

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT			1. CONTRACT ID CODE	PAGE OF PAGES	
			J	1	1
2. AMENDMENT/MODIFICATION NO. 0004	3. EFFECTIVE DATE 13-Sep-2004	4. REQUISITION/PURCHASE REQ. NO.		5. PROJECT NO.(If applicable) W912EQ-04-B-0008	
6. ISSUED BY US ARMY ENGINEER DISTRICT, MEMPHIS 167 N MAIN STREET B202 MEMPHIS TN 38103-1894	CODE W912EQ	7. ADMINISTERED BY (If other than item 6)		CODE	
		<b>See Item 6</b>			
8. NAME AND ADDRESS OF CONTRACTOR (No., Street, County, State and Zip Code)			X	9A. AMENDMENT OF SOLICITATION NO. W912EQ-04-B-0008	
			X	9B. DATED (SEE ITEM 11) 26-Mar-2004	
				10A. MOD. OF CONTRACT/ORDER NO.	
				10B. DATED (SEE ITEM 13)	
CODE			FACILITY CODE		
11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS					
<input checked="" type="checkbox"/> The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offer <input type="checkbox"/> is extended, <input checked="" type="checkbox"/> is not extended.					
Offer must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended by one of the following methods: (a) By completing Items 8 and 15, and returning <u>1</u> copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.					
12. ACCOUNTING AND APPROPRIATION DATA (If required)					
13. THIS ITEM APPLIES ONLY TO MODIFICATIONS OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.					
A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.					
B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(B).					
C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:					
D. OTHER (Specify type of modification and authority)					
E. IMPORTANT: Contractor <input type="checkbox"/> is not, <input type="checkbox"/> is required to sign this document and return _____ copies to the issuing office.					
14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.) This solicitation for Grand Prairie Pumping Station on the White River near De Valls Bluff, Prairie County, AR, scheduled to open bids on September 21, 2004 at 11:00 AM, is amended as follows:  The attached section 02521, entitled "Water Wells", is hereby added to this solicitation.					
Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.					
15A. NAME AND TITLE OF SIGNER (Type or print)			16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print)		
			TEL: _____ EMAIL: _____		
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA		16C. DATE SIGNED	
_____ (Signature of person authorized to sign)		BY _____ (Signature of Contracting Officer)		13-Sep-2004	

## DIVISION 02 – SITEWORK

## SECTION 02521

## WATER WELLS

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## SECTION 02521

## WATER WELLS

PART 1 - GENERAL

## 1.1 REFERENCES

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

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53/A 53M	(1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 139	(1996e1) Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)
ASTM C 150	(1999a) Portland Cement
ASTM D 2488	(1993e1) Description and Identification of Soils (Visual-Manual Procedure)
ASTM D 4750	(1987; R 1993e1) Determining Subsurface Liquid Levels in a Borehole or Monitoring Well (Observation Well)
ASTM D 5521	(1994e1) Guide for Development of Ground-Water Monitoring Wells in Granular Aquifers

## AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA EWW	(1999) Standard Methods for the Examination of Water and Wastewater
AWWA A100	(1997) Water Wells
AWWA B300	(1999) Hypochlorites
AWWA B301	(1992; Addenda B301a - 1999) Liquid Chlorine
AWWA C206	(1997) Field Welding of Steel Water Pipe
AWWA C654	(1997) Disinfection of Wells

## U.S. ARMY CORPS OF ENGINEERS (USACE)

COE TR GL-85-3	(1985) "Geotechnical Descriptions of Rock and Rock Masses," by William L. Murphy
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## 1.2 GENERAL REQUIREMENTS

The well shall be located as shown, and be constructed in accordance with these specifications. The water well shall be set with a minimum depth of 125 feet and shall be located in the sand formation (alluvial aquifer) capable of delivering the design flow as indicated on the drawings and herein. Each well shall be installed to prevent aquifer contamination by the drilling operation and equipment, intra- and inter-aquifer contamination, and vertical seepage of surface water adjacent to the well into the subsurface, especially the well intake zone.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are 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 01330 SUBMITTAL PROCEDURES:

### SD-03 Product Data

#### Well Installation Plan .

A plan as specified in paragraph WELL INSTALLATION PLAN describing the drilling methods, sampling, and well construction and well development 30 calendar days prior to beginning drilling operations. Mobilization activities may start prior to submittal of the plan. The plan shall be approved and signed by an experienced geologist as specified in paragraph QUALIFICATIONS.

#### Catalog Data; G .

Catalog data, and name of supplier, for well screens (to include the screen slot size), casing, riser pipe, filter pack material, bentonite, cement, centralizers, surface protective covers, well vaults, locking caps, airline oil filters for pneumatic drilling, dedicated sampling equipment, pumps, and chemical specifications on drill lubricants, tracers, disinfecting agents, and drill fluid additives, if used. Catalog data shall include any information, written or otherwise, supplied by the manufacturers or suppliers of the above listed items.

#### Qualifications .

Personnel qualification documentation.

#### Permits .

A copy of all permits, licenses, or other legal requirements necessary for execution of the work shall be furnished 30 working days before commencement of the work.

### SD-06 Test Reports

#### Well Development Records .

A well development record, for each well, within 30 working days of the completion of development.

Decommissioning/Abandonment Records .

A well decommissioning record, for each well, or test hole abandoned, within 10 working days of the completion of the abandonment procedure.

Tests; G .

Test Reports within 24 hours following the conclusion of each test.

#### 1.4 WELL INSTALLATION PLAN

The following requirements shall be incorporated into the Contractor's Well Installation Plan and followed in the field. The plan shall include, but shall not be limited to, a discussion of the following:

- a. Description of well drilling methods, and installation procedures, including any temporary casing used, placement of seal materials, drill cuttings and fluids disposal, and soil/rock sample disposition.
- b. Description of well construction materials, including well screen, riser pipe, centralizers, tailpiece (if used), bentonite, drilling fluid additives (if used), drilling water, cement, and well protective measures.
- c. Description of quality control procedures to be used for placement of seals in the boring, including depth measurements.
- d. Forms to be used for written boring logs, installation diagrams of wells, geophysical logs, well development records, well sampling data records, state well registration forms, and well abandonment records.
- e. Description of contamination prevention and well materials and equipment decontamination procedures.
- f. Description of protective cover surface completion procedures, including any special design criteria/features relating to frost heave prevention. The maximum frost penetration for the site shall be included in this description.
- g. Description of well development methods to be used.
- h. List of applicable publications, including state and local regulations and standards.
- i. List of personnel assignments for this project, and personnel qualifications.
- j. Description of well decommissioning/abandonment procedures.
- k. Description of well capacity testing techniques.
- l. Description and discussion of geophysical techniques to be employed at the site.

- m. Description of permanent pump to be installed, and discussion of pump operating tests to be employed at the site.
- n. Description of specific methods to be employed to control potential contamination or pollution arising from well installation activities.

## 1.5 QUALIFICATIONS

A geologist with at least 3 years experience in soil and rock logging, and well installation shall be on site and responsible for all drilling, well installation, developing and testing activities. The driller shall be licensed in the state of Arkansas, according to the state requirements. Geophysical log interpretation shall be done by a qualified log analyst. The log analyst shall be able to demonstrate competence through background, training, and experience when so called upon. The Contractor shall have a minimum of 5 years of well installation experience.

## 1.6 ABANDONMENT OF WELLS

If the Contractor fails to construct a well of the required capacity, or if the well is abandoned because of loss of tools, or for any other cause, the Contractor shall abandon the hole as specified in paragraph WELL DECOMMISSIONING/ABANDONMENT.

## 1.7 NOTIFICATION

The Contracting Officer shall be notified 10 days prior to drilling. The Contractor shall be responsible for contacting the State of Arkansas in accordance with the applicable reporting requirements. Before beginning work, the local United States Geological Survey office (USGS) and the state health department shall be notified of the type and location of wells to be constructed, the method of construction and anticipated schedule for construction of the wells.

## 1.8 DELIVERY, STORAGE, AND HANDLING

Well materials shall be stored and maintained in a clean, uncontaminated condition throughout the course of the project.

## 1.9 SITE CONDITIONS

Access to each well site, including any utility clearance, permits, licenses, or other requirements and the payment thereof necessary for execution of the work, is the responsibility of the Contractor. The Contractor shall visit each proposed well location to observe any condition that may hamper transporting equipment or personnel to the site. If clearing, or relocation is necessary, the Contractor and the Contracting Officer shall agree on a suitable clearing, or relocation plan, and the location of any required access road.

## PART 2 - PRODUCTS

### 2.1 CASING

All casing, screen, and other well material shall be of compatible materials to prevent galvanic reaction between components of the completed well.

### 2.1.1 Steel Casing and Couplings

Steel casing shall be new carbon steel, conforming to ASTM A 139 Grade B and shall be nominal 5 inch diameter, 0.258 inch wall thickness, as applicable. Joints shall be either threaded and coupled, or field welded in accordance with AWWA C206.

## 2.2 WELL SCREENS

Well Screens shall be a minimum of 4 inches nominal diameter, and shall be directly connected to the bottom of the inner casing by an approved method. The length of the screen shall be sufficient to provide an intake area capable of passing not less than the minimum required yield of the well, at an entrance velocity not exceeding 0.1 fps. The opening, or slot size of the screen, shall be determined by the Contractor designed based on analysis of the distribution of the grain size of the aquifer materials encountered during drilling be compatible with the material surrounding the screen, and shall be submitted for approval as part of the well installation plan. The well screen shall be of sufficient size and design to hold back and support the in-situ material surrounding the screen. The screen and all accessories required for satisfactory operation shall be essentially standard products of manufacturers regularly engaged in the production of such equipment. Field constructed screen is not acceptable. "Blanks" in the well screen may be utilized in nonproductive zones, or where centering devices are needed in the screened area, and shall be considered "casing." The bottom section, below the screen, shall be sealed watertight by means of a welded end cap of the same material as the well screen.

### 2.2.1 Metal Screen

Metal screen shall be of an approved wire-wound type and shall be type 304 or type 316 stainless steel, conforming to the applicable requirements of AWWA A100. A wire-wound screen manufactured with supporting bars or core of material different from the wire will not be acceptable. Joints shall be made of threaded couplings of the same material as the screens or by brazing or welding in accordance with AWWA C206.

## 2.3 BENTONITE SEAL

The bentonite seal shall consist of hydrated granular, or palletized, sodium montmorillonite furnished in sacks or buckets from a commercial source and shall be free of impurities which adversely impact water quality. If the bentonite seal is located above any borehole fluid levels, a layer of fine sand shall be placed at the top of the bentonite seal, to provide an additional barrier to any downward migration of sand.

## 2.4 CEMENT AND BENTONITE GROUT

### 2.4.1 Cement Grout

Cement grout shall consist of Portland cement conforming to ASTM C 150, Type I or II, sand and water. Cement grout shall be proportioned not to exceed 2 parts, by weight, of sand to 1 part of cement with not more than 6 gallons of water per 94 lb bag of Portland cement, with a mixture of such consistency that the well can be properly grouted. No more than 5 percent by weight of bentonite powder may be added to reduce shrinkage.

#### 2.4.2 Bentonite Grout

High-solids bentonite grout shall be made from sodium bentonite powder and/or granules. Water from an approved source shall be mixed with these powders or granules to form a thick bentonite slurry. The slurry shall consist of a mixture of bentonite and the manufacturer's recommended volume of water to achieve an optimal seal. The slurry shall contain at least 20 percent solids by weight and have a density of 9.4 lb/gallon of water or greater.

#### 2.5 PERMANENT PUMP

Permanent pump shall be an approved submersible type with a capacity sufficient to deliver 60 gpm. The pump shall be connected to the pump controls by a three-wire drop line. Piping for the well drop line shall be galvanized steel pipe conforming to ASTM A 53/A 53M. The pump shall operate on 460 volts, 60 Hz, 3-phase power, and the motor shall be of sufficient size to operate the pump under the maximum operating conditions without exceeding its rating. Pump shall be equipped with necessary controls to provide for automatic operation of the pump. The pump and motor unit shall be no larger than 4 inches in diameter at any point.

### PART 3 - EXECUTION

#### 3.1 PROTECTION OF EXISTING CONDITIONS

The Contractor shall maintain existing survey monuments and wells, and protect them from damage from equipment and vehicular traffic. Any items damaged by the Contractor shall be repaired by the Contractor. Wells requiring replacement due to Contractor negligence shall be re-installed according to these specifications. Wells scheduled for abandonment shall be protected from damage so that abandonment may be performed according to these specifications. Prior to excavation, the Contractor shall obtain written approval from the local utility companies to drill at each site, to avoid disturbing buried utilities.

#### 3.2 PREPARATION

##### 3.2.1 Water Source

If well drilling/installation requires the use of water, prior to its use at the site, the water source shall be sampled and tested, and approved by the Contracting Officer. The Contractor shall be responsible for locating the source, obtaining the water from the source, transporting it to, and storing it at the site. A water sample shall be obtained from the container used in transporting the water to the site before the water is used for decontamination. This sample shall be tested and approved in accordance with the above requirements.

#### 3.3 WELL CONSTRUCTION

The drilling method shall be as approved by the Contracting Officer and shall conform to all state and local standards for water well construction. The execution of the work shall be by competent workmen and shall be performed under the direct supervision of an experienced well driller. The drilling method shall prevent the collapse of formation material against the well screen and casing during installation of the well. The inside diameter of any temporary casing used shall be sufficient to allow accurate placement of the screen, riser, centralizer(s), seal and grout. Casing pipe, well screens, and joint couplings shall be of compatible materials throughout each well. The well shall be a naturally

developed well activated in the water-bearing stratum. The well shall be drilled straight, plumb, and circular from top to bottom. The well shall be initially drilled from the ground surface to the uppermost level of the water bearing strata and the bottom of the outer casing set at this elevation. The hole below the outer casing shall penetrate the water bearing stratum a sufficient depth to produce the required amount of water without causing excessive velocities through the aquifer. During construction of the wells, precautions shall be used to prevent tampering with the well or entrance of foreign material. Runoff shall be prevented from entering the well during construction. If there is an interruption in work, such as overnight shutdown or inclement weather, the well opening shall be closed with a watertight uncontaminated cover. The cover shall be secured in place or weighted down so that it cannot be removed except with the aid of the drilling equipment or through the use of drill tools.

### 3.3.1 Setting Outer Casing

The outer casing shall not be less than 8 inches in diameter. The hole shall be of sufficient size to leave a concentric annular space of not less than 2-1/2 inches and not more than 6 inches between the outside of the outer casing and the walls of the hole. The annular space between the outer casing and the walls of the holes shall be filled with cement grout. Acceptable methods of grouting are detailed in AWWA A100; the approved method shall specify the forcing of grout from the bottom of the space to be grouted towards the surface. A suitable grout retainer, packer, or plug shall be provided at the bottom of the inner casing so that grout will not leak into the bottom of the well. Grouting shall be done continuously to ensure that the entire annular space is filled in one operation. After grouting is completed, drilling operations shall not be resumed for at least 72 hours to allow proper setting of the grout.

### 3.3.2 Construction of Inner Casing and Screen

After the grout has set, the hole below the outer casing shall be reamed at the required diameter, to the required depth, by an approved method which will prevent caving of the hole before or during installation of the well screen and inner casing. The well screen and inner casing shall be firmly attached, and lowered into the hole by a method which will allow for control of the rate of fall of the well screen and inner casing at all times. Well screen and inner casing shall not be dropped or allowed to fall uncontrolled into the hole. The inner casing shall extend up through the outer casing to 1.5 feet above the ground surface. Approved centering devices shall be installed at a spacing of 120 degrees, between the outer casing and inner casing prior to well construction at [intervals not exceeding 25 feet along the length. If the screen length is greater than 8 feet, a 3 foot length of blank casing shall be placed in the middle of the screen interval for placement of centering devices. Centering devices shall not be placed on the screened interval, or within the bentonite seal, if used.

### 3.3.3 Bentonite Seal

After the inner casing and well screen have been installed, the annular space between the inner and outer casings shall be sealed by use of a bentonite seal. A minimum 3 foot thick hydrated bentonite seal shall be placed in a manner which prevents bridging of the bentonite in the annulus. The bottom of the bentonite seal shall be a minimum of 5 feet above the top of the well screen. The depth to the top of the bentonite seal shall be directly measured, and recorded immediately after placement, without allowance for swelling. If the bentonite seal is located above any borehole fluid levels, a 1 foot layer of fine sand shall be placed at the top of the bentonite seal.

### 3.3.4 Grout Placement

After the inner casing and well screen have been installed, a non-shrinking cement grout, shall be mechanically mixed in accordance with paragraph CEMENT AND BENTONITE GROUT, and placed by tremie pipe, in one continuous operation into the annulus between the inner and outer casings above the bentonite seal to the ground surface. Grout injection shall be in accordance with AWWA A100. If the casing interval to be grouted is less than 15 feet, and without fluids after any drill casing is removed, the grout may be placed either by pouring or pumping. The tremie pipe shall be thoroughly cleaned with high pressure hot water/steam before use in each well. The bottom of the tremie pipe shall be constructed to direct the discharge to the sides rather than downward. The discharge end of the tremie pipe shall be submerged at all times. Additional grout shall be added from the surface to maintain the level of the grout at the land surface as settlement occurs. Work shall not be conducted in the well within 24 hours after cement grouting. The alignment of the well shall be verified by passing a 5 foot long section of rigid PVC pipe 1/4 inch smaller in diameter than the inside diameter of the casing through the entire well. If the pipe does not pass freely, the well will not be accepted. The pipe section shall be thoroughly cleaned with high pressure hot water/steam prior to each test.

## 3.4 WELL DEVELOPMENT

Within 7 days of completion of each well, but no sooner than 48 hours after cement grouting is completed, the well shall be developed. The well shall be developed in accordance with the Well Installation Plan, by approved methods until the water pumped from the well is substantially free from sand, and until the turbidity is less than 5 on the Jackson Turbidity Scale specified in AWWA EWW. Developing equipment shall be of an approved type and of sufficient capacity to remove all cutting fluids, sand, rock cuttings, and any other foreign material. The well shall be thoroughly cleaned from top to bottom before beginning the well tests. Development shall be performed using only mechanical surging, over pumping, or jetting, or a combination thereof per ASTM D 5521. Details of the proposed development method shall be included in the Well Installation Plan. At the time of development of any well, the well shall be free of drawdown or surcharge effects due to pump testing, developing or drilling at another location. The Contractor shall be responsible for maintaining at the well site the needed access and work area and clearance, necessary to accomplish development. The Contractor shall furnish, install, or construct the necessary discharge line and troughs to conduct and dispose of the discharge a sufficient distance from the work areas to prevent damage. Development shall be conducted to achieve a stable well of maximum efficiency and shall be continued until a satisfactory sand test, as specified in paragraph Sand Test, is obtained. The Contractor shall provide an open tube or other approved means for accurately determining the water level in the well under all conditions. If, at any time during the development process it becomes apparent in the opinion of the Contracting Officer that the well may be damaged, development operations shall be immediately terminated. The Contracting Officer may require a change in method if the method selected does not accomplish the desired results. The Contracting Officer may order that wells which continue to produce excessive amounts of fines after development for 6 hours be abandoned, plugged, and backfilled, and may require the Contractor to construct new wells nearby. All materials pulled into the well by the development process shall be removed prior to performing the pumping test.

### 3.4.1 Jetting

Jetting should be performed using either a single or double ring jet. If a double ring jet is used the rings should be 2 feet apart. The jetting tool shall be constructed of high-strength material and conservatively designed and proportioned so that it will withstand high pressures. The jetting tool shall have two 3/8 inch diameter hydraulically balanced nozzles spaced 180 degrees apart and which shall exert the jetting force horizontally through the screen slots. The rings shall be constructed such that the

tips of the jets shall be within 1/2 inch from the inner surface of the well screen. The pump used in conjunction with the jetting tool shall be capable of providing pressures up to 250 psi. Prior to commencing jetting, and following each jetting cycle, all sand and/or other materials shall be removed from inside the screen. The jetting process shall start at the bottom of the screen and consist of rotating the jetting tool slowly while rotating the pipe 180 degrees for two minutes at each location then raising the pipe 6 inches. All wells, more than 4 inches in diameter, shall be pumped during the jetting cycle to remove incoming sand and other material. Such pumping shall be at a rate not less than 115 percent of the rate at which fluid is introduced through the jetting tool. This will allow a flow of material into the well as it is being developed. Water used for development shall be free of sand. The contracting officer may require other means of developing the well such as intermittent pumping method, variation of the intermittent pumping method, or surge block if it appears that the development of the well is not producing the desired results.

### 3.4.2 Well Development Criteria

A well development record shall be maintained in accordance with paragraph Well Development Records. Development is complete when all of the following criteria are met:

- a. Well water is clear to the unaided eye,
- b. Sediment thickness in the well is less than 1 percent of the screen length,
- c. A minimum of three times the standing water volume in the well is removed plus three times the volume of all added water and drilling fluid lost during drilling and installation of the well is removed, and

### 3.5 TESTS

After the wells have been developed, the Contractor shall notify the Government and shall make the necessary arrangements for conducting the capacity tests. If the capacity test indicates that the required capacity can be obtained, the tests for quality of water shall be made. If the capacity and quality tests indicate that the required capacity and quality can be obtained, the permanent well, as specified, shall be completed at that depth. Prior to making quality tests, drilling equipment, tools and pumps contacting well water shall be cleaned with live steam.

#### 3.5.1 Capacity Test

The Contractor shall furnish and install an approved temporary test pump, with discharge piping of sufficient size and length to conduct the water being pumped to point of discharge, and equipment necessary for measuring the rate of flow and water level in the well. An 8 hour constant-rate capacity test shall be run with the pumping rate and drawdown at the pump well and observation wells recorded every 30 minutes. The test shall begin at the rate of 60 gpm and at least that rate maintained throughout the duration of the test. If this capacity cannot be maintained for the test period, the capacity test shall be terminated and the test hole drilled deeper or relocated as directed. When the pump is shut off, water level readings shall be taken during the rebound period for the same intervals of time as the drawdown test. The record of the test, in triplicate, shall be delivered to the Contracting Officer.

### 3.5.2 Test for Plumbness and Alignment

Upon completion of the permanent well, plumbness and alignment shall be tested by lowering into the well, to the total depth of the well, a plumb 40 feet long or a dummy of the same length. The outer diameter of the plumb shall not be more than 1/2 inch smaller than the diameter of that part of the hole being tested. If a dummy is used, it shall consist of a rigid spindle with three rings, each ring being 12 inches wide. The rings shall be cylindrical and shall be spaced one at each end of the dummy and one in the center. The central member of the dummy shall be rigid so that it will maintain the alignment of the axis of the rings. If the plumb or dummy fail to move freely throughout the length of the casing or well screen for the depth of well or should the well vary from the vertical in excess of two-thirds the inside diameter of that part of the well being tested for each 100 feet of depth, the plumbness and alignment of the well shall be corrected by the Contractor. If the faulty alignment and plumbness is not correctable, as determined by the Contracting Officer, the well shall be abandoned as specified in paragraph WELL DECOMMISSIONING/ABANDONMENT and a new well drilled at no additional cost to the Government.

### 3.5.3 Test for Quality of Water

When the capacity test in the test hole has been completed, and again after the yield in the permanent well and drawdown test or capacity test have been completed, the Contractor shall secure samples of the water in suitable containers, and of sufficient quantity, to have bacterial, physical, and chemical analyses made by a recognized testing laboratory, except that the bacterial analysis may be made by the applicable State Board of Health, if desired. Water Quality Analysis shall address each item specified in the Water Quality Analysis Table at the end of this section. Expenses incident to these analyses shall be borne by the Contractor and the results of the analyses shall be furnished to the Contracting Officer. All sampling and analyses shall be performed using EPA and State approved methods, procedures, and holding times.

### 3.5.4 Sand Test

As part of each capacity test, or at the end of each intermittent pumping, a determination of the amount of sand a well is producing shall be performed. Prior to starting the sand test all material shall be removed from the bottom of the tailpipe. The Contractor shall test each well by pumping at a rate sufficient to produce approximately 5 feet of draw-down. After the pump is at the desired pumping rate the flow from the discharge shall be diverted into a container that will collect all the sand being carried by the water. Development of the well is satisfactory if the amount of sand collected is less than 1 pint per 25,000 gallons of water pumped at the specified rate. Upon completion of the test the amount of sand in the tailpipe shall be determined to verify that no material is being deposited in the bottom of the well.

## 3.6 INSTALLATION OF PERMANENT PUMP

The permanent well pump shall be installed in the well at a minimum depth of 25 feet below the maximum drawdown groundwater level after the drawdown test has been completed. The pump shall be secured at the required elevation as recommended by the pump manufacturer. After installation of the pumping units and appurtenances is complete, operating tests shall be carried out to assure that the pumping installation operates properly. Tests shall assure that the pumping units and appurtenances have been installed correctly, that there is no objectionable heating, vibration, or noise from any parts, and that all manual and automatic controls function properly.

### 3.7 DISINFECTING

After completion of tests of well, or installation of permanent pump, or at time of tests for yield and drawdown test, whichever is later, the wells shall be disinfected by adding chlorine, conforming to AWWA B301, or hypochlorite, conforming to AWWA B300, in sufficient quantity so that a concentration of at least 50 ppm of chlorine shall be obtained in all parts of the well. Chlorine solution shall be prepared and introduced into the well in an approved manner and shall remain in the well for period of at least 12 hours but not more than 24 hours. Information on methods for preparing chlorine solution and introducing it into the well may be found in AWWA C654. After the contact period, the well shall be pumped until the residual chlorine content is not greater than 1.0 ppm. The well shall be pumped to waste for an additional 15 minutes with less than 1 ppm chlorine residual after which two samples shall be taken not less than 30 minutes apart and tested for the presence of coliform bacteria. The well shall be disinfected and reinfected as may be required until two consecutive samples of water are found upon test to be free from Coli Acrogenes group of organisms.

### 3.8 PUMPCOVER AND SLAB

Pumpcover and slab shall be constructed preventing the infiltration of surface water or precipitation into the well. The slab shall be 2 feet square by 6 inches thick and constructed of reinforced concrete. The top of the outer casing shall extend 18 inches above the top of the slab. The top of the slab shall be at elevation 189.0 or higher. The pumpcover shall be constructed on the slab and thermally insulated.

### 3.9 SITE CLEAN-UP

After completion of the work, tools, appliances, surplus materials, temporary drainage, rubbish, and debris incidental to work shall be removed. Excavation and vehicular ruts shall be backfilled and dressed to conform with the existing landscape. Utilities, structures, roads, fences, or any other pre-existing item which must be repaired or replaced due to the Contractor's negligence shall be the Contractor's responsibility; repair or replacement shall be accomplished prior to completion of this contract.

### 3.10 DRILLING WASTE DISPOSAL

Slurry, drill cuttings, rock core; other solid or liquid material bailed, pumped, or otherwise removed from the borehole during drilling, installation, completion, and well development procedures; and fluids from material/equipment decontamination activities shall be disposed of by the Contractor.

### 3.11 WELL DECOMMISSIONING/ABANDONMENT

Any well disapproved by the Contracting Officer, or any well decommissioned/abandoned by the Contractor for any reason shall be decommissioned/abandoned according to the requirements of the State of Arkansas and the requirements of these specifications. Well decommissioning/abandonment includes the removal of all materials left in the borehole/well, excluding the filter pack, and including backfill materials, casing, screen, and any other material placed into the hole before the decision was made to abandon the borehole/well. Test holes decommissioned/abandoned for any reason shall be grouted from the bottom to within 4 feet of the top of the ground surface according to the protocol for grout/bentonite placement established in paragraph Grout Placement, using the grout mix specified in paragraph CEMENT AND BENTONITE GROUT. The top 4 feet shall be backfilled with material appropriate for the intended land use. The Contractor shall maintain a well decommissioning/abandonment record as specified in paragraph Well Decommissioning/Abandonment Records. Groundwater levels, if encountered before the decision is made for decommissioning/abandonment,

shall be measured in all borings prior to backfilling. These water levels shall be included in the well decommissioning/abandonment records. No well shall be decommissioned/abandoned without the approval of the Contracting Officer.

### 3.12 DOCUMENTATION AND QUALITY CONTROL REPORTS

The Contractor shall establish and maintain documentation and quality control reports for well construction and development to record the desired information and to assure compliance with contract requirements, including, but not limited to, the following:

#### 3.12.1 Borehole Logs

A borehole log shall be completed for each boring drilled. Borehole logs shall be prepared by the geologist present onsite during all well drilling and installation activities. The log scale shall be 1 inch equals 5 feet. Copies of complete well logs shall be kept current in the field at each well site and shall be available at all times for inspection by the Contracting Officer. Information provided on the logs shall include, but not be limited to, the following:

- a. Name of the project and site.
- b. Boring/well identification number.
- c. Location of boring (coordinates, if available).
- d. Make and manufacturer's model designation of drilling equipment and name of drilling firm.
- e. Date boring was drilled.
- f. Reference data for all depth measurements.
- g. Name of driller and name and signature of geologist preparing log.
- h. Nominal hole diameter and depth at which hole diameter changes.
- i. Total depth of boring.
- j. Method of drilling, including sampling methods and sample depths, including those attempted with no recovery. Indication of penetration resistance such as drive hammer blows given in blows per 6 inches of driven sample tubes. Information shall include hammer weight and drop distance. Information such as rod size, bit type, pump type, etc., shall be recorded. A description of any temporary casing used, drill fluids and fluid additives used, if any, including brand name and amount used, along with the reason for and start (by depth) of its use shall be included. If measured, mud viscosities and weight shall be recorded.
- k. Depth of each change of stratum. If location of strata change is approximate, it shall be so stated.
- l. Description of the material of which each stratum is composed, in accordance with ASTM D 2488, and/or standard rock nomenclature in accordance with COE TR GL-85-3, as necessary. Soil parameters for logging shall include, but shall not be limited to, classification, depositional environment and formation, if known, Unified Soil Classification Symbol,

secondary components and estimated percentages, color, plasticity, consistency (cohesive soil), density (non-cohesive soil), moisture content, structure and orientation, and grain angularity. Rock core parameters for logging shall include, but shall not be limited to, rock type, formation, modifier denoting variety (shaly, calcareous, siliceous, etc.), color, hardness, degree of cementation, texture, crystalline structure and orientation, degree of weathering, solution or void conditions, primary and secondary permeability, and lost core. The results of any chemical field screening shall also be included on the boring log. Classification shall be prepared in the field at the time of sampling. The results of visual observation of the material encountered, and any unusual odor detected shall also be duly noted and recorded.

- m. Depth of any observed fractures, weathered zones, or any abnormalities encountered.
- n. Depth and estimated percent of drill fluid loss or lost circulation. Measures taken to regain drill water circulation. Significant color changes in the drilling fluid return.
- o. Depth to water and date measured before, during, and after each drilling shift, and prior to well installation. The method of measuring the liquid level shall be noted on the boring log. Water level measurements shall be taken to the nearest 0.01 foot. It shall be noted on the boring log if the boring was purged and allowed to recover at intervals during the installation , or that water used in drilling was allowed to dissipate into the formation prior to measuring the water level.
- p. Box or sample number. Depths and the number of the core boxes and/or samples shall be recorded at the proper interval.
- q. Percent Rock Core Recovery. The percent core recovery for the individual drill runs, if rock is cored, shall be shown.

### 3.12.2 Installation Diagrams

The well will not be accepted before the geologic logs and installation diagrams are received. The diagram shall illustrate the as-built condition of the well and include, but not be limited to, the following items:

- a. Name of the project and site.
- b. Well identification number.
- c. Name of driller and name and signature of the geologist preparing diagram.
- d. Date of well installation.
- e. Description of material from which the well is constructed, including well casing/riser pipe and screen material, centralizer composition, if used, diameter and schedule of casing and screen, bentonite seal type (pellets, granules, chips, or slurry), grout type (cement or high-solids bentonite) and type of protective cover (protective casing or flush-to-ground), if used.
- f. Total depth of well.
- g. Nominal hole diameter.

- h. Depth to top and bottom of screen.
- i. Depth to top and bottom of any seals installed in the well boring (grout or bentonite).
- j. Type of cement and/or bentonite used, mix ratios of grout, method of placement and quantities used.
- k. Elevations/depths/heights of key features of the well, such as top of well casing/riser pipe, top and bottom of protective casing (if used), ground surface, the depth of maximum frost penetration (frost line), bottom of well screen, top and bottom of filter pack, and top and bottom of seal.
- l. Other pertinent construction details, such as slot size and percent open area of screen, type of screen, and manufacturer of screen.
- m. Well location by coordinates. A plan sheet shall also be included showing the coordinate system used and the location of each well. A plan sheet is not required for each well installation diagram; multiple wells may be shown on the same sheet.
- n. Static water level upon completion of the well.
- o. Special problems and their resolutions; e.g., grout in wells, lost casing, or screens, bridging, etc.
- p. Description of surface completion.

### 3.12.3 Well Development Records

A well development record shall be prepared for each well installed under the supervision of the geologist present during well installation operations. Information provided on the well development record shall include, but not be limited to, the following:

- a. Date, time, and elevation of water level in the well, before development.
- b. Depth to bottom of well, name of project and site, well identification number, and date of development.
- c. Method used for development, to include size, type and make of equipment, bailer, and/or pump used during development.
- d. Time spent developing the well by each method, to include typical pumping rate, if pump is used in development.
- e. Volume and physical character of water removed, to include changes during development in clarity, color, particulates, and odor.
- f. Volume of water added to the well, if any.
- g. Volume and physical character of sediment removed, to include changes during development in color, and odor.

- h. Source of any water added to the well.
- i. Clarity of water before, during, and after development. Nephelometric turbidity unit (NTU) measurements.
- j. Total depth of well and the static water level as per ASTM D 4750 from top of the casing, immediately after pumping/development, and 24 hours after development.
- k. Name and job title of individual developing well.
- l. Name and/or description of the disposal facility/area, for the waters removed during development.

#### 3.12.4 Well Decommissioning/Abandonment Records

Decommissioning/abandonment records shall include, as a minimum, the following:

- a. Project name.
- b. Well or test hole number.
- c. Well/boring location, depth and diameter.
- d. Date of decommissioning/abandonment.
- e. Method of decommissioning/abandonment.
- f. All materials used in the decommissioning/abandonment procedure and the interval in which test materials were placed.
- g. Casing, and or other items left in hole by depth, description, and composition.
- h. Description and total quantity of grout used initially.
- i. Description and daily quantities of grout used to compensate for settlement.
- j. Water or mud level (specify) prior to grouting and date measured.
- k. The reason for decommissioning/abandonment of the well/test hole.

### WATER QUALITY ANALYSIS TABLE

#### Physical Characteristics

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Color  
Taste  
Threshold odor number  
Turbidity

Resistivity in ohms per cubic  
centimeter and 25 degrees C.  
pH value  
Temperature

Chemical Characteristics (Expressed as mg/L)

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Arsenic	Total Hardness as CaCO(3)
Barium	Endrin
Cadmium	Lindane
Chromium	Methoxychlor
Copper	Toxaphene
Lead	2-4-D
Mercury	2, 4, 5 TP Silvex
Selenium	Total Organic Halogens
Silver	TOC
Zinc	Sulphates as SO(4)
Fluoride as F	Chlorides as Cl
Manganese as Mn (dissolved and total)	Bicarbonates as HCO(3)
Iron as Fe (dissolved and total)	Carbonates as CO(3)
Suspended Solids	Nitrates as NO(3)
Total Dissolved Solids	Alkalinity (methyl-orange)
Calcium as Ca	(Phenolphthalein) as CaCO(3)
Magnesium as Mg	Silica as SiO(2)
Sodium and Potassium as Na	

End of Section