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USACE / NAVFAC / AFCEC **UFGS-33 26 00.00 10 (February 2026)**

Preparing Activity: USACE **Superseding**
UFGS-33 26 00.00 10 (April 2008)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated April 2026
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RELIEF WELLS

02/26

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SECTION 33 26 00.00 10

RELIEF WELLS
02/26

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NOTE: This guide specification covers the requirements for relief wells (except materials and equipment specified to be furnished by the Government) to be constructed near dams, levees, floodwalls, or lock chambers to relieve the excess hydrostatic pressures created by the presence of pervious strata close to the surface. This section was originally developed for USACE Civil Works projects, but it can also be adapted for temporary applications such as dewatering of excavations during construction of other project features.

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 item(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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PART 1 GENERAL

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NOTE: Relief wells should be constructed of materials which will resist corrosion when installed and should, where practicable, be designed to have a service life equal to that of the structure they are designed to protect. Most often this will be stainless steel. Factors to be considered in

determining selection of material for wells are:

1. **Operating conditions of wells,**
2. **Corrosive characteristics of soil and water,**
3. **Method of installations,**
4. **Size and depth of wells,**
5. **Type of joints, and**
6. **External pressures on well casings.**

The riser pipe and screen should be designed in all cases to withstand, with a suitable factor of safety, the crushing pressures at depths to which wells extend. Design of relief wells to be constructed under structures must consider loads that will be induced into the well pipe due to structural settlement. The wells, including screen and riser pipe, should have a diameter which will permit the maximum design flow without excessive head losses but in no instance should the inside diameter be less than 150 mm 6 inches. Most often the diameter will be 200 mm 8 inches to 300 mm 12 inches. Pumping tests should be considered when choosing screen diameter. The size of pump that can produce the desired flow rate during a test should be checked that it can fit within the well. Based on design parameters it may require the designer to include a minimum collapse strength for the pipe and well screen and a minimum clear inside diameter through the fittings and screen to allow the installation of pumps at a later date.

Because of the large variation in design and wall thickness of the different types of well screen, no generic specifications have been included. For large contracts, specific necessary characteristics should be presented in detail. References to manufacturers should be eliminated.

Information on the design of filter packs, screen slot sizes, and relief wells can be found in the Engineering Manual EM 1110-2-1914, "Design, Construction, and Maintenance of Relief Wells". The filter criteria specified in EM 1110-2-1901 "Seepage Analysis and Control for Dams" and/or FEMA "Filters for Embankment Dams - Best Practices for Design and Construction" should be used to determine the gradation band of the filter material. To minimize segregation during installation of the filter pack, the filter should have a relatively uniform grain-size distribution band.

The filter material should have a minimum thickness of 100 mm 4 inches to 150 mm 6 inches for uniformly graded filters and 150 mm 6 inches to 200 mm 8 inches for well-graded filters measured radially from the outer circumference of the screen section, and its gradation should depend upon the gradation of the strata being drained. Laboratory tests should be performed to determine representative gradations of

the foundation soils that will be adjacent to a screen.

Because of the high potential for clogging by migrating fines or chemical precipitate, geotextiles are not to be used to protect relief well screens.

In adapting this specification to any project the form and phraseology should be changed as necessary to properly specify the work contemplated. Changes should be made in the original form to the extent required to adapt the guide specification to local conditions. Work such as concrete for backfill, painting of exposed metal surfaces and seeding of construction areas will have to be specified in this section when such sections cannot be referenced as a part of the contract.

For projects on which subsurface information is not sufficiently developed to permit detailed design of each well, a section should be added to the specifications requiring the drilling of a small diameter pilot hole within 1.5 meter 5 feet of the location of each well. Pilot holes should be sampled and logged in to provide continuous gradations of pervious zones and the depths between which screens should be set. The specifications should require that samples of pervious materials be taken at a maximum interval of 750 mm 2.5 feet. Grain-size distribution tests should be performed to provide a basis for the design of the filter pack and the screen openings. Samples taken by fishtail drilling and other wash boring methods will not be permitted. Where the subsurface information previously obtained is sufficient, pilot holes are not required.

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1.1 UNIT PRICES

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NOTE: If Section 01 20 00 PRICE AND PAYMENT PROCEDURES is included in the project specifications, this paragraph title (UNIT PRICES) should be deleted from this section and the remaining appropriately edited subparagraphs below should be inserted into Section 01 20 00.

There is one pay item for pump tests. However, the designer may choose to use two pay items. One would be for the standard amount of testing that is expected, and the second for any extra pumping tests that may be found to be necessary during construction. This could be necessary because extra pumping tests may require remobilization, etc.

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1.1.1 Relief Wells

1.1.1.1 Payment

Payment will be made for costs associated with relief wells, which price will constitute full compensation for construction of relief wells. Wells ordered abandoned by the Contracting Officer before installation of well screen and riser due to no fault of the Contractor will be paid for at [_____] percent of the contract unit price per linear meter foot, for Bid Item "Relief Wells". Wells ordered abandoned by the Contracting Officer due to no fault of the Contractor will be paid for at the full Contract unit price for Bid Item "Relief Wells".

Separate payment will not be made for relief well screen, riser, check valves, filter pack, development, backfill, discharge, or outfall pipes. Payment will not be made for:

a. Placement or replacement of temporary casings.

b. Repair of damage resulting from Contractor operations.

c. Wells that the Government considers to be abandoned due to Contractor fault or neglect.

1.1.1.2 Measurement

Relief wells will be measured for payment by the linear meter foot of completed well from the top of riser to the well screen bottom plug. Wells ordered abandoned by the Contracting Officer, due to no fault of the Contractor, will be measured for payment.

1.1.1.3 Unit of measure

Unit of measure: linear meter foot.

1.1.2 Pump Tests

1.1.2.1 Payment

Payment will be made for costs associated with successful pumping tests, including pump installation and removal. No payment will be made for pumping tests not successfully completed.

1.1.2.2 Measurement

Pumping tests will be measured for payment for each hour, measured to the nearest 15 minutes, of pumping test successfully performed as specified in Paragraph PUMPING TEST and as otherwise directed. Testing time will not include time required to place and remove testing and pump equipment.

1.1.2.3 Unit of measure

Unit of measure: per hour.

[1.1.3 Pilot Hole Borings

1.1.3.1 Payment

Payment will be made for costs associated with drilling, sampling, and

testing of exploratory pilot hole borings performed in accordance with Section 02 32 13 SUBSURFACE DRILLING AND SAMPLING.

1.1.3.2 Measurement

Pilot hole borings will be measured for each linear meter foot of drilling.

1.1.3.3 Unit of measure

Unit of measure: linear meter foot

][1.1.4 Pump Installation and Removal

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NOTE: Use this Paragraph if a pump will be installed in a more permanent application, such as construction dewatering. For pumping tests after relief well installation, pump installation/removal is typically included with payment for the pumping tests.
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1.1.4.1 Payment

Payment will be made for costs associated with installation and removal of the pumps used in pay item "Pumping Tests". No payment will be made for pump removal where pump test was not successfully completed.

1.1.4.2 Measurement

Pump installation and removal for pump test will be measured for each relief well tested.

1.1.4.3 Unit of measure

Unit of measure: each.

]1.2 SCOPE

The work covered by this Section consists of furnishing the plant, labor, material, and equipment, and performing the operations required for proper installation of relief wells as specified or indicated. This work includes:

[a. Drilling pilot hole borings.

b. Analyzing pilot hole soil samples.

] c. Drilling well boreholes.

d. Assembling wells in accordance with the Drawings and Specifications.

e. Hanging the wells in the boreholes.

f. Placing the filter packs.

g. Sealing the boreholes.

h. Installing the well discharge or flow collection features.

i. Well protection features.

j. Other incidental work.

1.3 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 Reference Identifier (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.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA A100	(2020) Water Wells
AWWA B100	(2025) Granular Filter Material

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2025) Structural Welding Code - Steel
AWS D1.2/D1.2M	(2014; Errata 1 2014; Errata 2 2020) Structural Welding Code - Aluminum
AWS D10.18M/D10.18	(2018) Guide for Weidling Ferritic/Austenitic Duplex Stainless Steel Piping and Tubing

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M	(2024) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A276/A276M	(2025) Standard Specification for Stainless Steel Bars and Shapes
ASTM A312/A312M	(2022a) Standard Specification for

	Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM C94/C94M	(2026) Standard Specification for Ready-Mixed Concrete
ASTM C136/C136M	(2025) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C387/C387M	(2023) Standard Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar
ASTM D75/D75M	(2019) Standard Practice for Sampling Aggregates
ASTM D1784	(2025) Standard Classification System and Basis for Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D1785	(2021) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D2240	(2015; R 2021) Standard Test Method for Rubber Property - Durometer Hardness
ASTM D2466	(2023) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D2467	(2020) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2564	(2020) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 1110-2-1914	(2025) Design, Construction, and Maintenance of Release Wells

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, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified 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 Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters 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 and Air Force projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

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Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Installation Plan; G, [_____]

Welder Qualification and Procedures; G, [_____]

SD-02 Shop Drawings

Drill Fluid Pit Systems; G, [_____]

Centering Devices and Alignment Tools; G, [_____]

Surge Block; G, [_____]

SD-03 Product Data

Well Screen and Riser Pipe; G, [_____]

Filter Pack; G, [_____]

Sealing Material Mixture Proportion; G, [_____]

Drilling Fluids; G, [_____]

Steel Casing; G, [_____]

Gasket ; G, [_____]

SD-06 Test Reports

Pilot Hole Boring Logs; G, [_____]

Pilot Hole Laboratory Tests; G, [_____]

Pumping Test Report; G, [_____]

ENG Form 6318; G, [_____]

Alignment And Plumbness Test

SD-11 Closeout Submittals

Video Inspection; G, [_____]

Well Installation Diagrams

1.5 QUALITY CONTROL

1.5.1 Installation Plan

Submit plan to include, at a minimum:

a. Locating relief wells in the field.

[b. Pilot hole drilling method.

] c. Proposed method for drilling.

d. Proposed drilling fluids, materials, mix designs, fluid delivery and pressure monitoring methods, and fluid cleaning (i.e., de-sanding) methods and equipment.

e. Coupling well screeen and riser sections together.

f. Placement of centralizers.

g. Installing the well screen and riser.

h. [Temporary][and][permanent] casing plan.

i. Methods for placing filter pack, bentonite, and grout.

j. Well development.

k. Trimming of riser pipe.

l. Installation of check valves.

m. Installation of well housing and outlet piping.

n. Well sterilization.

o. Backfilling.

p. Shop drawings showing the type of screen and size; slot size, shape and pattern; bottom plug material; and installation detail.

q. Planned sequence of well installation with an explanation of crews and

equipment proposed for work.

r. Documentation of the experience for each driller, Professional Engineer and Geologist staff, and drill rig type.

s. Pumping test methods and equipment, including the pump, motor, sand test sampler and method, water level measurement, discharge location, and discharge measurement.

t. Discharge sand Sampler.

Contractor-proposed substitutes or alternates in material construction details or methods must be presented in the shop drawings. No phase of the work will be initiated until the part of the installation plan concerning that phase has been approved.

1.5.2 Inspection

Ensure relief well operations conform to this Section, including but not limited to:

a. Survey for location and elevations.

b. Materials.

c. Drilling method.

d. Drilling fluid (type, weight, viscosity).

e. Joints.

f. Bottom plug.

g. Materials storage.

h. Well screen.

i. Well pipe assembly and installation.

j. Filter pack and grout placement.

k. Well cleaning.

l. Development.

m. Pumps.

n. Pumping tests.

o. Control of drilling fluids and well effluents.

p. Restoration of construction area.

q. Site safety.

Protect the completed wells against damage and contamination. Perform well installation and pumping tests in the presence of the Contracting Officer. At least five days in advance of the drilling, provide the Contracting Officer with a detailed schedule including the dates, shift

times, and number of shifts.

1.5.3 Welder Qualification and Procedures

Submit documentation certifying that the welders, welding operators, and tackers are qualified in accordance with the American Welding Society Standards covering the welding of stainless steel pipe, including but not limited to AWS D1.1/D1.1M or AWS D10.18M/D10.18.

1.5.4 Sampling, Testing, and Documentation

The results and documentation of each of these is considered an essential component of the work prescribed in this Section. Deliver the results in a timely manner and in the required format, organized, complete, accurate, and neat. Keep the test results and well construction documentation current and make the information available to Government immediately upon request.

1.6 PROJECT/SITE CONDITIONS

1.6.1 Location

Locate each well at the location shown, offsetting as needed to avoid obstructions. Offsets greater than 1.5 meters 5 feet require the written approval of the Contracting Officer. Mark the proposed well location in the field for inspection prior to drilling.

1.6.2 Well Component Elevations

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NOTE: Use the first bracketed option when pilot hole borings and analysis have been completed and final design of well screens and filter packs is already complete. Use the second bracketed option when the Contractor must drill pilot holes, so the Government may review the data and possibly adjust the screen design.

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[The length of well screen, length of riser pipe and the well discharge elevation must conform to the schedule shown in the Drawings.][The length of well screen, length of riser pipe, and the well discharge elevation shown in the Drawings is approximate and will be finalized by the Contracting Officer based on pilot hole logs and test results submitted by the Contractor.]

PART 2 PRODUCTS

2.1 DRILLING FLUIDS

[Potable water must be used as the drilling fluid for wells.]Water must be considered as the first alternative for drilling fluid. Water additives are limited to a liquid polymer emulsion (LPE) that can be broken down by adding a chlorine solution and removed from the filter pack during development. Do not use bentonite in the drilling fluid. If drilling fluid additives are to be used when placing the wells, submit product data sheet for the proposed drilling fluid. State why additives must be used and detail clean out methods so that the drilling fluid does not reduce well effectiveness.

Locate or provide a suitable water source for use in drilling each well. Providing water for drilling will be considered incidental to the drilling process and must be performed by the Contractor at no additional cost to the Government. Existing relief wells or piezometers, whether fully developed or not, may be used as a water source unless the Contracting Officer states otherwise.

2.2 WELL SCREEN

Provide well screen of the type and dimensions indicated. Submit the proposed well screen and riser pipe prior to installation. Screen openings must be uniform in size and pattern, and spaced equally around the circumference of the pipe.

2.2.1 Stainless Steel Well Screens

Fabricate permanent well screens and fittings entirely from stainless steel conforming to ASTM A312/A312M, Type 304, 304-L, 316, or 316-L. Provide stainless steel well screens with a keystone (v-wire) wire-wrapped continuous slot. The well screens, pipes, and fittings must have a minimum collapse strength of [_____]. The screen, pipe, and fittings must have a clear inside diameter of [_____] centimeters (cm) [_____] inches .

2.2.1.1 Couplings

Provide couplings for the stainless steel well screen consisting of the same material as the well screen and thread or fit with a welding ring. Provide couplings recommended by the manufacturer of the well screen.

2.2.1.2 Slots

Provide well screens with a[Number [_____] slot][[_____] millimeter (mm) [_____] inch wide opening]. Provide a total opening of no less than [_____] square cm per meter [_____] square inches per foot of well screen.

2.2.1.3 Angular Face Rings

Provide angular face rings conforming to ASTM A276/A276M and made from the same stainless steel alloy as the riser pipe. The dimensions of the angular face rings must be as shown.

[2.2.2 PVC Pipe Screen

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NOTE: PVC is recommended as screen/riser material only for temporary applications, such as for dewatering wells during construction or temporary observation wells. PVC is not recommended for permanent installation due to long-term durability concerns.
****

Provide temporary pipes, fittings, and screens of the size and types[specified][shown]. Provide pipes, fittings, and screen conforming to ASTM D1784, ASTM D1785, ASTM D2466, or ASTM D2467. Ensure joints in the PVC pipe include couplings and are glued with a solvent cement conforming to ASTM D2564. Use PVC pipe strength properties that are equivalent to PVC 1120 Schedule[40][80] unthreaded plastic pipe.[The well screen,

pipe, and fittings must have a minimum collapse strength of [_____].][The screen, pipe, and fittings must have a clear inside diameter of [_____].]

2.2.2.1 Couplings

Provide[bonded socket][threaded][certilock] type couplings. Produce fittings of the same material and equal quality as specified for plastic pipe screen. Bond socket type fitting connections of pipe sections with solvent cement. The determination of the proportions and preparation of adhesives, the method of application, and the procedure used for making and curing the connections are the responsibility of the Contractor. The system for making joints at the relief well site must provide a curing period adequate to develop the ultimate strength of the solvent cement. Self-tapping screws or other devices for holding pipe in the couplings during the setting period may be used as long as the screws do not penetrate the inside of the pipe. Do not stress a newly-made joint in the casing, lower it into the relief well, or submerge it in water prior to complete curing of the solvent cement adhesive.

2.2.2.2 Slots

The PVC well screens must be[mill slot][continuous wire wrapped rod base][continuous wire wrapped rod base on perforated pipe][continuous wire wrapped on perforated pipe screen]. Provide well screens with smooth, sharp-edged openings free of burns, chipped edges, and broken areas on the interior and exterior surfaces of the pipe.[The [_____] mm [_____] inch diameter well screen must have a[Number [_____] slot][[_____] mm [_____] inch wide opening]][The length of the slots measured on the inside of the pipe must be [_____] mm [_____] inch[es]]

]2.3 CASING

Provide[permanent][and][temporary] steel casing conforming to ASTM A53/A53M Grade B with a wall thickness of 10 mm 0.375 inch or greater. Submit documentation of the steel casing to the Contracting Officer that identifies the source and ordering details of the permanent steel casing to be used in this Contract. Provide casing that is of sufficient diameter to permit drilling of the borehole diameter indicated on the Drawings.

2.4 RISER PIPE, BLANK SECTIONS, AND WELL BOTTOM PLUG

Provide relief well riser pipe, blank section, and well bottom plug material and method of manufacture conforming to Paragraph WELL SCREEN, except omit the screen slots or perforations. Provide relief well riser pipe diameter and discharge details as shown. Provide couplings to the well screen and between riser pipe sections as specified in Paragraph COUPLINGS.

2.5 FILTER PACK

a. Provide filter pack for the annular space between the borehole wall and the well screen and riser meeting the following requirements:

(1) Comprised of naturally occurring grains and composed of non-calcareous, hard, tough, durable particles free from adherent coating, and contain no soft, friable, thin, or elongated particles, nor organic matter. Do not use crushed stone.

(2) From a source that can certify the site-specific manufacturing facilities are expressly qualified to produce and supply these materials for water wells in compliance with AWWA A100 or AWWA B100.

(3) Has an acid solubility less than 5 percent and specific gravity greater than 2.6.

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NOTE: Choose the first bracketed option for a uniform filter pack design; choose the second bracketed option for a well-graded filter pack design.

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(4) Has a coefficient of uniformity (Cu=D60/D10)[no greater than 2.5][between 2.5 and 6.0.]. D60 and D10 are the particle diameters corresponding to percentages finer than 60 percent and 10 percent, respectively.

(5) Meets the following size requirements:

Sieve Size (mm)U.S. Standard Sieve No.	Percent Passing By Weight
[_____]	[_____]
[_____]	[_____]
[_____]	[_____]

(6) The individual grading curves within these limits must not exhibit abrupt changes in slope denoting gap grading, skip grading, scalping of certain sizes, or other irregularities that would be detrimental to the proper functioning of the filter pack. Materials must be uniformly distributed among sieves.

b. Sample and test the filter packs:

(1) Prior to the delivery of filter packs to the site, provide manufacturer certification of the proposed filter pack that demonstrates the filter pack meets the requirements of this Paragraph. Include three gradations for each type of filter pack.

(2) Upon delivery, separate and label the filter pack materials designated for each well. Obtain at least two representative samples for each well according to ASTM D75/D75M and AWWA B100, prior to placement. Subject the representative samples of the filter pack for grain size analysis in accordance with ASTM C136/C136M and submit the filter pack gradations. Label the results of each test with the appropriate well number or name. Immediately notify the Contracting Officer if the gradation results do not meet the requirements of this Paragraph.

(3) Maintain the filter pack gradations in a continuous table in .xlsx

format that includes filter pack gradation testing, the information required by required by ASTM C136/C136M, other metadata associated with the sample, and the materials use on the project. Provide the continuous table in the required format each time the gradation results are submitted.

2.6 CHECK VALVES

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NOTE: This subpart can be deleted for temporary applications such as dewatering wells.

Insert provisions describing the materials and construction of a well pit, collector pipe, or ditch or any other proposed outlet for the relief well. Discharge details should be clearly shown on the drawings.

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a. Fit each well with an aluminum check valve to prevent surface water and debris from entering the well riser. Fabricate the check valves as specified and indicated. Make the check valves from either 3005-H14, 6061-T4, or 6061-T6 alloys and fabricate the components of each individual check valve entirely from the same aluminum alloy. Welding of aluminum must conform to the applicable provisions of AWS D1.2/D1.2M.

b. The seat for the check valve must consist of a flexible neoprene rubber gasket sandwiched between two 6 mm 1/4-inch aluminum plates, that are bolted together as indicated. The neoprene rubber gasket must consist of solid (closed cell) neoprene rubber at least 6 mm 1/4 inchin thickness and have a durometer hardness between 10A and 40A as measured on the "Shore A" scale in accordance with ASTM D2240. Cellular neoprene or neoprene foam is not acceptable. Submit manufacturer material data for approval.

c. Weld the aluminum guide rods and aluminum lifting ring to the aluminum plates as indicated. The aluminum guide rods must be dimensioned as indicated.

d. Ensure that the assembled check valve forms a seal between the neoprene rubber gasket and the angular face ring, can slide freely in and out of the well discharge without binding or jamming, and cannot shift to leave a portion of the well discharge open to the surface.

2.7 CONCRETE

Provide[concrete conforming to[Section[03 30 53 MISCELLANEOUS CAST-IN-PLACE CONCRETE][_____]][ASTM C94/C94M, Option A, with a [19][_____] mm [3/4][_____] inch nominal maximum size of aggregate, 13 cm 5 inches maximum slump, [five][_____] percent air content, and [17^{3}][_____] kPa [2500][_____] psi compressive strength]][packaged normal weight concrete conforming to ASTM C387/C387M].

2.8 SEALING MATERIAL

Use grouting and sealing materials that conform to AWWA A100. Submit sealing material mixture proportion and the location(s) the mix(es) will be used for approval, prior to the use of sealing materials on the

project. Materials placed in the annular space above the filter pack and below the top of riser must consist of a cement-bentonite grout, bentonite pellets, or other approved bentonite backfill having a permeability of less than 1E-6 cm per second 3E-8 foot per second.

PART 3 EXECUTION

3.1 PRELIMINARY WELL LAYOUT

Prior to the commencement of drilling operations, drive a wooden stake into the ground at each proposed relief well location to a horizontal accuracy of plus or minus 10 cm plus or minus 0.3 foot. Label each stake with the corresponding well number and the existing natural ground elevation to a vertical accuracy of plus or minus 3 cm plus or minus 0.1 foot. Notify the Government once the preliminary layout is complete. Within [_____] days of receipt of notification, the Contracting Officer will visit the site to review the proposed well locations and adjust as needed. Do not perform drilling, regardless of extent, until the Government has approved the proposed locations. Ensure the approved well locations remain clearly visible in the field until the relief wells are installed.

Document the installation of each well and provide well installation diagrams in accordance with Paragraph REPORTS. Maintain the well construction diagram as each well is being constructed.

[3.2 PILOT HOLE DRILLING

****

NOTE: This subpart can deleted if pilot holes have already been drilled and samples have been obtained to permit finalization of the filter pack and screen slot design. Pilot holes are drilled with standard methods such as hollow stem auger or rotary with split-spoon sampling or rotosonic.

It is strongly recommended to obtain continuous samples to reduce the chance of missing thinner soil layers that could cause performance issues for a relief well.

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After the layout has been approved and prior to drilling relief wells, drill a pilot hole boring within 1.5 meters 5 feet of the approved well location and perform laboratory tests on these borings to obtain soil classifications and gradations. Perform drilling and testing in accordance with Section 02 32 13 SUBSURFACE DRILLING AND SAMPLING. Submit pilot hole boring logs and results of pilot hole laboratory tests[for approval]. Ensure the borings provide a continuous set of sieve analyses along the depth of the hole. Upon receiving the logs and sieve results, the Government will provide the final relief well screen and filter pack designs within 30 business days. The estimated riser and screen lengths, screen slot size, and filter pack gradation in this Section are for estimating purposes only. These items will vary slightly in the final design.

]3.3 RESTRICTIONS DUE TO[LAKE][RIVER] ELEVATION

Do not start well drilling if[the lake is approaching or is above

elevation [_____] meters [_____] feet][the river is approaching or is above the lowest action level flood stage]. If drilling has already begun, the Contractor Officer may direct the Contractor to backfill partially completed boreholes with filter pack and cap the top 3 meters 10 feet with a mix of filter pack and bentonite. Do not leave open boreholes and wells without complete filter pack, grout seal, and protective cover unattended overnight. If high water elevations are forecasted before wells are completed, provide temporary covers for the riser pipes to prevent inundation from flood waters. If groundwater levels cause artesian conditions, provide additional temporary casings to create positive head and prevent uncontrolled flow from the borehole, which could erode filter pack and impact borehole stability.

3.4 DRILLING

Before drilling begins, demonstrate that the materials, equipment, and personnel necessary to successfully install each well are present and in good working order. Partial or total collapse of a borehole due to lack of material, unsuitable or defective equipment, inefficient operations, or negligence on the part of the Contractor will be considered cause for the Contracting Officer to order the Contractor to abandon the well and re-drill the borehole at no additional cost to the Government.

3.4.1 Drilling Method

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NOTE: The method of drilling may be different for permanent versus temporary installations. Methods that wouldn't normally be permitted for installing relief wells may be used for dewatering wellpoints, for example. The first bracketed option is for permanent relief wells; the second bracketed option may be used for temporary applications.
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Drill wells using the reverse rotary method, cased borehole method, or other Contracting Officer-approved industry-typical method suitable for the conditions encountered.[Other drilling methods (such as jetting or vibrating) that impart substantial disturbance of the aquifer, radical displacement of the formation, that are unproven, not recognized by industry, or that may reduce the overall efficiency of the well are prohibited.][For temporary installations such as wellpoints for dewatering, jetting may be used as a drilling method.] Use only approved drilling fluid additives as described in Paragraph DRILLING FLUID. Select a drilling method that will ensure acceptable placement of the well screen, riser pipe, filter pack, and satisfactory well construction. Dispose of cutting and other excess material resulting from the drilling process at the locations identified on the Drawings, unless otherwise approved by the Contracting Officer as part of the Installation Plan. The diameter of the borehole must be sufficient to accommodate the diameter of the well screen and riser, along with the required minimum filter pack thickness indicated.

3.4.2 Temporary[and Permanent] Casing

Make temporary well casing in accordance with Paragraph CASING of sufficient length to stabilize the borehole to the[bottom of the fine-grained blanket][bottom of borehole]. The Contracting Officer may direct the use of a temporary casing to the bottom of the borehole during

drilling and placement of screen, riser, and filter pack if necessary to provide adequate support to the sides of the hole. When the walls of the boring will require support only during development operations, a temporary casing must extend only to a depth of 1 meter 3 feet below the top of the filter pack.

Provide temporary casing with an inside diameter adequate to result in the borehole diameter indicated and a sufficient thickness to retain its shape and maintain a true section throughout its depth. The temporary casing may be in sections of any convenient length. Remove the temporary casing without disturbing the filter pack, riser, or well screen. Ensure cavities are not created outside of the temporary casing. If the temporary casing becomes distorted or bent, discard the casing and provide new.[Install permanent casing in accordance with Paragraph CASING and as indicated.]

3.4.3 Obstructions

If obstructions are encountered and the Government determines the obstacles prevent the Contractor from completing the well to the directed depth, the Contracting Officer may adjust the depth or direct the Contractor to abandon the well, plug the hole by backfilling with approved material by an approved procedure, and construct another well at an adjacent site.

3.4.4 Drill Fluid Pit Systems

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NOTE: Excavation of a pit may be permitted if the top confining blanket is thick enough after excavation to resist uplift pressures that may occur during construction.
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[Excavation for drill fluid pit systems will not be permitted.][As soon as practical after drilling, backfill the pit with soil of a similar permeability and density as the native soil.]Maintain a minimum operational capacity equal to three times the volume of the borehole to be drilled and incorporate desanders or baffles to separate fine material from the drilling fluid.

3.4.5 Groundwater

If fluid is necessary to maintain borehole stability during drilling, confirm that the natural groundwater at the site will be at least 3 meters 10 feet below the level of drilling fluid in the borehole.

3.5 INSTALLATION OF RISER PIPE AND SCREEN

Maintain drilling fluids, additives, and temporary casings to provide a stable and open borehole while performing the work.

3.5.1 Assembly

Ensure the riser pipes and screens are in good condition and couplings and other accessory parts are securely fastened in place before installation. Arrange successive lengths of pipe to provide accurate placement of the screen sections in the borehole.[Provide riser pipe with an approved cap and a flanged top section. Set the top at the required elevation.]

Attach centering devices and alignment tools to the assembled riser pipe and screen to center the riser pipe and screen in the borehole and hold it securely in position while the filter pack material is being placed. Ensure the centering device alignment does not inhibit the placement of tremie pipes in the well.

3.5.2 Joints

Joints between lengths of riser pipe must have strengths equal to or greater than the pipes being joined, must be in accordance with Paragraph COUPLINGS, and may be threaded, single bevel welded, or double bevel welded. Fully seat threaded joints. Weld metal for welded joints must have a corrosion resistance equal to or greater than that of the pipe or screen used. Design and construct joints to support the weight of the screen or pipe as it is lowered into the hole. Welding must be performed by a certified welder using appropriate welding rods. Ensure the well assembly (i.e. riser pipes and screens) retains its circular cross-section and straight alignment both during and after the welding process. Ensure that slag and other weld metal is not deposited inside the circumference of the pipe.

3.5.3 Installation

Verify borehole bottom elevations prior to installation of well components. Install each properly assembled well straight and plumb within the borehole. Place the assembled riser pipe and screen in the borehole,prevent jarring impacts, and ensure that the assembly is centered, connected, and undamaged. The screen must be suspended in the hole and not resting on the bottom of the hole. Handle well components carefully and prevent structural damage, degradation, clogging, and contamination throughout the construction process. If the Government determines that well components (including but not limited to riser pipes, screens, couplers, bottom plugs, well guards, check valves, and other fittings) are damaged, degraded, clogged, or contaminated during the construction process, repair, clean, or replace that component at no additional cost to the Government. This direction includes damage identified after well installation. Prevent mud, sand, organic materials, and other contaminants from entering the well borehole during the installation process. Minimize deformation of the well screen during handling and installation. Avoid impacts between the well components and the sides of the borehole during the installation process. Do not allow the well to rest on the borehole bottom before the filter pack is installed.

3.5.4 Alignment and Plumbness Test

a. Furnish a dummy cylinder, 3 meters 10 feet in length and with an outside diameter 1.5 cm 1/2 inch smaller than the inside diameter of the well, to test the alignment of each well. Lower the cylinder to the full depth of the well and withdraw the cylinder from the well. The well will be considered properly aligned if the maneuver can be completed without binding against the sides of the well. Perform at least one alignment check on each well after placement of the filter pack. Additional tests may be made during the performance of the work at the option of the Contractor.

b. Perform at least one plumbness test on each well after placement of the filter pack, in accordance with AWWA A100, Appendix D, and using a plummet. The test must include at least two perpendicular

measurements at every 3 meters 10 feet and at the bottom of the well. A variation of 15 cm per 30 meters 6 inches per 100 feet of depth will be permitted. Document the measurements on the well installation diagram.

c. If alignment and plumbness tolerances are not met and the Contracting Officer determines that there is not adequate clearance for surging, pumping, maintenance, and testing equipment, then the Contracting Officer may order the Contractor to abandon the well and re-install the well at no additional cost to the Government.

d. For each relief well, submit an alignment and plumbness test report containing, at a minimum, information required by AWWA A100, Appendix D.

3.6 FILTER PACK PLACEMENT

After the well screen and riser pipe have been installed, place the filter pack material by tremie, when using a well-graded material, in a manner that prevents segregation in accordance with the Installation Plan. When using a uniformly graded filter material, the material may be poured around the well screen at a rate that prevents bridging of the material. Place the material evenly around the screen to maintain a minimum thickness of [_____] mm [_____] inches between the outside of the well screen and the natural formation. Place the filter pack at a constant rate from the start of placement until it has reached[the elevation shown][the elevation directed][a minimum of 600 mm 2 feet above the top of the well screen]. Add granulated chlorine compound while adding filter pack. If a tremie is required, use a double string of tremie pipe. Place the pipes on opposite sides of the screen or casing and guide to ensure the pipes will remain in this position throughout the placing process. Set the tremie pipes in place and fill completely with filter pack prior to lifting the pipes off the bottom of the hole. Keep filter pack in the tremie pipe a minimum of 30 cm 1 foot above the water surface in the well throughout the placing process. Do not allow the gradation of the filter pack to fall outside of the range specified in Paragraph FILTER PACK.

3.7 DEVELOPMENT

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NOTE: The method of surging specified may be modified to specify a procedure considered most suitable for the particular project. Violent surging, as with compressed air, should not be permitted.

Sections for Surging, Pumping, and Jetting should be included if designer wants to provide more details on development methods.

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a. Following placement of filter pack materials and prior to placement of bentonite or grouting, develop the relief well for a minimum of four hours by jetting, surging, intermittent pumping, or other approved methods to give the maximum yield of water per 305 mm 1 foot of drawdown.[Submit methods for development in the Installation Plan.][Detail how the below procedures for surging, pumping, and jetting will be used for development in the Installation Plan.]

b. At the time of development of a relief well, ensure the well is free of drawdown or surcharge effects due to pumping tests, development, or drilling at another location. Maintain the needed access, the work area, and the clearance in the relief well necessary to accomplish development. Provide the necessary discharge lines and troughs to dispose of the discharge a sufficient distance from the work areas and prevent damage. Conduct development to achieve a stable well of maximum efficiency and continue until a sand test, as specified in Paragraph SAND TEST, is completed successfully.

c. Measure top of filter pack elevation periodically during development. Add filter pack material to the annular space around the screen to maintain the top of the filter pack to the specified elevation if top of filter pack elevation drops by more than 1.5 cm 0.5 inch. During the development process, if the filter pack becomes contaminated with silt or other foreign material, remove the material and restore the filter pack to the specified tolerance. Provide an open tube or other approved means for accurately determining the water level in the well, regardless of conditions.

d. Development will be considered complete after three development method cycles and when[sand content testing indicates an effluent with less than five parts per million (ppm) of sand][no visible sediment is present in pint jar water samples which have been allowed to stand for 10 minutes]. During the development process, if the Government determines that the well may be damaged or producing enough sand to risk stability of the dam, levee, or other structure, immediately terminate the development operations. 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 sand and fines in excess of five ppm after development for six hours be abandoned, plugged, and backfilled, and may require construction of new wells nearby. If excessive fines production is the result of the Contractor's action, take corrective actions at no additional cost to the Government. Remove materials pulled or introduced into the well during development prior to performing the pumping test. Within 48 hours after development is completed for each well, complete and submit ENG Form 6318 WELL DEVELOPMENT REPORT for approval.

[3.7.1 Surging

a. Furnish a surge block that consists of at least two sets of circular, neoprene rubber disks that have diameter 2.5 to 5 cm 1 to 2 inches less than the well screen, rigidly affixed to a central shaft comprised of a drill stem or other heavy duty pipe of sufficient mass to cause the surge block to free fall rapidly down the well under its own weight.

b. Replace the neoprene rubber disks as soon as they show evidence of wear or degradation.

c. Furnish the equipment necessary to raise and lower the surge block at a rate between0.5 and 1 meter per second 1-1/2 and 3 feet per second (ft/s) on both the up and down directions over the full length of the well.

d. Prior to inserting the surge block into the well, measure and record the depth of the well to the nearest 3 cm 0.1 foot. Compare this

measurement to the design depth of the well provided on the Drawings.

e. Prior to the start of the surging process, remove measurable sediment of debris found on the bottom of the well by air lifting.

f. Subject each well to at least three cycles of surging. A cycle consists of:.

(1) Placing the surge block at the top of the well screen, allowing the surge block to free fall for 6 meter 20 feet, raising the surge block at a rate between 46 and 91 cm per second 1-1/2 and 3 ft/s., and repeating this action at least 15 times.

(2) Lowering the surge block to 3 meter 10 feet below the top of the well screen and resume the surging process.

(3) Surging the entire well, beginning at the top and progressing toward the bottom, 3 meters 10 feet at a time, to prevent the surge block from becoming sand locked, over a period of at least 60 minutes.

g. Allow at least five minutes between cycles of surging to allow sand and other sediment to settle to the bottom. After five minutes, measure and record the depth of the well to the nearest 5 cm 0.1 foot and remove any sediment that may have accumulated at the bottom of the well.

h. Prevent the surge block from impacting the bottom of the well during the downstroke when surging near the bottom of the well.

i. If surging generates material that blocks 10 percent or more of the screen, cease surging and remove material pulled into the well before continuing the surging procedure.

][3.7.2 Pumping

Pumping may be used to aid in development; however, it may not be used as the primary means of development. Pumping may consist of up to 30 percent of the development time at the discretion of the Contracting Officer. The pumping rate must be sufficient to effect maximum drawdown but must not draw down below the top of the screen.[Do not set pump intake in a screened interval.] Perform pumping discharge in a manner that prevents surface erosion. Such damage must be immediately repaired.

][3.7.3 Jetting

Jetting may be used as a method of development. Jetting is described in EM 1110-2-1914. Perform jetting with an approved jetting tool, with a jetting velocity between46 and 91 meters per second 150 and 300 ft/s, and with centering devices and a pump below the jetting tool. The jet nozzles must direct the water toward the screen interval. Perform pumping simultaneously with jetting operations and at a higher rate than the jetting tool flow rate.

]3.8 BACKFILLING

After the well has been developed, add filter pack as necessary to meet the requirements of Paragraph FILTER PACK PLACEMENT. Backfill the annular space above the filter pack first by placing a 30 cm 12-inch minimum layer

of concrete sand on the filter pack and then filling the remainder of the space up to the[finished ground surface][well pit] with grout or concrete.[For PVC riser pipe, after the well has been developed, add filter pack as necessary for it to meet the requirements of Paragraph FILTER PACK PLACEMENT. Backfill the remaining annular space above the filter pack first by placing a 30 cm12 inch minimum layer of concrete sand on the filter pack and then filling the remainder of the space up to the[finished ground surface][well pit] with bentonite.] Withdraw the temporary casing, if used, in increments as the backfill is placed. Fill pits, such as those incidental to the reverse rotary circulation method of drilling, to original grade with impervious material.

3.9 PLUGGING OF ABANDONED WELLS

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NOTE: Use the first bracketed item if regulatory requirements exist. State the regulatory requirements along with applicable paragraphs to direct Contractor on how a well is to be abandoned.Use the second bracketed item if regulatory requirements do not exist.
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[Plug abandoned wells in accordance with [_____].][The Contractor has the option of attempting to remove the well screen. If the well screen can be removed, grout the bore hole starting from the bottom of the hole to within 1 meter 3 feet of ground surface. Start grouting at the bottom of the bottom plug of the well. If the well screen cannot be removed or if the screen breaks off during the removal attempt, grout the well from the bottom plug to within 1 meter 3 feet of ground surface. Either of the above abandonment procedures may require the Contractor to redrill the hole so that the bore hole can be grouted. Grout the well from the bottom plug to within 1 meter 3 feet of ground surface. After the grout has setup, cut off the riser pipe 1 meter 3 feet below ground. Then backfill the hole. Submit the cement grout mix to be used as part of the sealing material mixture proportion, for approval.]

3.10 VIDEO INSPECTION

Record a video inspection of each well and submit for approval, prior to Government acceptance of the project. Record video as the camera initially descends the well for clarity. The camera must have side (outward-facing) and downward view capability. At the beginning of each video, identify the well, date of inspection, and inspector's name. Move the camera down the well at a steady slow speed with minimal spinning or and shaking of the camera head. Digitally record the depths of well features. If foreign objects and deformations of the well are seen in the video, perform close inspection of the objects and deformation to determine if the object can be safely removed or repaired. If the well and screen are not plainly visible due to biofouling, stop the recording, brush and pump the well, allow turbidity to settle, and record a new inspection.

3.11 TESTS

Submit sampling and testing reports for each relief well, logs of the borings, well screen and riser pipe, backfill material, and pumping tests. Register each well with the State of [_____] as required. While pumping tests are being conducted, do not remove groundwater from the

aquifer within [_____] meter[_____] feet of the well being pumped, including but not limited to drilling, well or filter pack installation, excavation development, or other pumping into or out of the ground.

3.11.1 Pumping Test

Upon completion but before acceptance, subject each well to a pumping test, including a sand test, in accordance with the Installation Plan. Provide a[deep well turbine] pump, capable of producing the specified drawdowns over periods of time sufficient to satisfactorily perform the pumping test specified. Set the intake 3 meter 10 feet below the maximum expected drawdown in the well. Measure the quantity of sand after each test. Provide pump complete with gasoline, diesel, or electric motor of adequate size. If an electric motor is used, provide the electric power and the necessary wiring, at no additional cost to the Government. Provide an open tube or other approved means for accurately determining the water level in the well. Provide an orifice meter of approved design or other approved equipment for the purpose of measuring the discharge from the well during the pumping test. Provide the necessary pipeline, troughs, or ditches necessary to dispose of the discharge a sufficient distance from the work area to prevent damage. Notify the Contracting Officer at least one week prior to each test. Conduct the tests, under the observation of the Contracting Officer, as soon as each well is completed[and adjacent Government installed piezometer tubes are operational].[Test data will be recorded by Government personnel.]

Use the following procedure for testing the relief well(s):

a. Ensure that there is no more than 0.15 meter 0.5 foot of sediment at the bottom of a relief well when the pumping test begins.

b. Test the wells at five different pumped flow rates, measured in liters gallons per minute, and starting at the lowest rate. The minimum and maximum flow rates are estimated at [_____] and [_____] liters gallons per minute, but final flow rates will be determined by the Contractor in the field. If these rates produce a well drawdown of less than 1 meter 3 feet or more than 5 meters 15 feet, field-adjust to stay within a range of 1 to 5 meters 3 to 15 feet of drawdown. After the drawdown fluctuates less than 3 cm 0.1 foot at or after 60 minutes at the initial pumping rate at each step, the pumping rate may be increased to the next higher target flow rate. Maintain continuous pumping while changing flow rates.

c. Take water level readings inside the relief well to define the well drawdown curve for each discharge and create a continuous plot of drawdown versus time and flow. At a minimum, take check measurements of water level in the well at the following times with start of pump being time 0: 2, 4, 8, 10, 15, 20, 30, 45, and 60 minutes. This is in addition to continuous drawdown monitoring with a data logging device.

d. The pump test for each discharge will be considered complete after 60 minutes or when the well is stabilized between two subsequent readings, whichever is a longer period of time.

e. At 15 minute intervals during the test, determine the inflow of sand. If the sand inflow exceeds five ppm for the final 15 minutes of the test, the well must be redeveloped and the pump test rerun until the sand inflow rate is less than five ppm.

f. Allow aquifer to recover. Measure and document groundwater level during recovery period after pumps have been shut off. Monitor recovery until groundwater table returns to pre-pumping test elevation. If this process takes more than one hour, measure until elevation returns to within 3 cm 0.1 foot of pre-pumping test level.

g. Upon completing a pumping test, and before completing the well, ensure the well has adequate development. In two dimensions, plot flow rate on the X-axis versus specific drawdown on the Y-axis. Specific drawdown is the ratio of drawdown during the pumping test at a given flow rate divided by that flow rate. If the plot shows that the slope of this line is positive, proceed with well completion. If the slope of the plotted data is negative, run an additional cycle of development and rerun the pumping test.

3.11.2 Sand Test

As part of each pump test, determine the amount of sand (filter pack or foundation material) a well is producing. Submit results using[USACE ENG FORM 6317 RELIEF WELL PUMPING TEST REPORT][USACE ENG FORM 6319 SAND INFILTRATION TEST]. Prior to starting the sand test, remove all material from the bottom of the tailpipe. After the pump is at the desired pumping rate, divert the flow from the discharge[into a container that will collect the sand being carried by the water][through a Rossum Sand Tester]. Development of the well is satisfactory if the amount of sand collected is less than 0.5 liter per 100,000 liters 1 pint per 25,000 gallons of water pumped at the specified rate. Upon completion of the test, calculate and record the quantity of sand in the bottom of the well.

3.12 REPORTS

Include in the reports for each relief well, logs of the boring, elevations of the well screen and blank sections, top of riser pipe, screen bottom plug, filter pack gradation, quantity of filter pack added during development, pump test, sand test, and report of backfilling. Ensure the elevation of changes between materials on these logs are to the nearest 0.1 meter 0.1 foot. Include the filter pack particle size distribution test data and notes concerning installation and development of the relief well in the log of backfill material. Include the duration of the test and rate of flow in liters gallons per minute, and the drawdown response data with time in the pumped well, in adjacent wells, and in piezometers between the pumping and adjacent wells in the test log. Submit the relief well log and the pump test log to the Contracting Officer as part of the weekly quality control report specified in Section 01 45 00 QUALITY CONTROL. Also submit a report of the well installation to the appropriate public agency and in the form required by state statutory and/or regulatory requirements.

At the end of each phase of construction, submit the relief well installation documentation, including well installation diagrams, field logs, well development reports, pumping test reports, and video inspection data.

a. Well installation diagrams must include, at a minimum:

(1) Subsurface stratigraphy at the well location.

(2) Elevations of all housing components, top of riser, top and bottom of well screen, top and bottom of blank and plug, top and

bottom of grout, top and bottom of bentonite plug, top and bottom of each type of filter pack, and filter pack annulus dimensions.

(3) Elevation changes between materials to the nearest 0.1 meter 0.1 foot.

b. Boring logs must include, at a minimum:

(1) Identificaton of subsurface soils.

(2) Groundwater elevations.

(3) Drilling conditions.

(4) Drilling methods.

(5) Elevations of material change shown to the nearest 0.1 meter 0.1 foot.

c. The pumping test report must include, at a minimum:

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NOTE: Ensure ENG Form 6317 is available to the Contractor, either at https://www.publications.usace.army.mil/USACE-Publications/Engineer-Forms/ or https://www.wbdg.org/dod/ufgs/ufgs-33-26-00-00-10. If the form is not available at either source,[[an older copy is available at https://www.mvs.usace.army.mil/Portals/54/Attachment2 - Relief Well Pumping Test Report.pdf][contact [_____] and request a copy] to be used as an attachment to this Section.]

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(1) ENG Form 6317 RELIEF WELL PUMPING TEST REPORT.

(2) Rate of pumping and the amount of drawdown for each step.

(3) Length of time of each step of the pumping test conducted.

(4) Amount of sand infiltration during pumping.

(5) Plot of flow rate versus specific drawdown with each step of the pumping test.

(6) Equipment used, including types, sizes, and serial numbers.

(7) Diagram showing elevation of pump intake.

(8) Method of water level measurement.

(9) All piezometer data used to monitor drawdown.

(10) Plot of drawdown versus time, including recovery.

(11) Piezometric data for any adjacent wells or piezometers that were monitored.

(12) A downhole video inspection of the completed well will be

submitted electronically.

(13) Representative photographs of well installation and testing procedures and equipment.

(14) Completion dates for each relief well.

-- End of Section --