meinzer

FIGURE

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MATERIALS/COST LOG

Page 1 of 1

Wells: 1, 2, 3, 4S, 4D, 5, 6S, 6D
Site Location: PARADISE, PA
Project/No.: EMANON, INC
Calculated By: H. DARCY
Checked By: DWM

Well	Footage Drilled (ft)	Split Spoons (ea)	Screen	Casing	Sand or Gravel (bag)	Bentonite		Cement (bag)	Developing Time (hrs)	Rig time (hrs)	Other Items*
			Diam/Length (ft)	Diam/Length (ft)		Pellets (lb)	Powder (bag)				
1	21.5	4	2" / 5' 20 SLOT 10' 10 SLOT	2" / 8'	–	25 lbs 0.5 BUCKET	–	40 lbs 0.5 BAG	1	1 1/4	NO STAND BY TIME PROTECTIVE CASING
2	17.5	3	2" / 10' 10 SLOT	2" / 9.5'	–	0.5 "	–	0.5 BAG	1	3	NO STAND BY TIME PROTECTIVE CASING
3	6.0	3	2" / 10' 10 SLOT	2" / 9.5'	–	0.5 "	–	0.5 BAG	1	1 1/2	PROTECTIVE CASING
4S	16.0	–	2" / 5' 10 SLOT	2" / 1.5'	1 BAG	0.5 "	–	1 BAG	1	1/2	
4D	14.5	3	2" / 10' 10 SLOT	2" / 12'	1 BAG	0.5 "	0.5 BAG	1 BAG	1	1 1/3	
5	6.0	2	2" / 10' 10 SLOT	2" / 6'	–	0.5 "	–	0.5 BAG	1	3	1 HR STANDBY TIME PROTECTIVE CASING
6S	6.0	–	2" / 5' 10 SLOT	2" / 1.5'	100 lbs 1 BAG	0.5 "	–	0.5 BAG	1	1/2	PROTECTIVE CASING
6D	17.0	3	2" / 5' 10 SLOT	2" / 13'	1 BAG	0.5 "	45 lbs 0.5 BAG	80 lbs 1 BAG	1	1 1/4	PROTECTIVE CASING
Totals	104.5	18	5' 20 SLOT 65' 10 SLOT	61'	4 BAGS	4 BUCKETS	1 BAG	5.5 BAGS	8	12.33	
Unit Cost	$ 6.75	$ included	4.00 20 SLOT $ 4.50 10 SLOT	$ 2.50	$ 8.50	$ 100.00	$ 11.50	$ 8.50	$ 90.00	$ included	STAND BY TIME $75/HOUR $ PROTECTIVE CASING $100
Cost Totals	$ 705.38	$ —	$ 312.50	$ 152.50	$ 34.00	$ 400.00	$ 11.50	$ 46.75	$ 720.00	$ —	$ 675.00

FIGURE

Figures.

MONITORING WELL

INSTALLATION

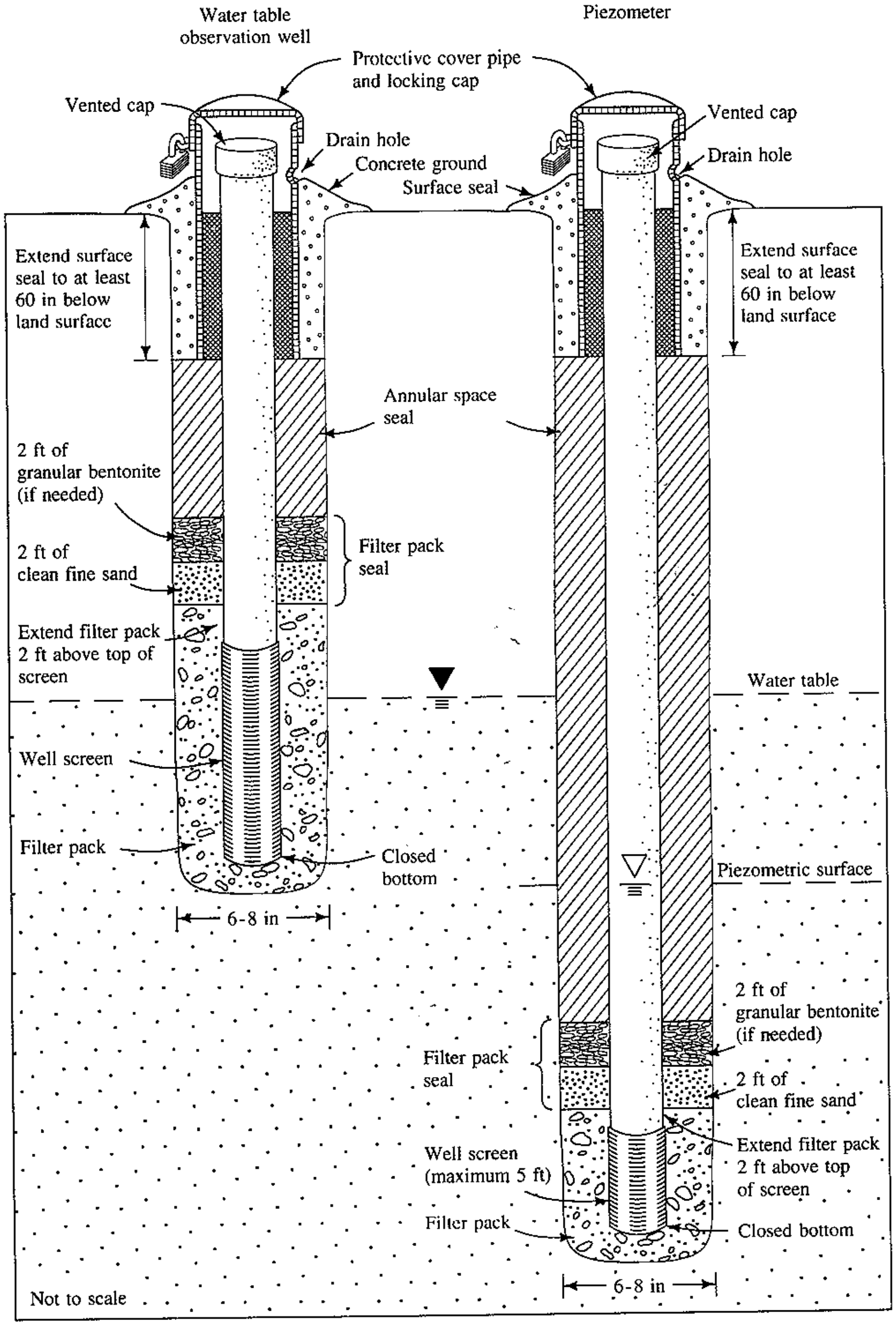

FIGURE 8.8 Construction details of a water table observation well and piezometer. *Source:* Wisconsin Department of Natural Resources.

8.3 Installation of Monitoring Wells

8.3.1 Decontamination Procedures

Because the purpose of drilling a moni
analyze it for very small concentrations
duce any chemicals into the aquifer as a
dure. The process of cleaning the equi
decontamination.

When materials are manufactured,
as grease and oil. Therefore, unless th
article has been decontaminated and ha
be decontaminated. Equipment that ha
assumed to be contaminated and shoul
site. Even at the same site, if a drill rig or a
is required to prevent cross contamina
duced into a clean area) that could occ

There is wide variability in requi
dures between the USEPA and the var
The hydrogeologist must consult with t
if a specific decontamination procedure
ment, the following generic procedure
In some cases not all the steps are re
drilling rig, a specific area must be
constructed to capture all the fluids use
water from it may also become contar
accidentally released to the environme
can be cleaned in buckets set on a pol
by running various wash solutions thr

The following steps are used to c
ing drill rig, augers, drill rod, tools, sa

1. Use a wire brush or similar equi
accumulations of grease.
2. Wash the equipment with a soft br
3. In extreme conditions organic resi
with an organic solvent such as m
trichloroethene that might be expe
4. Clean and rinse the equipment wit
5. Rinse the equipment with deionize

Steam cleaning with a pressure
can withstand the heat and force of t

When equipment has been deco
It can be wrapped in clean paper or

Sampling equipment should als
ment has not come into contact wi

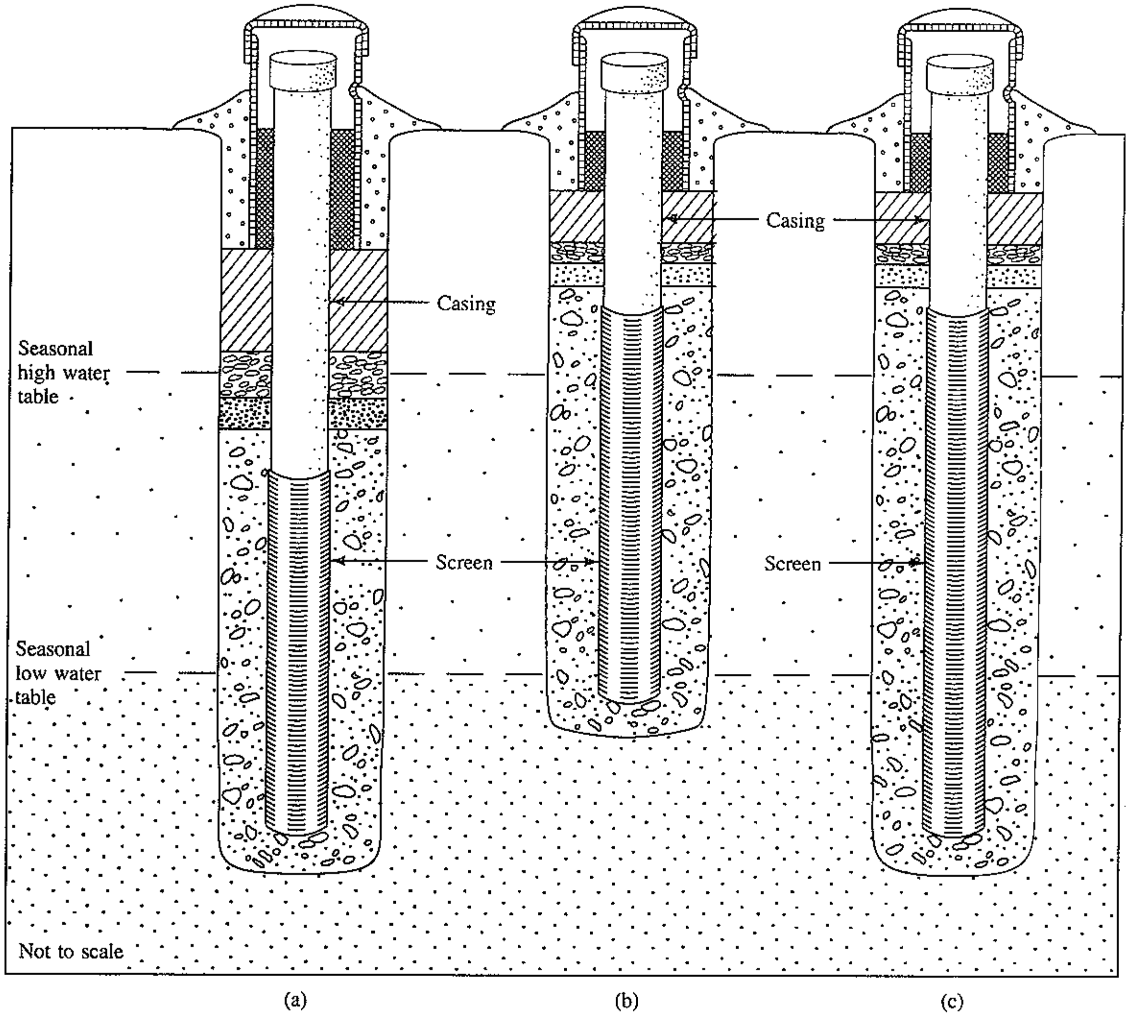

FIGURE 8.6 (a) Incorrect placement of water table–monitoring well screen. Seasonally high water table is above the top of the screen and floating, nonaqueous phase liquids would be above the screen and not detected. (b) Incorrect placement of water table–monitoring well screen. Seasonally low water table is so far down in well that there is not enough water in well to collect a sample for chemical analysis. (The water table elevation could still be determined.) (c) Correct length and placement of water table–monitoring well screen.

will yield the greatest amount of information about the hydraulic head as well as the water quality.

If a monitoring well is intended to serve as warning that a plume of contamination is escaping from a potential source, then it should be screened in the most permeable parts of the aquifer. Ground water and contaminants that it may be carrying not only

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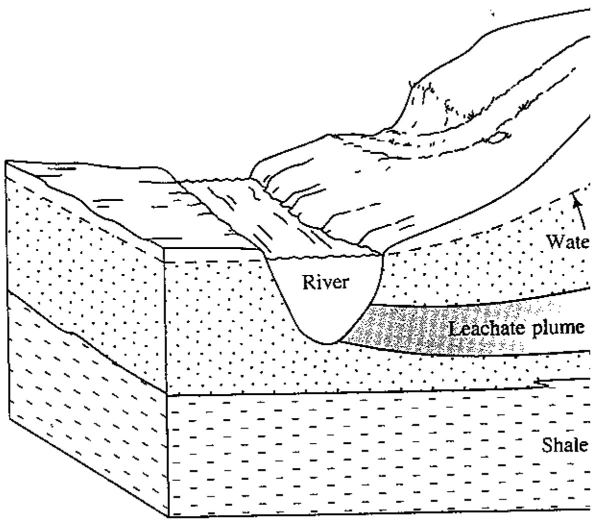


FIGURE 8.7 Effect of monitoring well–screen length on wat
fully screened through the thickness of the aquifer. It intersects
concentration will be less than the actual concentration as wa
and uncontaminated parts of the aquifer. Piezometer B is also sc
The reported concentration will be representative of the leachate
well D don't intersect the plume, indicating that it is deep in th

preferentially travel through the most
Hence, the leading edge of a plume
pathway.

If the plume of contaminated wat
conductivity, it may flow in a direction
the location of the plume is not exac

On the other hand, if an aquife
installed to monitor the progress of a
in the most permeable part of the a
preferentially travel through and flush
in a permeable zone may indicate th
less permeable zones located nearby
that have yet to be removed.

8.2.8 Summary of Monitoring Well

Figure 8.8 illustrates details of the fi
piezometer illustrating all the design

8.5 Installation of Monitoring Wells

Following the collection of samples during the installation of borings, a monitoring well can be installed in the borehole. Boreholes drilled with mud should stay open with the drill rod removed. Hollow-stem augers are generally left in the ground and the well is installed through them, as is drive casing in cable-tool drilling. There must be a sufficient

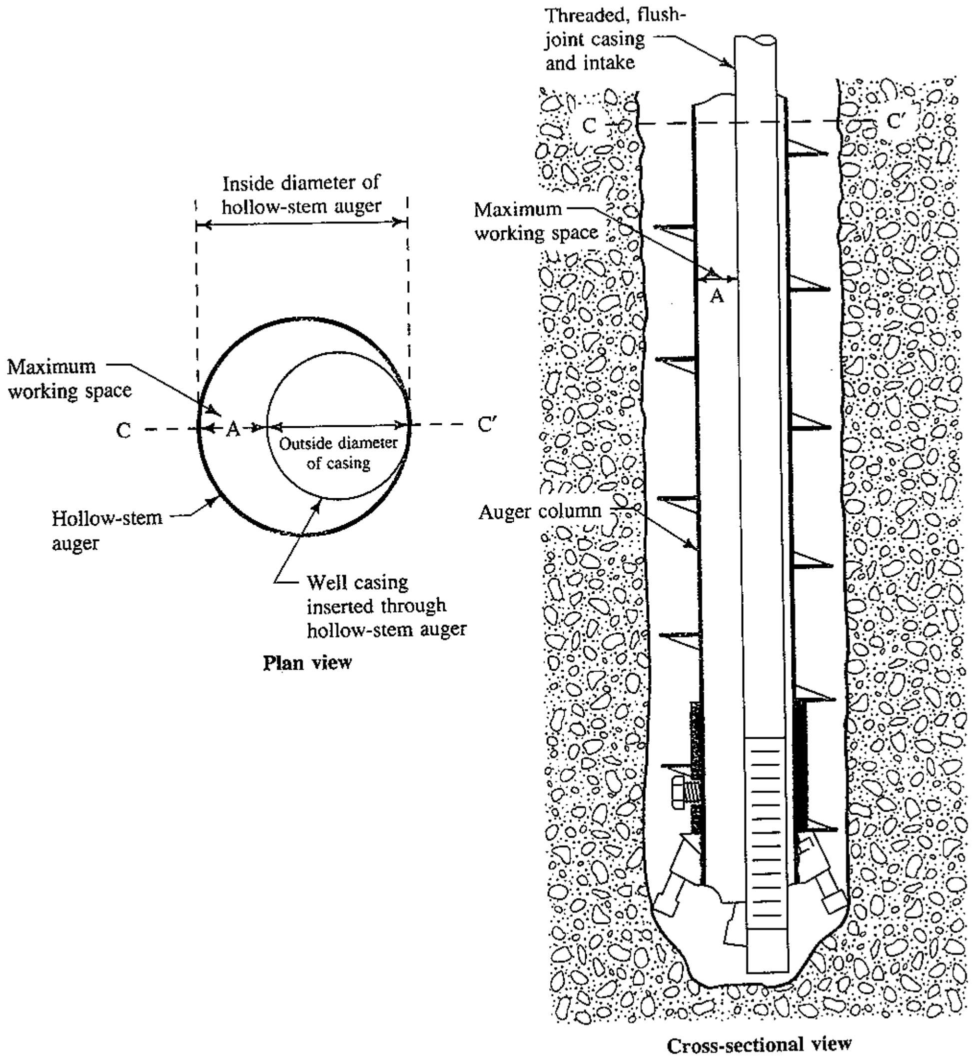


FIGURE 8.15 Casing offset inside hollow-stem auger to give greatest working opening. *Source:* Glen Hackett, *Ground Water Monitoring Review* 8, no. 1 (1988):60–68. Used with permission. Copyright © 1988 Water Well Journal Publishing Co.

---

working opening inside the casing
means a minimum $4\frac{1}{4}$-in. opening i
to give the largest working openin
and a 2-in. nominal casing, this cre

The first step in the installati
to the casing and then lower the ass
casing. Prior to installation the casir
The casing and screen may be wr
contaminated and then kept wrap
Figure 8.16 shows a 20-ft casing and
to be lowered on a cable using the

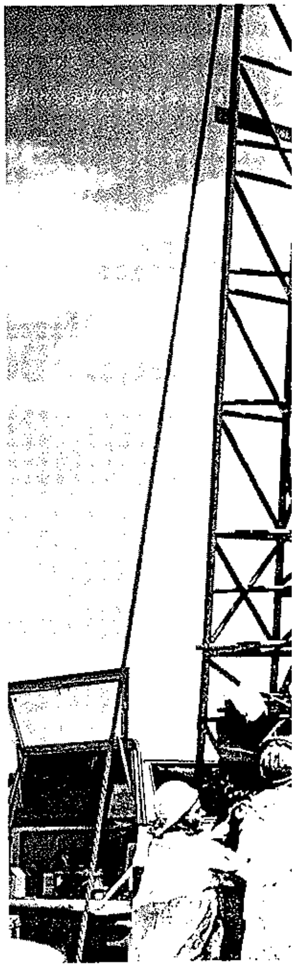
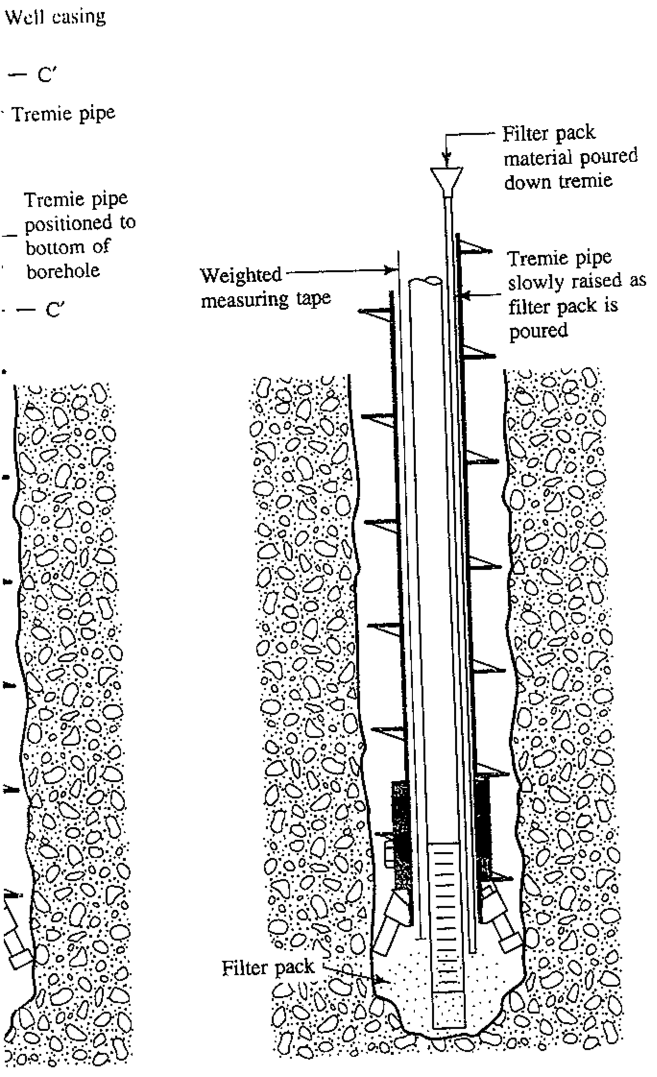


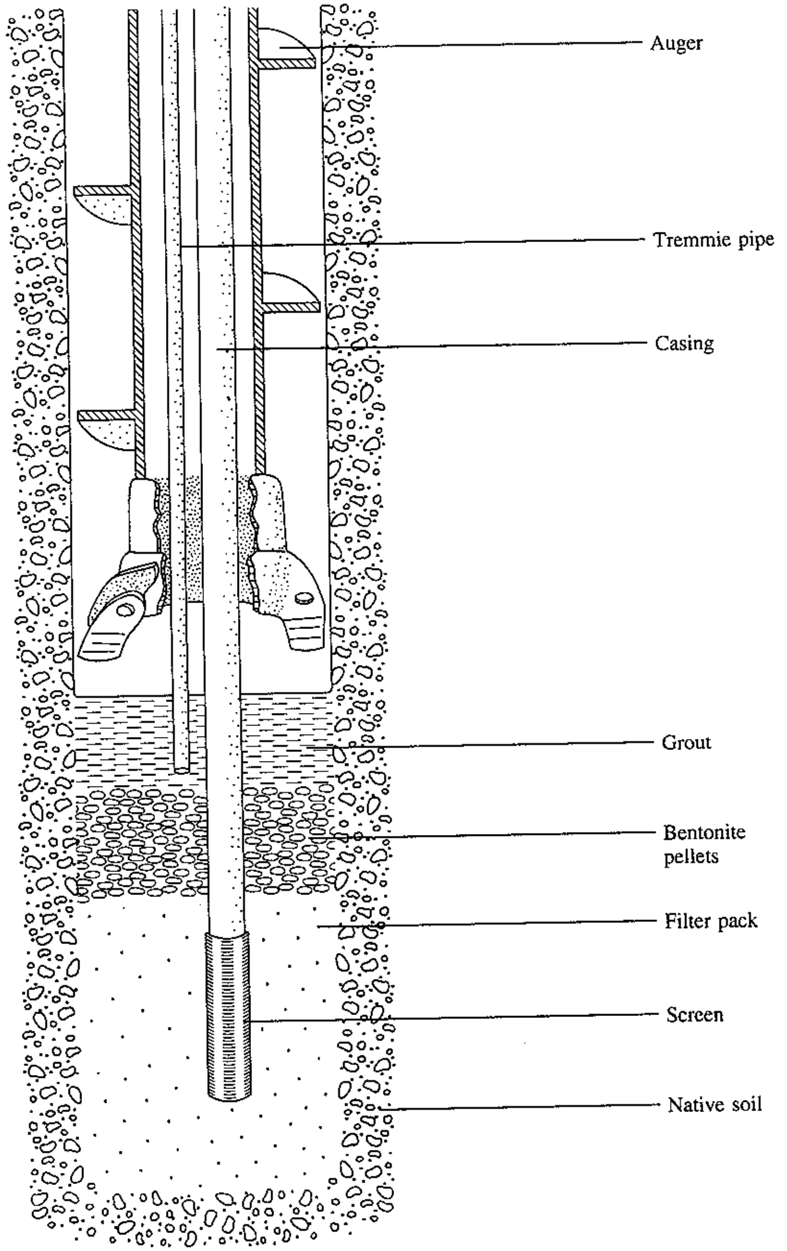
FIGURE 8.16 Lowering well screen and
around the decontaminated casing. *Photo*



. view
tape and
ted

Filter pack poured through bottom-discharge tremie pipe

mie pipe for emplacement of filter-pack material. *Source:* Glen Hackett, ew 8, no. 1 (1988):60–68. Used with permission. Copyright © 1988 Water



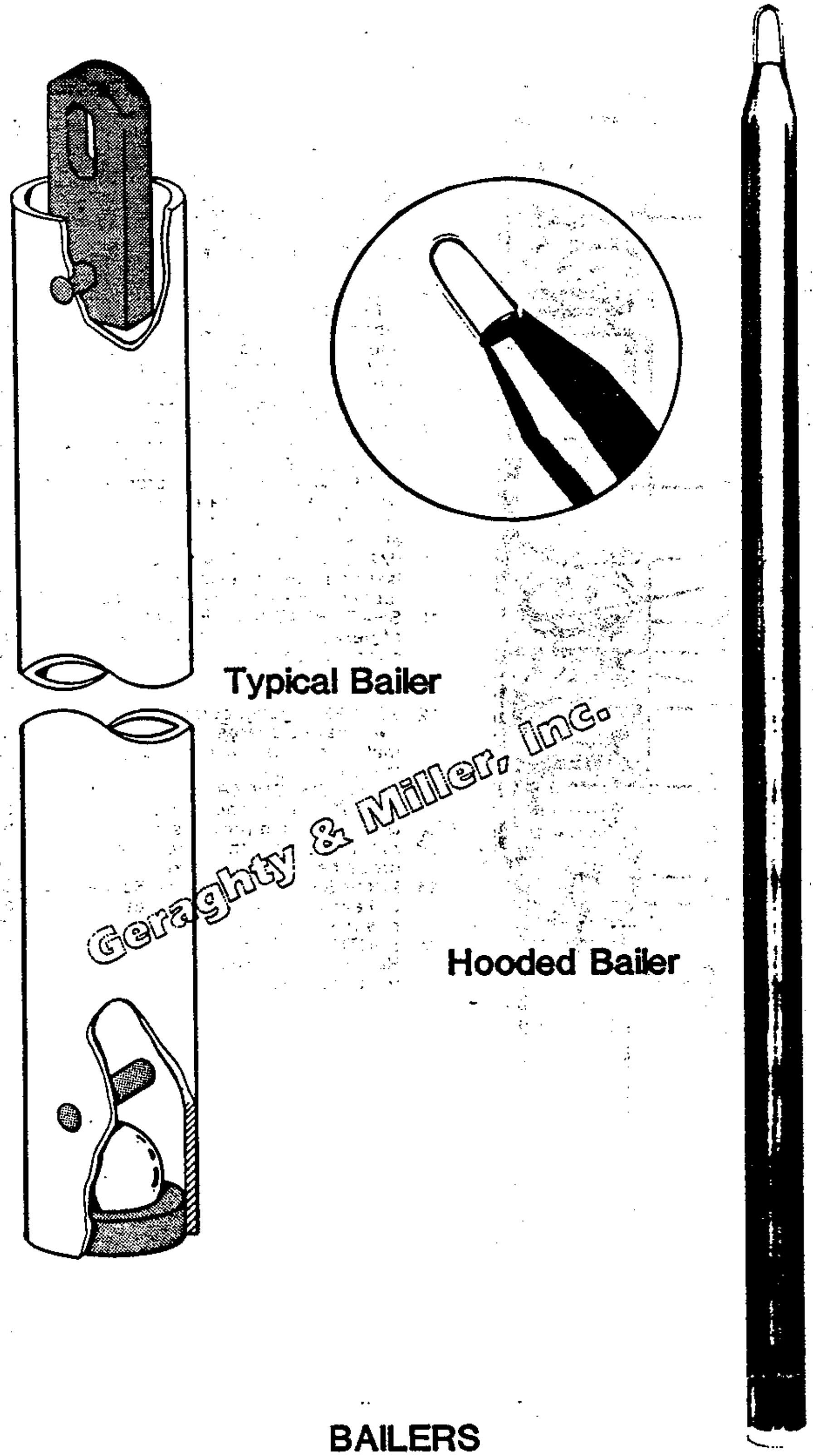
Not to scale

FIGURE 8.19 Use of a tremmie pipe for emplacement of grout above the bentonite pellets.

Flumes.

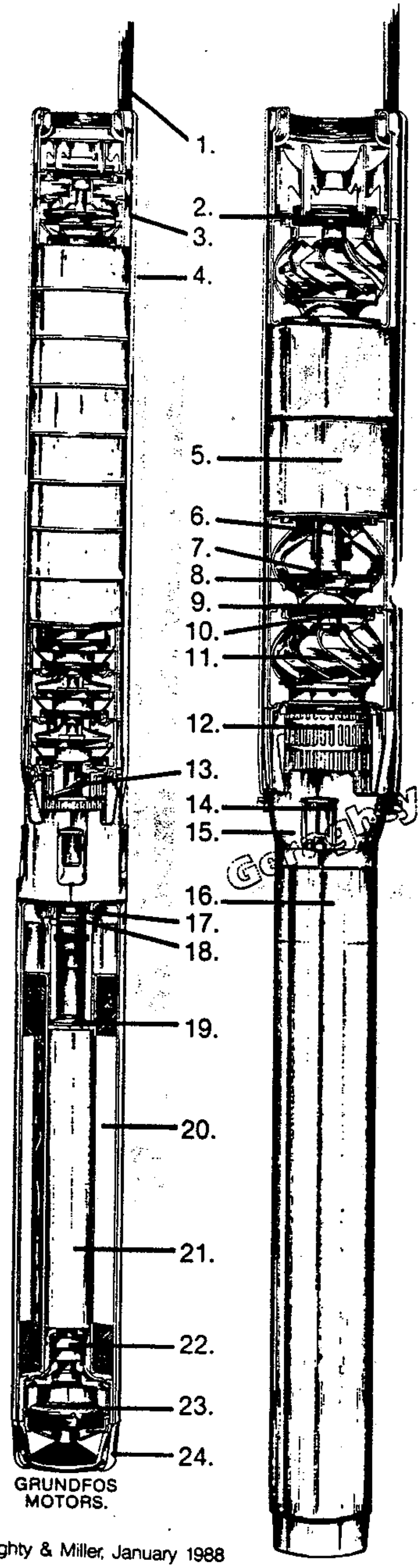
WATER

SAMPLING



BAILERS

FIGURE 3



1. CABLE: Neoprene jacketed RHW insulated wire.
2. CHECK VALVE: stainless steel full-flow, non-clog, non-slamming design. Valve positively seats on stainless steel reinforced rubber ring assuring no backflow.
3. STRAPS: High-tensile strength stainless steel
4. CABLE GUARD: stainless steel
5. DIFFUSER CHAMBERS: Integral fabricated units of stainless steel specifically designed to eliminate up thrust. Chambers contain diffuser guide vanes and intermediate shaft bearings.
6. SHAFT: Centerless-ground stainless steel for true running.
7. SPLIT CONES AND SPLIT CONE NUTS: stainless steel or bronze.
8. IMPELLERS: Fabricated stainless steel to improve hydraulic efficiencies.
9. IMPELLER SEAL RINGS: Long lasting abrasion resistant rubber. Stainless steel reinforced.
10. SHAFT BEARINGS: Rubber of hexed design for long life and good lubrication.
11. DIFFUSER GUIDE VANES. Fabricated stainless-steel
12. SCREEN: Strong, durable stainless steel having a large flow area to match the rated flow capacity of the pump.
13. PRIMING INDUCER: All stainless steel assures proper pump lubrication and prevents dry running, even if the water level drops below pump intake.
14. PUMP SHAFT COUPLING: Splined or keyed stainless steel to assure positive nonslip action.
15. SUCTION INTERCONNECTOR: Rugged all stainless steel or ni-resist cast iron.
16. MOTOR: Canned rotor desig a hermetically sealed epoxy encapsulated stator sealed i stainless steel enclosure. All that are in contact with the medium being pumped are constructed of corrosion resi stainless steel
17. SHAFT AND SEAL: Tungsten carbide running on tungsten-carbide. The upper seal ring i molded into a rubber diaphrag which is spring loaded and ac a relief valve for excess moto fluid.
18. UPPER RADIAL BEARINGS: V lubricated diamond-hard cera running against a tungsten-ca shaft journal.
19. MOTOR CIRCULATION PUMP Exclusive Grundfos feature. T stainless steel pump circulate water in the rotor can chambe ensure effective bearing lubric and winding heat dissipation.
20. STATOR: Hermetically sealed stainless steel and encapsulat thermal plastic resin for maxi heat transfer and resistance t moisture penetration.
21. ROTOR: Clad in stainless steel
22. LOWER RADIAL BEARING: W lubricated diamond-hard cera running against a tungsten-ca shaft journal.
23. THRUST BEARING: Adjustable chell design (improved 'Kings type) constructed of ceramic running against self-aligning impregnated carbon pads.
24. DIAPHRAGM: Rubber diaphra automatically compensates fo internal motor liquid expansio due to temperature or pressur changes.

ELECTRIC SUBMERSIBLE PUMP

FIGURE 4

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SAMPLING OF MONITORING WELLS
DAILY CHECKLIST

PROJECT: ____________________

WELL(S): ____________________

LOCATION: ____________________

DATE: ____________________

G&M PERSONNEL ON SITE: ____________________

TIME: ____________________

CHECKED BY: ____________________

ITEMS	OK/NA	COMMENTS
PRIOR TO SAMPLING:		
Health & safety precautions (HASP) received; equipment ready		
Sample containers, coolers, received from laboratory; ice or ice packs ready		
Sampling equipment and supplies inventoried, clean, and operational		
Checked in with client at site.		
Integrity of well noted		
Well area prepared for sampling; plastic placed around well; gasoline-powered pumps placed downwind.		
Well and water-level measurements made and recorded along with other pertinent field information on water sampling log.		
Field instruments calibrated.		
Sample containers labelled; preservatives added, if necessary.		
DURING AND AFTER SAMPLING:		
Well purged three to five times its volume		
Sample collected using a bailer or pump as per sampling plan.		
Measurement of field parameters recorded on sampling log.		
Sample containers filled according to collection protocol of analyses.		
Field and trip blanks collected; replicates or split samples collected as per sampling plan.		
Samples stored at 4^{o}C in coolers for transport to lab.		
Water sampling log and chain-of-custody form completed.		
Reusable equipment decontaminated; non-reusable equipment disposed of in appropriate manner.		
Well secured and locked.		
Laboratory contacted to confirm receipt and condition of samples		

Additional Comments:

Instructions: Original to Field Project File; copy to Project Manager and to QA Representative.

Portable Sampling Devices					Ground Water Parameters													
					Inorganic							Organic				Radioactive		Biol.
	Device	Approximate Maximum Sample Depth	Minimum Well Diameter	Sample Delivery Rate or Volume	EC	pH	Redox	Major Ions	Trace metals	Nitrate, Fluoride	Dissolved Gases	Non-volatile	Volatile	TOC	TOX	Radium	Gross Alpha & Beta	Coliform Bacteria
Grab	Open bailer	no limit	$\frac{1}{2}$ in.	Variable	•			•	•	•		•				•		•
	Point-source bailer	no limit	$\frac{1}{2}$ in.	Variable	•	•	•	•	•	•		•	•	•	•	•		•
	Syringe sampler	no limit	$1\frac{1}{2}$ in.	0.01–0.2 gal	•	•	•	•	•	•		•				•	•	•
Positive displacement (submersible)	Gear-drive	200 ft	2 in.	0–0.5 g/min									•					
	Bladder pump	400 ft	$1\frac{1}{2}$ in.	0–2 g/min	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Helical rotor	160 ft	2 in.	0–1.2 g/min	•	•	•	•	•	•	•	•	•	•	•	•	•	
	Piston pump (gas-drive)	500 ft	$1\frac{1}{2}$ in.	0–0.5 g/min	•			•	•	•		•				•	•	
	Centrifugal	variable	3 in.	variable	•			•		•						•	•	
Suction lift	Peristaltic	26 ft	$\frac{1}{2}$ in.	0.01–0.3 g/min	•			•		•		•				•		•
Gas contact	Gas-lift	variable	1 in.	Variable														
	Gas-drive	150 ft	1 in.	0.2 g/min	•			•		•		•				•		

FIGURE 8.25 Matrix showing applications of a number of ground-water sampling devices. *Source:* K. F. Pohlmann and J. W. Hess, *Ground Water Monitoring Review* 8, no. 4 (1988): 82–84. Used with permission. Copyright © 1988 Water Well Journal Publishing Co.

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WATER SAMPLING LOG

Project/No. ______________________ Page ______ of ______

Site Location ______________________

Site/Well No. ____________ Coded/ Replicate No. ____________ Date ____________

Weather ____________ Time Sampling Began ____________ Time Sampling Completed ____________

EVACUATION DATA

Description of Measuring Point (MP) ______________________

Height of MP Above/Below Land Surface ____________ MP Elevation ____________

Total Sounded Depth of Well Below MP ____________ Water-Level Elevation ____________

Held ______ Depth to Water Below MP ____________ Diameter of Casing ____________

Wet ______ Water Column in Well ____________ Gallons Pumped/Bailed Prior to Sampling ____________

Gallons per Foot ____________

Gallons in Well ____________ Sampling Pump Intake Setting (feet below land surface) ____________

Evacuation Method ______________________

SAMPLING DATA/FIELD PARAMETERS

Color ____________ Odor ____________ Appearance ____________ Temperature ______ °F/°C

Other (specific ion; OVA; HNU; etc.) ______________________

____

Specific Conductance, umhos/cm ____________ pH ____________

Sampling Method and Material ______________________

Constituents Sampled	Container Description From Lab ______ or G&M ______	Preservative

Remarks ______________________

Sampling Personnel ______________________

WELL CASING VOLUMES

GAL./FT	1-¼" = 0.077	2" = 0.16	3" = 0.37	4" = 0.65
	1-½" = 0.10	2-½" = 0.24	3-½" = 0.50	6" = 1.46

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CHAIN-OF-CUSTODY RECORD

Page ______ of ______

Project Number ____________________

Project Location: ____________________

Laboratory ____________________

Sampler(s) ____________________

____

		SAMPLE BOTTLE / CONTAINER DESCRIPTION										
SAMPLE IDENTITY	Date Sampled											TOTAL
											Total No. of Bottles/ Containers	

Relinquished by: ____________________	Organization: ____________________	Date ___/___/___ Time ________	Seal Intact?
Received by: ____________________	Organization: ____________________	Date ___/___/___ Time ________	Yes No N/A
Relinquished by: ____________________	Organization: ____________________	Date ___/___/___ Time ________	Seal Intact?
Received by: ____________________	Organization: ____________________	Date ___/___/___ Time ________	Yes No N/A

Special Instructions/Remarks: ____________________

☐ Lab Courier ☐ Other

& MILLER, INC.
Ground-Water Consultants

SAMPLE CONTAINER INVENTORY

Project N1099MB1

Shipped from (laboratory) Envirotex, Inc.
29 Childs Lane
Grayville, N.Y. 19024

Phone (718) 798-0286

Shipped to Geraghty & Miller, Inc.
125 East Bethpage Road
Plainview, N.Y. 11803

Attn. David Schantz

SHIPMENT CONTENTS

Shipped			Received	
Bottle Size and Composition	Preservative	Quantity	Quantity	Condition/Comments
10 ml Vial	None	12	12	ok
1 Amber	None	6	6	ok
1/2 pt. glass	None	6	6	ok
10 ml trip blank	None	1	1	ok

Packed by John D. Smith
Date 1/22/87
Shipped by B. Lee Jones
Date 1/22/87
Sealing Method G&M seal

Received by David Schantz
Date 1/23/87
Inspected by David Schantz
Date 1/23/87
Seal Intact? Yes

Remarks:

GERAGHTY
& MILLER, INC.
Ground-Water Consultants

WATER SAMPLING LOG

Project/No. XYZ Chemical N999WV1

Page 1 of 4

Site Location Wellsville, NY

Site/Well No. Well 1A

Coded/ Replicate No. none

Date 10/29/85

Weather overcast 60s

Time Sampling Began 9^{30} AM

Time Sampling Completed 10^{45} AM

EVACUATION DATA

Description of Measuring Point (MP) Top of Casing

Height of MP Above/Below Land Surface 2.1' above

MP Elevation

Total Sounded Depth of Well Below MP 54.3'

Water-Level Elevation

Held 25.00'

Depth to Water Below MP 22.54'

Diameter of Casing 2"

Wet 2.46'

Water Column in Well 31.8'

Gallons Pumped/Bailed Prior to Sampling 25.5

Gallons per Foot 0.16

Gallons in Well 5.1

Sampling Pump Intake Setting (feet below land surface) 30'

Evacuation Method Centrifugal Pump

Geraghty & Miller, Inc.

SAMPLING DATA/FIELD PARAMETERS

Color Slightly Brown

Odor Faint Solvent

Appearance Silty

Temperature 20 °F/[✓ °C]

Other (specific ion; OVA; HNU; etc.)

Specific Conductance, umhos/cm 1250

pH 5.75

Sampling Method and Material Teflon Bailer

Constituents Sampled	Container Description From Lab ✓ or G&M	Preservative
Volatile Organics	(2) 40 ml vials	cool 4°C
Base/Neutral Extractables	1 liter amber glass	"
Heavy Metals	500 ml plastic	filter, acidify to pH <. cool 4°C

Remarks Well pumped at slow rate ~½ gal/min to avoid drawing level do
too quickly.

Sampling Personnel RS, DS

WELL CASING VOLUMES

GAL./FT
1-¼" = 0.077
1-½" = 0.10
2" = 0.16
2-½" = 0.24
3" = 0.37
3-½" = 0.50
4" = 0.65
6" = 1.46

FIGURE

& MIL R, INC.
Ground-Wa Consultants

CHAIN-OF-CUST Y RECORD

Page ____

Project Number N1099M3I

Project Location: MOSBY, NY

Laboratory ENVIROTEX, INC.

Sampler(s) SCHANTZ
RASKIN

		SAMPLE BOTTLE / CONTAINER DESCRIPTION										
SAMPLE IDENTITY	Date Sampled	VOC 40 ml vial	PCB 1 l amber glass	Trip Blank 40 ml vial	VOC 1/2 pt. glass jar							TOTAL
WELL GM-01	1-28-87	2	1	1								4
WELL GM-02	"	2	1									3
WELL GM-03	"	2	1									3
SURFACE WATER #1	"	2	1									3
SURFACE WATER #2	"	2	1									3
SOIL #1	"				2							2
SOIL #2	"				2							2
FIELD BLANK	"	2										2
											Total No. of Bottles/ Containers	22

Relinquished by:	Organization: Geraghty + Miller, Inc.	Date 01/28/87 Time 11:00 AM	Seal Intact?
Received by:	Organization: Envirotex	Date 01/28/87 Time 11:00 AM	[✓ Yes] No N/A
Relinquished by:	Organization:	Date / / Time	Seal Intact?
Received by:	Organization:	Date / / Time	Yes No N/A

Special Instructions/Remarks:

GERAGHTY
& MILLER, INC.
Ground-Water Consultants

CHAIN-OF-CUSTODY RECORD

Page 1 of 1

Location: Wellsville NY Plant

Laboratory: Enviro Test

Project/Number XYZ Chem/ N999WV1

Shipping Container ID:

Sampler(s) RS, DS

SAMPLE CONTAINER DESCRIPTION

SAMPLE IDENTITY	Date Sampled	(2) 40 ml vials Volatile Organics	1 liter amber glass Base/Neutral	500 ml Plastic Metals (acidified)	500 ml Plastic standard Inorganics									Total	Remarks
Well 1A	10/29/85	2(1 set)	1	1										4	
" 1B	"	2	1	1										4	
" 1C	"	2	1	1										4	
" 2A	"	2	1	1										4	
" 2B	"	2	1	1										4	
" 2C	"	2	1	1										4	
" 3A	10/30/85	2	1	1										4	
" 3B	"	2	1	1										4	
" 4A	"	2	1	1										4	
" 4B	"	2	1	1										4	
Leachate #1	"	2	1	1	1									5	High conc. volatiles
" #2	"	2	1	1	1									5	"
Stream #1	"	2	1	1	1									5	
" #2	"	2	1	1	1									5	
Field Blank	"	2												2	
Trip Blank	"	2												2	

Total No. of Containers 64

Relinquished by: Robert [illegible] Organization: Geraghty & Miller

Date: 10/31/85 Time: 9^{00} AM

Received by: Joe Smith Organization: EnviroTest

Date: 10/31/85 Time: 9^{05} AM

Relinquished by: Organization:

Date: Time:

Received by: Organization:

Date: Time:

Relinquished by: Organization:

Date: Time:

Received by: Organization:

Date: Time:

Dr · Method: Hand-Delivered (attach shipping if any)

(Use extra sheets, if necessary)

FIGURE 10

TABLE 3. (Cont'd.)

Parameter No./name	Container[1]	Preservation[2,3]	Maximum Holding Time[4]
Cobalt	P, G	HNO_3 to pH <2	6 months
Copper	P, G	do	do
Gold	P, G	do	do
Iridium	P, G	do	do
Iron	P, G	do	do
Lead	P, G	do	do
Magnesium	P, G	do	do
Manganese	P, G	do	do
Mercury	P, G	HNO_3 to pH <2	28 days
Molybdenum	P, G	do	do
Nickel	P, G	do	do
Osmium	P, G	do	do
Palladium	P, G	do	do
Platinum	P, G	do	do
Potassium	P, G	do	do
Rhodium	P, G	do	do
Selenium	P, G	do	do
Silver	P, G	do	do
Sodium	P, G	do	do
Thalium	P, G	do	do
Tin	P, G	do	do
Titanium	P, G	do	do
Vanadium	P, G	do	do
Zinc	P, G	do	do
Nitrate	P, G	Cool, 4°C	48 hours
Nitrate-nitrite	P, G	Cool, 4°C, H_2SO_4 to pH <2	28 days
Nitrite	P, G	Cool, 4°C	48 hours
Oil and grease	G	Cool, 4°C, H_2SO_4 to pH <2	28 days
Organic carbon	P, G	Cool, 4°C, HCl or H_2SO_4 to pH <2	do
Orthophosphate	P, G	Filter immediately, Cool, 4°C	48 hours
Oxygen, Dissolved-Probe Method	G bottle and top	None required	Analyze immediatel
Oxygen, Dissolved-Winkler Method	do	Fix on site and store in dark	8 hours
Phenols	G only	Cool, 4°C, H_2SO_4 to pH <2	28 days
Phosphorus (elemental)	G	Cool, 4°C	48 hours
Phosphorus, total	P, G	Cool, 4°C, H_2SO_4 to pH <2	28 days
Residue, total	P, G	Cool, 4°C	7 days
Residue, filterable	P, G	do	48 hours
Residue, nonfilterable (TSS)	P, G	do	7 days
Residue, settleable	P, G	do	48 hours
Residue, volatile	P, G	do	7 days