TECHNICAL PROVISION 31.0

INDIVIDUAL WATER WELL DRILLING

31.01 Scope

The work covered by this section includes the furnishing of all plant, labor, transportation, tools, equipment and materials, and performing all operations in connection with the drilling, casing, screening, developing, and testing of individual water wells for home sites, and site cleanup, all in accordance with these specifications and applicable drawings.

31.02 General

The Contractor shall drill cased wells at the locations indicated on the location plans. The well(s) shall be drilled no deeper than the depth directed by the Project Manager for that particular site without authorization from the Project Manager or Contracting Officer. If a satisfactory yield is obtained at a lesser depth, the drilling shall be terminated and the well developed at that depth. Wells shall be constructed to meet or exceed the Washington State Administrative Code (WAC) Standards for Construction and Maintenance of Wells.

31.03 Drilling Rig

The drilling shall be accomplished by a cable tool, mud rotary, or air rotary drilling machine. Equipment used shall be in good repair and capable of drilling to a depth of 400 feet.

31.04 Materials and Equipment

31.04.01 Casing

Casing used as a permanent part of the well structure shall be seamless or electric resistance welded steel pipe conforming to ASTM A53, Type E or S, Grade B, black wall, meeting the following specifications. It shall be of standard brand manufacture and have the brand name clearly printed on each length of pipe. Manufacturer rejected pipe shall not be used.

Nominal size:	6-inches
Outside diameter:	6.625-inches
Wall Thickness:	0.250-inches
Weight per Foot:	17.01-pounds

31.04.02 Drive Shoes

If permanent steel casing is to be installed by driving methods the use of drive shoes is required. The type and weight of drive shoes shall be determined by the Contractor and approved by the Project Manager. The use of drive shoes is considered incidental to the drilling and casing of the well, and no additional payment will be allowed.

31.04.03 Screen

Design: Continuous slot; outer windings welded to longitudinal bars.

Materials: ANSI Type 304 stainless steel

Length: As directed by the Project Manager.

Fittings: The type of bottom fitting depends on method of screen installation. The fitting must close off the bottom of the screen and shall be of mild steel. The packer shall be self-sealing neoprene with a mild steel or stainless steel collar.

The contractor shall also use a 5-foot minimum riser pipe on the top of the screen. A 2-foot extension pipe shall be attached to the bottom of the screen.

Slot size: The screen shall be sized to permit the maximum practical sand-free yield after development. The diameter shall be as stated in the Bid Schedule. The slot size shall be based on a sieve analysis of the formation and approved by the Project Engineer prior to installation.

The length of the screen shall be dependent upon the length and type of aquifer encountered. Length shall limit the entrance velocity to a maximum of 0.1 feet per second. The screen opening size, length, and diameter shall be approved by the Project Manager before ordering or placing the screen.

Manufacturer: Johnson Screens, Alloy Machine Works, or approved equal.

31.04.04 Liner Pipe

All liner pipe shall be of steel or PVC, and must be in new, or like new condition. Steel liner pipe shall meet or exceed the minimum ASTM A-53 A or B specification for steel pipe. PVC liner pipe must conform to ANSI/ASTM F 480-81, or the most recent version; shall be of type 1220 or 1120, SDR 21 (Class 200) or higher pressure rating; and must conform to National Sanitation Foundation (NSF) Standard 14-84, or the most recent version. PVC liner joints must be watertight.

31.04.05 Sanitary Grout

Cement Grout: Cement conforming to ASTM C-150, Type 1 or Type 3 (high early strength) with the least quantity of water -- not over 6 gallons per cubic foot of cement -- required to give a mixture of such consistency that it can be forced through the grout (tremie) pipe. Bentonite clay may be added in amounts from 3 to 5 pounds per cubic foot of cement to reduce shrinkage and improve fluidity. In

this case up to 8 gallons of water per cubic foot of cement may be used with the approval of the Project Manager.

Wet Bentonite: Bentonite grout shall be Baroid Aquagel or equal mixed 75 pounds per 100 gallons of water. This type of bentonite shall not be applied dry.

Dry Grout: Dry grout shall be granular or pelletized dry bentonite.

31.05 Drilling

Drilling shall commence at the location as indicated on the site drawings or as staked by the Project Manager. The Contractor shall begin drilling with an oversize bit for the first 18-feet or as directed by the Project Manager. This oversize hole shall be used to allow a 2-inch minimum grout seal to be positioned around the casing. Drilling shall continue below this point with a bit large enough to install the casing.

In unconsolidated formations, the Contractor shall drive the casing closely to the drill bit location with a drive block to prevent caving. Properly sized drive shoes shall be attached to the bottom of the casing to prevent possible damage.

Drilling shall be terminated after an adequate aquifer is encountered. The determination to stop drilling when an adequate aquifer is encountered shall be made by the Contractor and confirmed by the Project Manager. The determination to stop drilling when no aquifer is encountered shall be made by the Project Manager. The Project Manager may require the Contractor to perform a yield test by using a bailer in the encountered aquifer. No additional payment shall be made for this check.

31.06 Precautions Against Contamination

The Contractor shall take all precautions necessary to prevent undesirable physical or chemical contaminants from entering the well. At all times during progress of the work, the Contractor shall protect the well so as to prevent the entrance of foreign matter, including surface water. Upon completion, the well shall be covered with a welded cover plate or similar device.

In the event the well becomes contaminated because of negligence on the part of the Contractor, they shall perform such work and supply such casing, seals, disinfecting agent or other materials as may be necessary to eliminate the contamination. No additional payment shall be allowed for such corrective work.

31.07 Welding

Surfaces to be welded shall be free from loose scale, rust, grease, paint, and other foreign material, except for mill scale which withstands vigorous wire brushing. Joint surfaces shall be free from fins and tears.

The technique of welding employed, the appearance and quality of the welds made, and the methods of correcting the defective work shall conform to normally accepted standards of workmanship.

All welding operations shall cease when the temperature is below 0 degrees F. When welding at a temperature below 32 degrees F the surface of all areas within 3-inches of the edges to be welded shall be heated until they are too hot to touch before welding is started.

Sections of casing after welding shall be true to line and free from twists, bends, offsets, and open joints. All welded joints shall be watertight.

31.08 Sampling of Formation

Formation sampling is considered an essential part of this contract. Samples shall not be washed, and shall be kept in containers approved by the Project Manager. These samples shall be furnished to the Project Manager if requested as drilling progresses. When an aquifer is encountered, the Contractor shall obtain a sufficient unwashed soil sample from the potential aquifer for use in a sieve analysis. The Contractor shall arrange and pay for the sample to be so analyzed by the manufacturer of the well screen, the manufacturer's representative or by persons approved by the Project Manager. The analysis report shall include the recommended slot size of the well screen. The results of the analysis shall be submitted to the Project Manager.

The Contractor shall collect and save samples taken from each 10-feet of drilling and at every change in formation. If so directed by the Project Manager, the driller may be required to take samples at 1 foot intervals in a potential aquifer.

31.09 Well Record

The Contractor shall keep a written daily record on each hole drilled, on forms supplied by the Project Manager. The following information shall be recorded:

1) Well location -- section, range, township.
2) Stratum information -- depth, thickness, type.
3) Water information -- static water level for each aquifer.
4) Type and length of well casing, liner, and screen.

Within one week after the completion of each well, the Contractor shall furnish the Project Manager a signed original and two copies of the completed well log (digitally is acceptable).

The Contractor shall furnish the Project Manager an **as-built** plan sketch of the well location and any unsuccessful holes. The sketch shall show any significant topographical features and include two measured distances from the well or abandoned hole to "permanent" site features which can easily be identified and located.

31.10 Well Screen

The well screen, if required based on formation, shall be installed by either the pull back method, the open hole method, the bail down method or the wash down method.

The screen shall be positioned in the lower 1/3 to 1/2 of the aquifer thickness. A packer shall be used to seal the annular space between the screen's extension pipe and well casing.

31.11 Well Liner

Liner pipe installed in a well shall extend or telescope at least eight feet into the lower end of the well casing. In the event that more than one string of liner is installed, each string shall extend or telescope at least eight feet into the adjacent larger diameter liner pipe. Liner pipe shall be removable. Liner pipe may be welded or hooked onto the permanent well casing but shall not be permanently fixed to a well casing or borehole wall using packers or grout which would prohibit the liner's removal.

31.12 Well Development

The Contractor shall develop the well by such methods as will effectively extract from the water bearing formation the maximum practical quantity of mud, fine sand, silt, or other fine materials. Development shall bring the well to a maximum yield per foot of draw-down, and the water shall be sand-free (less than 2 ppm) at the maximum stabilized capacity. One of the following methods shall be used to develop the wells: Surge plunger, compressed air, or high velocity water jetting.

Neither bailing nor pumping shall be considered to be development under this contract.

The development work must be done in a manner that does not cause undue settlement of the stratum above the water bearing form.

31.13 Test Pumping

The Contractor shall notify the Project Manager at least 24 hours in advance of starting the test pumping. The Contractor shall furnish all labor, equipment, materials, and power required for test pumping. This shall include all necessary equipment for accurately measuring the water level in the well and the rate of pump discharge. The pumping equipment shall be cable of pumping 15 gpm for residential wells and 100 gpm for community wells at the required pumping depth.

Equipment shall be approved by the Project Manager prior to test pumping. The depth gauge and flow meter shall be properly adjusted. The Project Manager may request a calibration test be made on-site on the testing apparatus.

The Contractor shall install the pump intake at the depth indicated by the Project Manager. The initial static water level shall be measured and recorded by the Contractor on the test pump forms supplied. The pumping test shall consist of maintaining a constant discharge rate, and recording

the time and corresponding drawdown. The discharge shall be maintained within five percent of the designated flow rate by means of a gate valve or similar type of throttling device.

Test pumping shall run for a minimum of 4 hours. Running the test beyond these times shall be done only with the approval of the Project Manager. The draw-down and time of reading shall be measured and recorded on the test pump form according to the following schedule:

from 1 to 10 minutes -- every 1 minute
from 10 to 20 minutes -- every 2 minutes
from 20 to 30 minutes -- every 5 minutes
from 30 to 120 minutes -- every 10 minutes
from 2 hours to end of test -- every 1 hour

Whenever a stabilization point is reached, the pumping rate may be modified at the direction of the Project Manager. Should the measurements not be made exactly at the times specified, the actual time of each measurement shall be recorded.

Immediately upon completion of the test pumping, the Contractor shall take recovery measurements and record them on the test pump form. The recovery readings shall be measured according to the following schedule:

from 1 to 10 minutes -- every 1 minute
from 10 to 20 minutes -- every 2 minutes
from 20 to 30 minutes -- every 5 minutes
from 30 to 120 minutes -- every 10 minutes

Recovery readings shall last for two hours, or until the water level recovers to within 2 feet of static water level, whichever comes first. Compensation for recovery measurements is included in the test pumping payment.

31.14 Placement of Sanitary Grout

The annular space between the oversize hole and the well casing shall be grouted from a minimum 18-feet below the surface to the surface. When deemed necessary and at the direction of the Project Manager, this distance may be changed. A spacer plug may be used between the well casing and the drilled hole to prevent the grout from flowing below the 18-foot level. If consolidated formations are encountered above the depth shown, casing will be grouted a minimum of 5-feet into the formation. A minimum annular grout thickness of 2-inches for the entire length of casing grouted shall be maintained. A temporary casing shall be installed to insure the minimum specified grout thickness. This casing shall be withdrawn as the grout is placed. The method of grouting must be approved by the Project Manager prior to the commencement of grouting. Wet grouting method must force the grout under pressure from the bottom of the space to be grouted towards the surface, in a single operation. No work on the well will be permitted within 72 hours after completion of grouting if Type 1 cement or bentonite is used. This period may be reduced to 24 hours if Type 3 (quick-set) cement is used.

Cement grout is required where bedrock is encountered within the grouted zone or where the static water level of the well is at or above the zone to be grouted.

Dry bentonite grouting shall be permitted only where the interval to be grouted is 30 feet or less, clearly visible from the surface and dry. Dry bentonite grout may not be used if groundwater or bedrock is encountered in the zone to be grouted. The grouting method shall use tamping or vibration of the grout to ensure that no voids are left in the grouted zone. Quantities of dry grout shall be compared to the volume of grouted space, and the Contractor shall ensure that all voids are filled.

No grout shall be placed in the utilized aquifer. If an open hole has been drilled below the depth specified, the lower part shall also be grouted with cement. No payment shall be made for this additional footage or grouting.

31.15 Disinfection

Upon completion of construction and test pumping, the well shall be thoroughly cleaned of foreign substances including but not limited to cement, oil, grease, joint dope, and scum. The well shall then be disinfected with a chlorine solution. The chlorine solution used for disinfecting shall be prepared prior to injection into the well and shall be of such volume and strength and so applied that a minimum concentration of 50 ppm of free available chlorine shall be maintained in all parts of the well and water system for at least 24 hours before removal by the Contractor. The Contractor shall test for this concentration and shall submit the results of the test to the Project Manager. After the 24 hour period the well shall be pumped until the chlorine residual drops to a maximum of 0.4 parts per million (ppm). The Contractor shall test for this residual and shall submit results to the Project Manager.

Use of undissolved granular HTH for disinfection is not allowed.

31.16 Abandonment

Wells shall be abandoned when there is insufficient capacity, unsatisfactory water quality, poor alignment, loss of tools, or other unforeseen problems.

Abandoned wells shall be sealed to prevent the vertical movement of water into the aquifer. The Contractor may pull the well casing from the hole while filling with grout, concrete, or puddling clay. If the casing cannot be pulled, it shall be cut off at least 2 feet below ground surface and sealed with grout, concrete, or puddling clay.

The Contractor shall adhere to the state and local health department rules and regulations for well abandonment. The guiding principle to be followed in sealing the abandoned well is to restore the controlling geological conditions that originally existed.

If a well is abandoned due to no fault of the Contractor, they shall be reimbursed as described under the method of payment.

A well abandoned due to contamination, poor alignment, loss of tools, or any other cause attributable to the Contractor shall be sealed as described at the Contractor's expense.

31.17 Water Analysis

The Contractor shall collect water samples from each completed well and submit them to the State or E.P.A. certified laboratory. Samples from all wells shall be analyzed for total coliform bacteria, nitrate as nitrogen, and all other contaminants/physical characteristics listed in applicable attachments.

If positive bacteriological results are obtained, the well disinfection shall be repeated and samples retaken until negative results are obtained.

31.18 Clean Up

The well site shall be restored to its original condition. All underbrush or trees damaged during the drilling operation shall be completely removed, burned, or buried. All drill tailings shall be removed from the site or buried and the surface profile shall be restored to its original condition.

31.19 Marking

The well casing protruding through the ground shall have specific well data scribed upon it. The steel well casing shall be scribed with a welding rod or by stamping with steel. The following data serves as typical example:

Completion Date May 2020
Well Depth 150 feet
Static Water Level 20 feet (below ground surface)
Length of Screen 10 feet
Yield 10 gpm

The Contractor would then scribe the following data on the casing:

5/20 D-150' SWL 20' S10' Y10

31.20 Well Cap

Once the well has been properly disinfected and the water analyzed, the Contractor shall temporarily cap the well with a steel plate welded securely to the top of the casing. The cap shall be watertight. No additional payment shall be made for this requirement; payment shall be incorporated in the overall well cost.

31.21 Submittals

The Contractor shall submit after construction the following information:

1. Water well report (log).

2. Bacteriological Analysis Results.
3. Water Chemical Analysis Results.
4. Pump Test Field Data Recording Form (Using the attached template).