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USACE / NAVFAC / AFCESA / NASA | **UFGS-33 24 00.00 20 (April 2006)**

Preparing Activity: NAVFAC | **Replacing without change UFGS-02525N (September 1999)**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2012
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DIVISION 33 - UTILITIES

SECTION 33 24 00.00 20

[EXTRACTION] [MONITORING] WELLS

04/06

-- End of Section Table of Contents --

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SECTION 33 24 00.00 20

[EXTRACTION] [MONITORING] WELLS
04/06

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NOTE: This guide specification covers the requirements for installation of extraction/monitoring wells and associated testing.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).
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NOTE: This guide specification is not appropriate for vapor extraction and two phase extraction wells.
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NOTE: Drawings should include the following and any other information necessary to indicate layout and general configuration of the well:

1. Diameter of drilled hole

2. Casing diameter

3. Well screen diameter, length, location, and slotted opening size

4. Minimum depth of casing and minimum depth well screen

5. Limits of primary and secondary filter packs

6. Limits of bentonite seal and grout seal

7. Type of cap, cover, or seal required at top of well.

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PART 1 GENERAL

1.1 REFERENCES

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NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A312/A312M	(2012) Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A53/A53M	(2012) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM C117	(2004) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C150/C150M	(2011) Standard Specification for Portland Cement
ASTM D1586	(2011) Penetration Test and Split-Barrel

	Sampling of Soils
ASTM D1587	(2008) Thin-Walled Tube Sampling of Soils for Geotechnical Purposes
ASTM D1785	(2012) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D2487	(2011) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D2488	(2009a) Description and Identification of Soils (Visual-Manual Procedure)
ASTM D4397	(2010) Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM D5088	(2002; R 2008) Decontamination of Field Equipment Used at Nonradioactive Waste Sites
ASTM D5092	(2004; R 2010e1) Design and Installation of Ground Water Monitoring Wells in Aquifers
ASTM F480	(2012) Thermoplastic Well Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR), SCH 40 and SCH 80
ASTM F883	(2009) Padlocks

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2008; Errata 1-2010; Changes 1-3 2010; Changes 4-6 2011) Safety and Health Requirements Manual

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 530/F-93/004	(1993; Rev O; Updates I, II, IIA, IIB, and III) Test Methods for Evaluating Solid Waste (Vol IA, IB, IC, and II) (SW-846)
EPA 600-4-89-034	(1990) Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells
EPA 600/4-79/020	(1983) Methods for Chemical Analysis of Water and Wastes

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	Occupational Safety and Health Standards

1.2 DESCRIPTION OF WORK

Provide [extraction] [monitoring] well[s] including drilling, casing, well

screen, gravel packing, grouting, development, monitoring device, and incidental related work complete and ready for operation.

1.3 GENERAL REQUIREMENTS

Each system, including equipment, materials, installation, and performance, shall be in accordance with local, State, and Federal regulations, ASTM D5092, and EPA 600-4-89-034 except as modified herein. Consider the advisory or recommended provisions to be mandatory, as though the word "shall" has been substituted for the word "should" wherever it appears. Reference to the "Project Representative" and the "Owner" shall be interpreted to mean the Contracting Officer. Additional requirements are included under Section 01 50 00 TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS. Mark and secure monitoring well[s] to avoid unauthorized access and tampering.

1.4 SUBMITTALS

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NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project.

The Guide Specification technical editors have designated those items that require Government approval, due to their complexity or criticality, with a "G". Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item, if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.
****

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Well construction

SD-03 Product Data

Well casing

Well screen

Filter pack

Neat cement grout

Bentonite seal

SD-07 Certificates

Well Drilling/Development Material Handling Plan[; G][; G, [_____]]

Health and Safety Plan[; G][; G, [_____]]

Field Sampling and Laboratory Testing Plan[; G][; G, [_____]]

Treatment facility permit

Installation Survey Report

Well Development Report

Borehole Analysis Report

SD-11 Closeout Submittals

Well Construction Permit

Shipment manifests

Delivery certificates

Treatment and disposal certificates

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver materials in an undamaged condition. Unload and store with minimal handling. Store materials in on-site enclosures or under protective coverings. Store [plastic piping and jointing materials, and] rubber gaskets under cover, out of direct sunlight. Store materials off the ground. Keep insides of pipes and fittings free of dirt and debris. Replace defective or damaged materials with new materials.

1.6 QUALITY ASSURANCE

1.6.1 Required Drawings

Submit well construction drawings showing components and details of well casing, well screen, filter pack, annular seal, and associated items. Drawings shall be prepared by a State certified professional geologist or hydrogeologist, or by a State registered professional civil engineer, hereafter referred to as the Contractor's Professional Consultant (CPC).

Drawings shall be sealed.

1.6.2 Well Drilling/Development Material Handling Plan

A material handling plan shall be furnished by the Contractor 15 days prior to initiation of the work that describes phases of dealing with the potentially contaminated soil and groundwater, including the following: a schedule to be employed in the well drilling and development stages, a sequence of operations, the method of drilling and development, material hauling, proposed equipment, handling of the contaminated materials, soil and water testing requirements, and safety precautions and requirements.

1.6.3 Health and Safety Plan (HASP)

Describe safety precautions for each phase of the project as specifically related to handling of soil and water removed during well drilling and development operations. Identify appropriate requirements of 29 CFR 1910 and EM 385-1-1. Identify safety equipment and procedures to be available and used during the project. Furnish the name and qualifications based on education, training, and work experience of the proposed Health and Safety Officer (HASO) and the members of the drill crew. The CPC may perform the responsibilities of the HASO if properly qualified.

1.6.4 Field Sampling and Laboratory Testing Plan

Describe field sampling methods and quality control procedures. Identify laboratory and laboratory methods to be used for contamination testing. Sample reports shall show sample identification for location, date, time, sample method, contamination level, name of individual sampler, identification of laboratory, and quality control procedures.

1.6.5 Treatment Facility Permit

Verification that the proposed treatment facility is permitted to accept the contaminated materials specified, prior to the start of excavation.

1.6.6 Well Development Report

Provide report, containing the following data [for each well]: project name and location, well designation, date and time of well installation, date and time of well development, static water level from top of well casing before development and 24 hours after development, field measurements of pH, temperature, and specific conductivity, depth of well from top of casing to bottom of well, screen length, description of development methodology size/capacity of pump or bailer, pumping rate, and recharge rate.

1.6.7 Well Construction Permit

Submit a completed permit application and a proposed method of construction to the appropriate state agency prior to construction of the well. Construction of the well[s] will not be allowed until an approved Well Construction Permit has been submitted to the Contracting Officer.

1.6.8 Shipment Manifests

Copies of manifests and other documentation required for shipment of waste materials within 24 hours after removal of waste from the site. Shipment manifests shall be signed by the Contracting Officer.

1.6.9 Delivery Certificates

Verification that the wastes were actually delivered to the approved treatment facility, within 7 days of shipment.

1.6.10 Treatment and Disposal Certificates

Verification that the wastes were successfully treated and remediated to the levels specified herein.

PART 2 PRODUCTS

2.1 WELL CASING

****

NOTE: Selection of casing and screen material type is critical to both the life of the well and the accuracy of the sampling data. Analysis of the existing groundwater chemistry is crucial to making an appropriate material selection. In the absence of water quality data, it is prudent to choose conservative materials.

Stainless steel (SS) piping offers high strength and rigidity sufficient to withstand virtually any subsurface condition, and is highly resistant to corrosion. SS is susceptible to degradation in long-term exposure to highly corrosive environments, including saline and certain acidic environments. This degradation results in the leaching of nickel and cadmium into the sampling regime.

PVC piping is lightweight, corrosion resistant, durable, and generally chemically resistant. PVC is susceptible to degradation in long-term exposure to high concentrations of certain organic solvents. These include tetrahydrofuran (THF), methyl ethyl ketone (MEK), methyl isobutyl ketone (MIBK), and cyclohexanone.

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2.1.1 Stainless Steel Piping

ASTM A312/A312M, Type 304, Schedule 40S, with flush threaded joint end fittings. Threaded joints shall be wrapped with flouropolymer tape, and provided with nitrile O-ring gaskets.

2.1.2 PVC Piping

ASTM F480, Type 1, Grade 1, PVC 12454, NSF wc or NSF pw, Schedule [40] [80], with flush threaded joint fittings. Threaded joints shall be wrapped with flouropolymer tape, and provided with nitrile O-ring gaskets.

2.2 WELL SCREEN

****

NOTE: Well screens are located in the most reactive zone of the well environment. The material

selection should be made based on similar criteria as the well casing materials. However, in some situations, well screen material may be different from the material selected for the casing. Strength of the screen is important, as it has large open area. The width of the slotted openings should be sized relative to the filter pack material, and should retain between 90 and 99 percent of that material. The open area of the screen should allow flow through the screen at approximately the same rate as the natural permeability of the aquifer.

****

Well screens shall be located as indicated. The length of [each] [the] screen shall be as indicated. Slot size shall be [_____] mm inch. Slotted openings shall be distributed uniformly around the circumference of the screen. Open area shall approach the formation's natural porosity.

2.2.1 Stainless Steel Screens

ASTM A312/A312M, Type 304, Schedule 40S, continuous slot construction, wire wound, with flush threaded joint ends.

2.2.2 PVC Screens

ASTM D1785, PVC 1120, NSF wc or NSF pw, Schedule [40] [80], screen, Schedule 80, machine-slotted construction, flush threaded joint ends. Slots shall be even in width, length, and separation.

2.3 PRIMARY FILTER PACK

****

NOTE: The primary filter pack selected should have a 30 percent finer (d-30) grain size that is 4 to 10 times greater than the d-30 grain size of the aquifer. For extraction wells, select a primary filter pack with a d-30 grain size 8 to 10 times greater than the d-30 grain size of the aquifer. The uniformity coefficient (60 percent passing, d-60/10 percent passing, d-10) should be less than 2.5, and ideally in the 1.0 to 1.5 range. Primary filter should extend 600 to 1500 mm 2 to 5 feet above the top of the well screen. The secondary filter should be a minimum of 300 mm one foot thick, preferably 600 mm 2 feet thick.

****

Provide clean, durable, well-rounded, and washed quartz or granite, with less than 5 percent non-siliceous material. The filter pack shall not contain organic matter or friable materials. The filter pack shall allow free flow of water in the well, and shall prevent the infiltration of aquifer materials. Filter pack shall have a 30 percent finer than (d-30) grain size of [_____] mm inch, and a uniformity coefficient less than [2.5] [_____], in accordance with ASTM C117 and ASTM C136.

2.4 SECONDARY FILTER PACK

Gradation in accordance with ASTM D5092. Provide clean, durable, well-rounded, and washed quartz or granite. Pack shall not contain organic

matter or friable materials.

2.5 ANNULAR SEALANTS

2.5.1 Bentonite Seal

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NOTE: Sodium bentonite is most widely used, however, calcium bentonite may be more appropriate for high calcium environments. Bentonite seal should be placed above the secondary filter and approximately 600 to 1500 mm 2 to 5 feet above the highest well screen.
****

Provide powdered, granular, pelletized, or chipped [sodium] [calcium] montmorillonite in sealed containers from a commercial source, free of impurities. Diameter of pellets shall be less than one fifth the diameter of the borehole annular space to prevent bridging. Bentonite base grout shall be in accordance with ASTM D5092.

2.5.2 Neat Cement Grout

Provide neat cement grout in accordance with ASTM D5092. Cement shall be in accordance with ASTM C150/C150M. Quick setting admixtures shall not be allowed. Drilling mud or cuttings shall not be used as a sealing material.

2.6 BOTTOM PLUGS

Provide flush threaded solid plug at the bottom of the well. Plug shall be the same material as the well [casing] [screen] to which it is attached. Joints shall be wrapped with fluoropolymer tape and provided with nitrile O-ring gaskets.

2.7 LOCKING WELL CAP

Provide flush threaded, weatherproof, and non-removable locking well cap on the top of the well. Well cap shall be of the same material as the well casing to which it is attached. Well cap shall accommodate padlock. Provide a long shackled padlock in accordance with ASTM F883. Provide two keys for the padlock, and turn them over to the Contracting Officer. [Locks at the well site shall be keyed alike.]

2.8 WELL HEAD COMPLETIONS

Clearly mark and secure the well to avoid unauthorized access and tampering. Cast the words ["MONITORING WELL"] ["EXTRACTION WELL"] on the well head cover. Provide a sign reading, "WELL IS FOR MONITORING AND IS NOT SAFE FOR DRINKING." Provide stamped metal identification tag as follows:

DO NOT DISTURB
ID #: Date:
Installed By:
Total Depth:
Screened Interval:
TOC Elevation:
Other:
For Information, Call:

2.8.1 Aboveground Completions

Provide protective outer casing around the well casing extending above grade. The diameter of the protective outer casing shall be a minimum of 100 mm 4 inches larger than the well casing diameter. The top of the protective outer casing shall extend a minimum of 150 mm 6 inches above the top of the well casing cap. The protective outer casing shall be set in cement grout and the bottom of the protective well casing shall extend [below the depth of the frost line] [to the depth indicated]. A 6 mm 1/4 inch diameter weep hole shall be drilled in the protective outer casing 75 mm 3 inches above the ground surface. The annular space between the protective outer casing and the well casing shall be filled with pea gravel or coarse sand to just below the level of the cap on the well casing. The locking well cap shall be provided on top of the protective outer casing. [Provide 150 mm 6 inch diameter steel pipe bollards, filled with concrete as indicated to protect the exposed well head.]

2.8.1.1 Protective Outer Casing [and Bollards]

ASTM A53/A53M, Type E or S, Grade B.

2.8.1.2 Well Casing Cap

Provide cap on top of the protective outer casing. Cap shall be flush threaded and of the same material as the protective outer casing. Threaded joints shall be wrapped with fluoropolymer tape and provided with nitrile O-ring gaskets.

2.8.2 At-Grade Completions

Provide [cast iron] [aluminum] vault box, [750 by 750 mm 30 by 30 inches] [300 mm 12 inch diameter] [_____], with watertight frame and cover. Vault shall support [H-20 loading for traffic areas] [a 45,360 kg 100,000 pound loading for airfield locations]. The frame shall be 150 mm 6 inches deep, and shall be set in a concrete collar a minimum of 200 mm 8 inches thick, and extending 100 mm 4 inches beyond the edge of the frame in all directions. Frame and concrete collar shall be [set flush with the level of the existing pavement] [set 75 mm 3 inches above the existing grade]. Locking well cap shall be provided on top of the well casing, which will terminate inside the vault as indicated.

2.9 POLYEHTYLENE SHEETING

ASTM D4397.

PART 3 EXECUTION

3.1 GENERAL

Notify the Contracting Officer at least 15 days prior to commencement of work. Location[s] of well[s] shall be as indicated. Drilling, installation, and development of the [monitoring] [extraction] well[s] shall be supervised, directed, and monitored by the CPC. Drilling, sampling, and well development equipment introduced to the well shall be decontaminated before and after each use in accordance with ASTM D5088.

3.2 DRILLING

****
NOTE: Type of drilling equipment is dependent upon site geology, hydrogeology, and intended use. If possible, utilize drilling methods which do not introduce water or drilling fluids into the borehole. If other methods are required, drilling fluid must be purged from the well during well development.
****

Borehole shall be advanced using conventional [[250] [_____] mm [10] [_____] inch hollow-stem auger] [solid auger] [rotary wash] [_____] drilling methods. If it is the opinion of the CPC that an alternate drilling method is required, justification for a boring method change shall be submitted to the Contracting Officer, and approval for the change granted prior to drilling. Drill crew shall be experienced and trained in drilling and safety requirements for contaminated sites.

3.2.1 Sampling

Obtain samples in accordance with ASTM D1586 or ASTM D1587. Perform standard penetration tests at the following depths: 0 to 450 mm; 450 to 900 mm; 900 to 1350 mm; and 1500 mm 0.0 to 1.5 feet; 1.5 to 3.0 feet; 3.0 to 4.5 feet; and 5 foot centers or at changes in soil formation thereafter. Each soil sample shall be screened in the field with an organic vapor analyzer/flame ionization device (OVA/FID) capable of detecting vapors to a minimum of one ppm. Log boring in accordance with ASTM D2487 and ASTM D2488. Groundwater elevation shall be indicated.

3.2.2 Analysis

The CPC shall review the log data from each borehole and compare the data with the well design requirements. The CPC shall verify the adequacy of the well design, or shall offer a proposed modification to the design based on the geologic and hydrogeologic data obtained from the borehole. This review and analysis shall be conducted [for each borehole] [for one borehole considered representative of the entire project]. The CPC shall submit the borehole boring logs, the analysis of the well design, and any proposed design modifications to the Contracting Officer in a Borehole Analysis Report. Any modifications to the well design approved by the Contracting Officer shall be considered a change to the contract documents and shall be negotiated in accordance with the "CHANGES" clause.

3.2.3 Alignment

Verify that the well is straight by lowering a 3 m 10 foot section of [_____] mm inch diameter steel pipe in to the well. [For wells deeper than 60 m 200 feet, Contractor shall verify that the well is plumb.]

3.3 SOIL REMOVED FROM THE BOREHOLE

3.3.1 Temporary Containment of Soil Removed from the Borehole

Soil removed from the borehole shall be placed in a temporary containment area. Provide a temporary containment area near the well site. Cover containment area with 0.25 mm 10 mil reinforced polyethylene sheeting. Place soil removed from the borehole[s] on the impervious barrier and cover

with 0.15 mm 6 mil reinforced polyethylene sheeting. Provide a straw bale berm around the outer limits of the containment area and cover with polyethylene sheets. Secure edges of sheets with weights to keep the polyethylene sheeting in place. Water runoff shall be diverted from the stockpiled material. As an option, soil may be stockpiled in trucks suitable for transporting contaminated soils as specified herein.

3.3.2 Testing Requirements for Stockpiled Soils

3.3.2.1 Sampling

A minimum of one composite sample shall be developed and analyzed for each required test [for every 76.4 cubic meters 100 cubic yards or fraction thereof] from a composite stockpile of soil removed from all well sites. To develop a composite sample of the size necessary to run the required tests, the Contractor shall take several samples from different areas along the surface and in the center of the stockpile. These samples shall be combined and thoroughly mixed to develop the composite sample.

3.3.2.2 Testing

****

NOTE: Testing standards and limits for contaminated soil vary widely from state to state. Designer must contact the appropriate State regulatory authority to determine the testing standards and the cleanup levels to specify.

****

a. The soil shall contain no free liquid as demonstrated by EPA 530/F-93/004, Method 9095, paint filter liquids test.

b. The sum of benzene, toluene, ethyl benzene, and xylene (BTEX) concentrations shall be determined by using EPA 530/F-93/004, Method [5030/8020] [_____].

c. TPH (total petroleum hydrocarbons) concentrations shall be determined by using EPA 530/F-93/004, Method [8015] [_____], which has been modified for use with soil.

d. Material shall be tested for TOX (total organic halogens) in accordance with EPA 530/F-93/004, Method [9020] [_____].

e. Material shall be analyzed for full TCLP in accordance with EPA 530/F-93/004, Method [1311][_____] and for ignitability, corrosivity, and reactivity.

f. Material shall be tested for polychlorinated biphenyls (PCB's) in accordance with EPA 530/F-93/004, Method [8080] [_____].

g. Moisture content of the sample shall be determined in accordance with EPA Method 160.3.

h. [_____].

3.3.2.3 Disposal of Stockpiled Soils

a. Soils exhibiting TPH less than [100] [_____] ppm, BTEX less than [10] [_____] ppm, TOX less than [100] [_____] ppm, passing TCLP tests, and

testing negative for PCB's shall be considered clean as shall be disposed of [on-site] [on station] as directed by the Contracting Officer.

b. Soils failing the TCLP test or exhibiting TOX greater than [100] [_____] ppm shall be managed in accordance with [applicable State and local regulations] [_____]. Payment for disposal of materials failing the TCLP metals test or TOX test shall be made in accordance with the "CHANGES" clause of the General Conditions.

c. If the concentration of total BTEX is greater than [10] [_____] ppm or TPH greater than [100] [_____] ppm, the soil shall be treated and disposed of at a permitted soil recycling facility.

3.4 WELL INSTALLATION

Well installation shall be in accordance with ASTM D5092 and EPA 600-4-89-034, and as indicated on the well construction drawings submitted by the CPC and approved by the Contracting Officer. Borehole shall be stable and shall be verified straight before beginning installation.

3.4.1 Casings and Screens

Well casings, screens, plugs, and caps shall be decontaminated prior to delivery by the manufacturer and shall be certified clean. Materials shall be delivered, stored, and handled in such manner as to ensure that grease, oil, or other contaminants do not contact any portion of the well screen and casing assembly prior to installation. If directed by the Contracting Officer, the well screen and casing assembly shall be cleaned with high pressure water prior to installation. Personnel shall wear clean cotton or surgical gloves while handling the assembly. Centralizers shall be used to ensure that the well screen and casing assembly is installed concentrically in the borehole. When the assembly has been installed at the appropriate elevation, it shall be adequately secured to preclude movement during placement of the filter packs and annular seals. The top of the well casing shall be capped during filter pack placement.

3.4.2 Primary and Secondary Filter Packs

Primary and secondary filter packs shall be placed as indicated on the approved well construction drawings to fill the entire annular space between the screen and casing assembly and the outside wall of the borehole. Place both the primary and secondary filters with a tremie pipe in accordance with EPA 600-4-89-034 and ASTM D5092. Placement of the primary and secondary filters by gravity or free fall methods is not allowed. Control speed of filter placement to prevent bridging and to allow for settlement. Prior to commencement of work, equipment and methods required to place filters shall be approved by the Contracting Officer.

3.4.3 Bentonite Seal

Bentonite shall be placed as a slurry through a tremie pipe. Control speed of bentonite placement to prevent bridging or segregation of slurry. Additional water shall be added to the annular space as directed by the CPC to ensure complete hydration of the bentonite. Bentonite shall cure a minimum of 48 hours before the placement of cement grout to ensure complete hydration and expansion of the bentonite.

3.4.4 Neat Cement Grout

Cement grout shall be placed in the annular space above the bentonite seal as indicated on the well construction drawings. Cement grout shall be placed as a slurry through a tremie pipe, and injected under pressure to reduce chance of voids. Grout shall be injected in one continuous operation until full strength grout flows out at the ground surface without evidence of drilling cuttings or fluid. Cement grout shall cure a minimum of 48 hours before beginning well development operations.

3.4.5 Well Head Completions

Well head completions shall be as indicated and as specified herein.

3.5 WELL DEVELOPMENT

Well development shall be in accordance with EPA 600-4-89-034 and ASTM D5092 except as modified herein. Bailing, surging, and pumping/overpumping/backwashing are acceptable development methods. Air surging and jetting are prohibited. Method of development shall be chosen by the CPC and approved by the Contracting Officer. Well development shall not begin until the well installation is complete and accepted by the Contracting Officer. Well development operations shall be conducted continuously until development water flows clear and free of drilling fluids, cuttings, or other materials. At such time representative water samples shall be tested for pH, temperature, and specific conductivity in accordance with EPA 600/4-79/020. Samples shall be taken every 3 hours. When stabilized readings of these parameters, as accepted by the Contracting Officer, have been achieved for 12 consecutive hours, well development operations shall cease.

3.6 WATER FROM WELL DEVELOPMENT OPERATIONS

Water from the well development operations shall be containerized in accordance with State and local regulations. One sample shall be taken and analyzed for each required test for every [3780] [_____] liters [1000] [_____] gallons of stored water from well development operations.

3.6.1 Testing

****

NOTE: Testing standards and limits for contaminated water vary widely from state to state and from locality to locality. Designer must contact the appropriate State and local regulatory authorities to determine the testing standards and cleanup levels to specify.

****

a. The sum of benzene, toluene, ethyl benzene, and xylene (BTEX) concentrations shall be determined by using EPA 530/F-93/004, Method [8020] [_____].

b. TPH (total petroleum hydrocarbons) concentrations shall be determined by using EPA 530/F-93/004, Method [8015] [_____].

c. [_____].

3.6.2 Disposal of Containerized Water

a. Water exhibiting TPH less than [0.5] [_____] ppm and BTEX less than [1] [_____] ppb shall be considered clean and shall be disposed of [on-site] [on station] as directed by the Contracting Officer.

b. If the concentration of total BTEX is greater than [1] [_____] ppb or TPH greater than [0.5] [_____] ppm, the water shall be treated and disposed of at a permitted facility.

c. [_____].

3.7 TRANSPORTATION OF CONTAMINATED SOIL AND WATER

The Contractor shall be solely responsible for complying with Federal, State, and local requirements for transporting contaminated materials through the applicable jurisdictions and shall bear responsibility and cost for any noncompliance. In addition to those requirements, the Contractor shall do the following:

a. Inspect and document vehicles and containers for proper operation and covering.

b. Inspect vehicles and containers for proper markings, manifest documents, and other requirements for waste shipment.

c. Perform and document decontamination procedures prior to leaving the worksite and again before leaving the disposal site.

3.8 DISPOSAL OF CONTAMINATED SOIL AND WATER

Contaminated materials removed from the site shall be disposed of in a treatment/disposal facility permitted to accept such materials.

[3.9 INSTALLATION SURVEY

Upon completion of well installation and development and acceptance by the Contracting Officer therefore, the Contractor vertical [and horizontal] position of each well shall be determined by a registered land surveyor licensed in the State of [_____]. The survey shall document the vertical elevations of the top of the casing pipe and the ground surface elevation adjacent to each well. [The survey shall also determine the horizontal location of each well based on the [_____] coordinate system.] Survey shall be accurate to the nearest 3 mm .01 foot. This data shall be submitted with a well location map as the Installation Survey Report.

]3.10 CLEANUP

Upon completion of the well construction, remove debris and surplus materials from the jobsite.

-- End of Section --