



**SPECIAL PROVISION  
FOR  
RELIEF WELLS**

**Pottawattamie County  
IM-NHS-029-3(86)52--03-78**

**Effective Date  
June 21, 2011**

**THE STANDARD SPECIFICATIONS, SERIES 2009, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.**

**090124.01 DESCRIPTION.**

The work covered by this Special Provision consists of furnishing all labor and materials, and performing all operations in connection with the design, installation and testing of relief wells, and other incidental work as may be necessary to complete the relief wells and any modifications, as shown on the Contract Documents.

The geotechnical information for the levee construction is provided in the document entitled "FINAL REPORT - Relocation of Council Bluffs Levee Unit and Agricultural Levee L627 – Section 1, Council Bluffs Interstate System, Segment 2, Interstate 80 and 29 Interchange, Pottawattamie County, Iowa," prepared by HDR, Inc., dated November, 2010. Subsurface profile for the South Levee is provided at the end of this Special Provision for Levee Construction.

**090124.02 MATERIALS.**

**A. References.**

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.

ASME INTERNATIONAL (ASME)

ASME B1.20.1 (1983; R 2006) Pipe Threads, General Purpose (Inch)  
ASME B31.9 (2008) Building Services Piping

ASTM INTERNATIONAL (ASTM)

ASTM A 312/A 312M (2008a) Standard Specification for Seamless, Welded, and Heavily Worked Austenitic Stainless Steel Pipes  
ASTM A 53/A 53M (2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless  
ASTM A 615/A 615M (2008) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

ASTM C 136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 33	(2007) Standard Specification for Concrete Aggregates
ASTM C 387/C 387M	(2008) Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete
ASTM C 94/C 94M	(2007) Standard Specification for Ready-Mixed Concrete
ASTM D 1056	(2007) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 75	(2003) Standard Practice for Sampling Aggregates
ASTM D 2487	(2010) Classification of Soils for Engineering Purposes
ASTM E 11	(2004) Wire Cloth and Sieves for Testing Purposes

**B. Buy America.**

Materials furnished for the relief wells shall be in accordance with the Buy America Act.

**C. Well Screen.**

Well screen shall be of the type and dimensions indicated. Screen openings shall be uniform in size and pattern, and shall be spaced approximately equally around the circumference of the pipe.

**1. Stainless Steel Well Screen.**

The well screen and fittings shall be fabricated entirely from stainless steel conforming to ASTM A 312/A 312M, Type 304, 304-L, 316 or 316-L. The well screen shall be of stainless steel with a keystone wire-wrapped continuous slot strainer equivalent to that manufactured by Howard Smith Screen Company, Houston, TX, telephone (713) 869-5771 or Johnson Screens, St. Paul, MN 55164, telephone (612) 636-3900. The well screen, pipe, and fittings shall have a minimum collapse strength as recommended by the manufacturer. The screen, pipe, and fittings shall have a clear inside diameter of 8 inches.

**a. Couplings.**

Couplings for the stainless steel well screen shall consist of the same material as the well screen and shall be threaded, flanged, and/or fitted with a welding ring. The couplings shall conform in design to the couplings recommended by the manufacturer of the well screen.

**b. Perforations.**

The slot size and open area of the perforations shall be selected by the Contractor to meet the requirements of this Specification.

**2. Tailpipe for Well Screen.**

The tailpipe for each well screen shall be made of the same material and at least the same minimum thickness as the riser pipe and shall include a bottom plug. The tailpipe shall be the same diameter as the well screen. Tailpipes shall be a minimum of 5 feet in length and fastened to the bottom of the screen in an approved manner.

**D. Riser Pipe.**

The relief well riser pipe material and method of manufacture shall conform to the requirements specified in Article 090124.02, B, 1, Well Screen, except that the screen perforations or opening shall be omitted. The riser pipe shall be the same diameter as the well screen. The relief well riser pipe diameter and discharge details shall be as shown. Couplings to the well screen and between riser pipe sections shall be as specified in Article 090124.02, B, 1, a, Couplings.

**E. Filter Pack.**

Material for the filter pack around the riser pipes and screens shall be a washed sand and gravel composed of hard, tough, and durable particles free from adherent coating. The filter pack shall not be crushed stone. The filter pack material shall contain no detrimental quantities of organic matter nor soft, friable, thin, or elongated particles in accordance with the quality requirements in ASTM C 33, Table 1 and Table 3, Class 5S, and in ASTM E 11, Table 1. The filter pack shall not

include any particles that cause encrustation of the screen by dissolution or precipitation. Iron based materials are not acceptable. The filter pack shall be designed by the Contractor and the gradation shall be submitted to the Engineer for approval.

**F. Concrete and Steel Reinforcement.**

Concrete shall conform to the requirements specified in ASTM C 94/C 94M, Option A, with a 3/4 inch Nominal Maximum Size of Aggregate, a maximum slump of 5 inches, air content of 5 percent, and a compressive strength of 3000 psi.

Steel reinforcement shall conform to the requirements of ASTM A 615.

**G. Submittals.**

Approval is required for the following submittals prior to installation:

Qualifications

- The Contractor and its foreman, at least five (5) years of continuous experience in the installation, development and testing of Relief Wells.

Shop Drawings

- Shop drawings, as specified.
- Logs of test borings, including gradation test results.

Product Data

- Well Screen.
- Riser Pipe.
- Tail Pipe.
- Approved filter pack material and its gradation, before it is placed.
- Cement sand, concrete, and/or grout for backfill above filter pack.
- Cement grout mixture proportion to be used in plugging abandoned wells.

Test Reports

- Sampling and testing reports for each relief well, logs of the borings of each well, well screen and riser pipe, backfill material, and pump tests. Register each well with the state as required by the state in which the well is installed.

**090124.03 CONSTRUCTION.**

**A. Quality Assurance.**

All Work performed by the Contractor shall be in accordance with Division 11 of the Standard Specifications and with the State and Municipal statutory and regulatory requirements for subsurface drilling .

**1. Shop Drawings.**

Show details of the proposed methods for drilling, coupling well screen and riser sections together, placement of centralizers, installing the well screen and riser, and limit(s) of backfilling. Show on the shop drawings the type of screen and size; slot size, shape and pattern; bottom plug or tailpipe material; and installation detail. The riser pipe and well discharge details shall also be shown on the shop drawings. Any Contractor-proposed substitutes or alternates in material construction details or methods shall be presented in the shop drawings. No phase of the work shall be initiated until all shop drawings concerning that activity have been approved.

**2. Depth of Well.**

The length of well screen, length of riser pipe and the well discharge elevation shall conform to the Relief Well detail and the dimensions shown on the Drawings.

**3. Test Holes.**

The Contractor shall drill four test holes to determine gravel pack gradation and slot size, shape and pattern. The test holes shall be equally spaced between the relief wells and shall extend to a depth equal to the deepest relief well in the vicinity. The Contractor shall be responsible for collecting the representative samples, creating a log of the drilling operation, and performing the sieve analysis necessary for the well design. The test holes shall utilize an approved drilling method. The test holes shall be filled with a bentonite based grout from the bottom of the boring to within 7 feet of the existing surface. The remaining test hole shall be filled within 2 feet of the surface with a cement-bentonite grout slurry. The remaining 2 feet of the test hole shall be filled with a low permeability clay derived from the drilling operation. Excess cuttings and drilling waste shall be removed from the project site on a daily basis. Test holes shall be covered with a temporary plug at the end of day. All holes shall be sealed immediately if a high water event is anticipated.

**4. Well Design.**

From data obtained from exploratory drilling, the Contractor shall determine the diameter of the well screen, size of openings, the lengths and positions of the screens, and the gradation of the material for the filter pack which is to be installed around the well screen. The required discharge of the well shall be as shown on the Drawings. The minimum well screen diameter shall be 8 inches.

**B. Project/Site Conditions.**

**1. Location.**

The exact location of each well, with respect to the toe of the embankment, will be determined in the field by the Engineer. The total number of wells and spacing may be modified by the Engineer as the work proceeds.

**2. Obstructions Encountered.**

If obstructions are encountered in the foundation, which in the opinion of the Engineer render it impracticable to complete the well to the directed depth, the Engineer may adjust the depth. Alternatively, the Engineer may 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. Water Supply.**

The new wells are being constructed adjacent to existing wells. The Contractor does have the option of pumping water from the existing wells for the drilling operation. No guarantee is made or implied on the condition of the existing wells or the amount of flow available from the wells. Damage to existing wells caused by the Contractor's operations shall be repaired at no cost to the Contracting Authority. In the event the well is damaged beyond repair, the Contractor shall abandon the well in accordance with Article 090124.03, H, Plugging of Abandoned Wells.

**C. Drilling.**

Wells may be drilled by the reverse rotary circulation method or other method approved, which will insure proper placement of the well screen, riser pipe, and filter pack. Methods which involve radical displacement of the formation, or which may reduce the yield of the well, will not be permitted. Excavated material shall be disposed of as directed.

**1. Reverse Circulation Method.**

If the reverse circulation method is used for drilling wells, remove all of the drilling fluid from the filter pack and the natural pervious formation. If in the opinion of the Engineer the walls of the hole above the top of the filter pack require support during development operations, place a temporary casing similar to that specified in Article 090124.03, C, 2, Temporary Casing. The diameter of the hole shall be such as will permit the placement of the minimum thickness

of filter pack as specified in Article 090124.03, E, Filter Pack Placement. The drilling fluid shall be a suspension of fine grained soil or shall be a commercial product of a recognized manufacturer, shall be approved by the Engineer, and shall have the characteristic of being readily removable from the filter pack and the walls of the formation by development as specified in Article 090124.02, F, Development. The use of bentonite will not be permitted. Drilling fluid or chemical additives that allows biological growth in the wall shall not be used. The Contractor shall monitor and record the viscosity of drilling fluid during the course of the drilling operation.

## **2. Temporary Casing.**

Temporary well casing of either iron or steel of sufficient length to case to the bottom of all borings shall be available at the construction site. The Engineer will direct the use of a temporary casing to the bottom of the boring during drilling and placement of screen, riser, and filter pack when he believes it is 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 will be required to extend only to a depth 3 feet below the top of the filter pack. The temporary casing, shall have an inside diameter of not less than 20 inches, shall have sufficient thickness to retain its shape and maintain a true section throughout its depth, and may be in sections of any convenient length. The temporary casing shall be such as to permit its removal without disturbing the filter pack, riser, or well screen. The setting of temporary casing shall be such that no cavity will be created outside of it at any point along its length. In the event the temporary casing should become unduly distorted or bent it should be discarded and a new casing should be used during installation of any additional relief wells.

## **D. Installation of Riser Pipe and Screen.**

### **1. Assembly.**

All tailpipe, riser pipe, and screen shall be in good condition before installation and all couplings and other accessory parts shall be securely fastened in place. The successive lengths of pipe shall be arranged to provide accurate placement of the screen sections in the bore hole. The riser pipe shall be provided with an approved cap and a flanged top section, the top of which shall be set at the elevation directed or shown. Centralizers shall be attached to the assembled tailpipe, riser pipe, and screen in such numbers and of a type that they will satisfactorily center the tailpipe, riser pipe, and screen in the bore hole and will hold it securely in position while the filter pack material is being placed.

### **2. Joints.**

Sections of relief well pipe shall be joined together as specified in Article 090124.02, B, 1, a, Couplings. Joints shall be designed and constructed to have the strength of the pipe and where possible a strength capable to support the weight of the relief well stem as it is lowered into the hole. When not practicable to construct joints that will support the weight of the relief well stem, the stem shall be supported at the lower end by any approved means that will assure that the joints do not open while being lowered into place in the well.

### **3. Installation.**

The assembled tailpipe, riser pipe, and screen shall be placed in the bore hole in such manner as to avoid jarring impacts and to insure that the assembly is centered and not damaged or disconnected. The tailpipe should be suspended in the hole and not resting on the bottom of the hole. After the tailpipe, screen, and riser pipe have been placed, a filter pack shall be constructed around the tailpipe and screen section as specified in Article 090124.03, E, Filter Pack Placement, and the well developed as specified in Article 090124.03, F, Development. The top of the riser pipe shall be held at the designated elevation during placement of the filter pack.

**4. Check for Plumbness and Alignment.**

The well shall be constructed and all casing set round, plumb, and true. Perform the following tests after the installation of the well but prior to backfilling, and before its acceptance. Additional tests may be made during the performance of the work at the option of the Contractor. Should the Contractor fail to correct, at no additional cost to the Contracting Authority, any faulty alignment or plumbness disclosed as a result of these tests, the Engineer may refuse to accept the well. If in the judgment of the Engineer the Contractor has exercised all possible care in constructing the well and the defect is due to circumstances beyond the Contractor's control or if the utility of the completed well is not materially affected or if the cost of necessary remedial measures will be excessive, the requirements for plumbness may be waived. In no event will the provisions with respect to alignment be waived.

**a. Plumbness.**

Test plumbness by use of a plumb line. The plummet shall be a short cylinder with an outside diameter approximately 1/4 inch smaller than the inside of the well and/or temporary casing. It shall be suspended from a small diameter wire rope and its point of suspension shall be in the exact center of the plummet. The plummet shall be sufficiently heavy to stretch the wire rope taut. The wire rope shall pass over a guide sheave which shall be positioned at least 10 feet above the top of the well and adjusted horizontally so that the plummet hangs in the center of the well. Displacement of the wire rope during the plumbness check shall be measured by means of a transparent plastic sheet on which a number of concentric circles shall be scribed or drawn, and which is centered on the top of the well. The exact center of these circles shall be marked, and then a slot, slightly larger than the plumb line and extending from this center to the edge, shall be cut in the plastic sheet. As the plummet is lowered, any out-of-plumb condition of the well will be indicated by the wire rope tending to drift away from the center, and the plastic sheet shall be rotated until the slot is oriented in the direction of this drift, while at all times maintaining the center of the concentric circles coincident with the center of the well. Measurement of the amount of drift shall be made along the edge of the slot for each increment by which the plummet is lowered into the well. Drift at any depth shall be determined by multiplying the measured plumb line displacement by the total length of the plumb line and dividing the result by the fixed distance between the guide sheave and the top of the well. If desired, alignment may be calculated from the plumbness data in lieu of the alignment check described in Article 090124.02, D, 4, b, Alignment. Should the well vary from the vertical in excess of 6 inches per 100 feet of depth, the plumbness of the well shall be corrected by the Contractor at no additional cost to the Contracting Authority.

**b. Alignment.**

Should the cylinder fail to move freely throughout the length of the well, the alignment of the well shall be corrected at no additional expense to the Contracting Authority.

**E. Filter Pack Placement.**

After the tailpipe, screen, and riser pipe have been installed, the filter pack material shall be placed by tremie, when using a well graded material, in an approved manner such that segregation will not occur. When using a uniform graded filter material, the material may be poured around the well screen at a rate that will prevent bridging of the material. The material should be placed around all sides of the screen to assure that the screen is not pushed against the side of the bore hole causing the tailpipe and screen to come in contact with foundation material or prevent the proper thickness of filter from being placed uniformly around the tailpipe and screen. The filter pack shall have a minimum thickness of 6 inches between the outside of the tailpipe and screen and the natural formation. The filter pack shall be placed at a constant rate from the start of placement until it has reached the elevation shown. If a tremie is required, a double string of tremie pipe shall be used. The pipes shall be placed on opposite sides of the tailpipe, screen, and/or casing, that is, 180 degrees apart, and shall be guided in such a manner that they will remain in this position throughout the placing process. The tremie pipes shall be set in place, filled completely with filter pack prior to being lifted off the bottom of the hole. The filter

pack in the tremie pipe shall be kept a minimum of 1 foot above the water surface in the well throughout the placing process. In no case shall the gradation of the filter pack fall outside of the range specified in Article 090124.02, D, Filter Pack.

## **F. Development.**

### **1. Developing the Relief Well.**

Following placement of filter pack materials, develop the relief well by jetting, surging, intermittent pumping, or other approved methods as may be necessary to give the maximum yield of water per foot of drawdown. At the time of development of any relief well, the well shall be free of drawdown or surcharge effects due to pump testing, developing or drilling at another location. The Contractor is responsible for maintaining at the relief well the needed access and work area and clearance in the relief well necessary to accomplish development. 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 Article 090124.03, I, 2, Sand Test, is obtained. As development proceeds, filter pack material shall be added to the annular space around the screen to maintain the top elevation of the filter pack to the specified elevation. 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 Engineer that the well may be damaged, development operations shall be immediately terminated. The Engineer may require a change in method if the method selected does not accomplish the desired results. The Engineer 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.

#### **a. 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 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 Engineer 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.

#### **b. Intermittent Pumping.**

Intermittent pumping shall be performed by pumping the well at a capacity sufficient to produce a rapid drawdown of approximately 10 feet stopping the pump (backflow through pump will not be permitted) to permit the water surface to rise to its former elevation, and repeating this procedure. Cycle time for this procedure will vary as directed but will not be more than 3 cycles per minute. A discharge pump will be required. A deep well turbine pump, or electric submersible pump with check valve, shall be used with any attachment necessary to accomplish rapid starting and stopping for intermittent pumping.

The intake shall be set at least 10 feet below the maximum expected drawdown in the well. Prior to commencing intermittent pumping, and periodically during development by this method, all sand and/or other materials shall be removed from inside the screen. The amount of drawdown may be decreased if, in the opinion of the Engineer, the efficiency of the well might otherwise be impaired.

**c. Surging.**

Surging of the well shall require use of a circular block which is approximately 1 inch smaller in diameter than the inside diameter of the relief well and is constructed of a material which will not damage the screen if the block comes in contact with the screen, and a bailer or pump to remove materials drawn into the well. The surge block shall be equipped with a 1-way valve to promote surge action throughout the entire filter pack. The surging shall be continued for a period of approximately one hour or until little or no additional material from the foundation or filter pack can be pulled through the screen. The surge block shall be moved by a steady motion up and down the full length of the well screen. Prior to commencing surging, and periodically during development by this method, all sand and/or other materials shall be removed from inside the screen. All materials pulled into the well by the surging process shall be removed.

**G. Backfilling.**

After the well has been developed, additional filter pack should be added if necessary to meet the requirements of Article 090124.03, E, Filter Pack Placement. Then the annular space above the filter pack, shall be backfilled by first placing a 12 inch minimum layer of concrete sand on the filter pack and then filling the remainder of the space up to the well pit with grout or concrete. The concrete backfill shall be placed to a depth at least equal to the existing impervious blanket, but in no case less than 4 feet. The temporary casing, if used, shall be withdrawn in increments as the backfill is placed. Fill with impervious material, to original grade, all pits such as those incidental to the reverse rotary circulation method of drilling.

**H. Plugging of Abandoned Wells.**

The well shall be grouted from the bottom of the tailpipe to within 3 feet of ground surface. After the grout has setup the riser pipe shall be cutoff 3 feet below ground. Then the hole shall be backfilled. The cement grout mixture proportion to be used shall be submitted for approval.

**I. Tests.**

**1. Pump Test.**

Upon completion but before acceptance, each well shall be subjected to a pump test of which a sand test will form a part. The pump test shall not commence until after the concrete and grout has set. Provide a deep well turbine pump, capable of producing the specified drawdown over periods of time sufficient to satisfactorily perform the pump test specified herein. The intake shall be set 10 feet below the maximum expected drawdown in the well. The amount of sand should be measured after each test. The pump shall be complete with either gasoline, diesel, or electric motor of adequate size. In case an electric motor is used, provide, without additional cost to the Contracting Authority, the electric power and the necessary wiring. Provide an open tube or other approved means for accurately determining the water level in the well. Furnish and install an orifice meter of approved design or other approved equipment for the purpose of measuring the discharge from the well during the pumping test. The meter shall be certified by the manufacturer for the anticipated flow rate. Furnish, install, or construct the necessary pipe discharge line, troughs, or ditches necessary to dispose of the pumping test discharge a sufficient distance from the work area to prevent damage.

The tests will be conducted under the direction of the Engineer and may be made as soon as each well is completed. Test data will be recorded by the Contractor. Test each well by pumping continuously for a minimum of 6 hours. Prior to starting the pump test all material shall be removed from the bottom of the well. The pumping shall be sufficient to produce

approximately 6 feet of draw-down which will be considered the steady state condition. If the test is interrupted, other than by order of the Engineer, prior to the completion of the specified period of continuous operation, the test shall be re-run. In addition to the required pumping test, the Engineer may direct the Contractor to perform additional pump tests. Such additional testing shall conform in general to the requirements specified herein except that the duration of the tests and the approximate draw-down will be determined by the Engineer. In the event that sand or other material collects in the well as a result of the pump test, accurate measurements shall be taken as to the quantity of material in the well and all such material shall be removed. Upon completion of the pump test, remove all equipment, discharge lines, electrical lines, lumber, and debris, and shall backfill any excavated areas with impervious material.

**2. Sand Test.**

As part of each Pump Test or at the end of each intermittent pumping a determination of the amount of sand (filter pack and/or foundation material) a well is producing shall be performed. Prior to starting the sand test all material shall be removed from the bottom of the tailpipe. Test each well by pumping sufficient to produce approximately 10 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. Filter Pack Sampling and Testing.**

Verify that all materials conform to the specifications before delivery to the project. The particle size distribution of the filter pack shall be sampled and tested in accordance with ASTM C 136 and ASTM D 75. Prior to delivery to the project site, at least two samples of material should be collected and tested for every 750 tons produced under this contract. A pump test shall be performed in accordance with technical provisions herein specified.

**4. Reports.**

Include in the reports for each relief well, logs of the boring, elevations of the well screen, top of riser pipe, bottom of the tailpipe, filter pack gradation, quantity of filter pack added during development, pump test, sand test, and report of backfilling. The development data report shall state the method of development, time of development, and sand test results. The elevation of changes between materials on these logs shall be to the nearest 0.1 foot. The log of backfill material shall include the filter pack particle size distribution test data, and notes concerning installation and development of the relief well. The pump test log shall include the duration of the test and rate of flow in gpm, and the draw-down response data with time in the pumped well, in adjacent wells, and in nearby piezometers. The relief well log and the pump test log shall be submitted to the Engineer. 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.

**090124.04 METHOD OF MEASUREMENT.**

Measurement will be made as follows for the quantity as specified or as directed by the Engineer.

- A. The quantity of Relief Wells will be measured by count for each Relief Well installed for which payment made for the quantity shown in the contract documents.
- B. The quantity of Test Borings will be measured by count for each Test Boring completed for which payment made for the quantity shown in the contract documents.
- C. The quantity of Sealing of Wells will be measured by count for each Sealing of Well completed for which payment made for the quantity shown in the contract documents.

**090124.05 BASIS OF PAYMENT.**

**A. Quantities Accepted for Payment.**

The quantities accepted for payment will be paid for at the contract unit price for the following items

<b>PAY ITEM</b>	<b>UNIT</b>
Relief Wells	Each
Test Borings	Each
Sealing of Wells	Each

The contract unit prices for the above items will be full and complete payment for providing all design, materials, labor, equipment, and incidentals to complete the work.

**B. Payment for Relief Wells.**

Payment for each Relief Well will be at the Contract Unit Price. Payment is full compensation for furnishing, installing and testing each Relief Well as shown in the Contract Documents.

**C. Payment for Test Borings.**

Payment for each Test Boring will be at the Contract Unit Price. Payment is full compensation for drilling a 50-foot deep test boring with Standard Penetration Test Sampling completed at 5-foot intervals, and the preparation of a boring log providing a description of the materials encountered in accordance with ASTM D 2487. Soil samples shall be retained for a period of at least 60 days in the event that subsequent laboratory testing is required.

**D. Payment for Sealing of Wells.**

Payment for each Sealing of Wells will be at the Contract Unit Price. Payment is full compensation sealing abandoned relief wells as described in this Special Provision.