Drilling of BGD-14 Project
Solicitation Number: CO-00261-SM
Job No.: 19-8607

ADDENDUM 2
April 2, 2019

To Bidder of Record:

This addendum, applicable to work referenced above, is an amendment to the bid proposal, plans and specifications and as such will be a part of and included in the Contract Documents. Acknowledge receipt of this addendum by entering the Addendum number and issue date on the space provided in submitted copies of the bid proposal.

RESPONSES TO QUESTIONS

1. Question

In reviewing the well diagram for Well BGD-14 Construction the specifications state that the test hole shall be reamed to a diameter of 24 inches to depth of 1300'. Then the lower portion of well is underreamed to 22-inches in diameter to Total Depth. The final well screen is 12" nominal diameter and centered in the lower formation with 80' of lap pipe into 18" casing set in upper part of well.

For wells this deep, Hydro Resources uses the Flooded Reverse Mud Rotary Drilling Method. Our rig can drill a 24" borehole to total depth without the need for underreaming. When it comes to well completion, we would backfill with sand to the casing point. Set and cement the casing as specified and then clean out the sand from the production zone using our reverse circulation drilling method. After the screen assembly has been set and centered in the hole, the annular space between the outside of the screen assembly and the side of the hole shall be filled with gravel as specified.

Using this approach, we can provide SAWS with the well design specified, while eliminating the need for underreaming and a desander.

Is this an acceptable drilling method for this project?

Is this an acceptable approach to completing the Well BGD-14?

Response

No, neither the suggested drilling method nor the suggested completion method will be acceptable.

2. Question

Has TCEQ approval been obtained for construction of the new wells? If not, when is it anticipated to be received?

Response

Specifications have been sent to TCEQ for plan review. It is anticipated that SAWS will receive approval prior to beginning construction of the well.

3. Question

Are there after hours/holiday/weekend inspection costs that the contractor will have to pay?

Response

No, there are no costs for weekend or after hours inspection. If an inspection is anticipated to fall on a weekend, SAWS will require notification on the Wednesday prior to the weekend inspection. For holidays, SAWS requests that work requiring inspection be scheduled for a normal workday unless it is an emergency.

4. Question

Will water be provided for construction supply and if so where will can we get water?

Response

The Contractor may elect to drill a rig supply well on the pad or use Monitor Well C-2 (Carrizo Monitor Well) located approximately 250 feet from the BGD-14 well site. If Monitor Well C-2 is used, the Contractor will be required to remove the existing sample pump and place their own pump in the well. At the conclusion of the project, the Contractor will be required to reinstall the SAWS sample pump back in the well.

5. Question

Can the contract time of 150 days be extended to 210 days?

Response

The contract time will be extended to 180 days. See changes to Contract Documents below.

6. Question

Can all weather/crushed limestone access road and pad be left in place OR will it need to be removed once construction is completed?

Response

The Contractor will not be required to remove the all-weather/crushed limestone access road and pad at the conclusion of the project.

7. Question

Please clarify if the owner and/or engineer will stake the well location.

Response

The engineer will stake the well location prior to construction.

8. Question

Please clarify how often/phases of work that construction photos are required and if it must be a professional photographer.

Response

Please see Specification Section 01322 "Construction Photographs and Video Surveys". A professional photographer is not required. Construction photographs should be taken on first working day of each month, prior to mobilization at drilling site, during drilling and other significant stages of construction.

9. Question

Please clarify that the test pump must be line shaft turbine and that a submersible pump is not acceptable.

Response

A submersible pump is not acceptable for development. If for some reason after development is complete the contractor elects to use a submersible pump for testing, a submersible pump may be used for testing. No additional payment will be made for provision, installation, and removal of the submersible pump for testing in that case.

10. Question

Please clarify that the drilling rig must set all casing and that a crane cannot be used to install.

Response

The drilling rig shall set all casing. A crane will not be acceptable.

11. Question

Are temporary field offices required and if so what are the specific requirements?

Response

Please see Specification 01500 "Construction Facilities and Temporary Controls" Section 1.9. Field offices are optional and at the discretion of the Contractor.

12. Question

The 18" casing is specified to have weld collars. These aren't necessary and can be very cumbersome during construction. Will plain end beveled pipe be acceptable (this is the industry standard)?

Response

It is our understanding that Roscoe Moss (the main commercial provider of HSLA casing) usually provides weld collars on their casing. However, the specification has been modified in this addendum to allow plain end beveled casing.

13. Question

The 18" casing is specified to be .500" WT. We are told that the delivery time is very long but .437" WT is available immediately. Is .437" WT acceptable?

Response

The cement specification has been modified to permit the use of 0.437" thickness casing.

14. Question

Please provide details/drawings for the where the erosion control is required (i.e. where silt fence is to be installed and quantity (LF)).

Response

The contractor is to provide an erosion and sedimentation control plan as part of the work.

15. Question

Will density testing be required for the road and pad? If so, please provide the required specifications.

Response

No.

16. Question

Please provide details/specs/drawings on the fencing (such as the type of posts, wire, etc.).

Response

Please see the notes in the plans.

17. Question

Will the contractor be required to have a licensed well driller on site around the clock during drilling operations (we would strongly recommend this be required)?

Response

Yes, please see Specification Section 02633 "Well Drilling and Testing, General". A licensed driller, superintendent, or tool pusher meeting the requirements of Specification Section 02633 (1.1) (A) will be acceptable. Further, our understanding of the state water well drillers' rules is that since June 2016 a licensed driller is required to be on site during drilling and construction of a water well.

CHANGES TO THE SPECIFICATIONS

1. Remove the Price Proposal (pages PP-1 thru PP- 4) in its entirety and replace with the revised version attached to this
Addendum. Respondents should use the revised Price Proposal when submitting a proposal for this project.

2. Remove the Proposal Certifications (page PC-1) in its entirety and replace with the revised version attached to thisAddendum. Respondents should use the revised Proposal Certifications when submitting a proposal for this project.

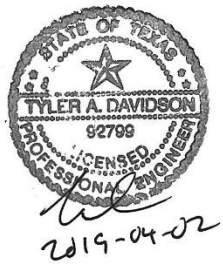
3. Remove Section 02634 (pages 02634-01 thru 02634-28) in its entirety and replace with the revised version attached to this Addendum.

CHANGES TO THE PLANS

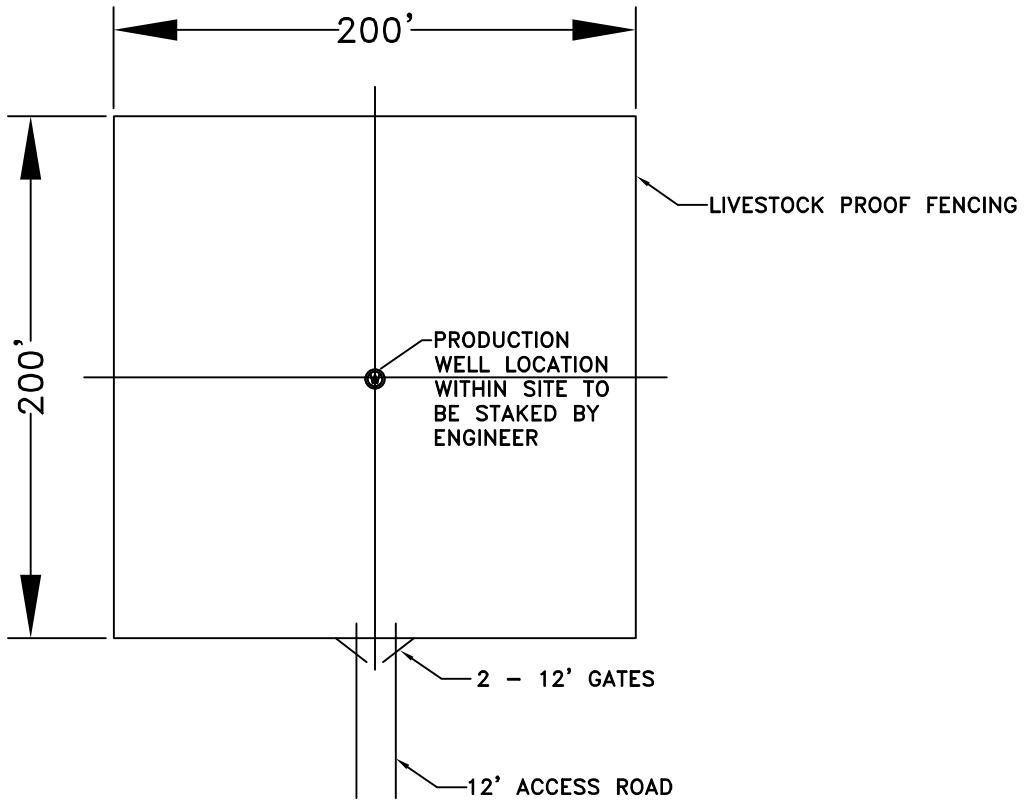
1. Drawing 2 “Site Layout and Production Well” has been revised and is included with this addendum.

END OF ADDENDUM

This Addendum, including these 5 pages, is 39 pages with attachments in its entirety.



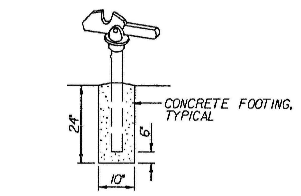
Tyler A. Davidson, P.E.
WSP USA



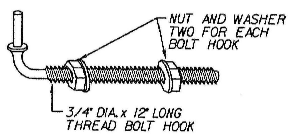
NOTES:

1. FENCE CONSTRUCTED WITH FIVE STRANDS OF BARBED WIRE STRETCHED TAUT.
2. METAL T–POSTS EVERY 15 FEET WITH BRACED WOODEN, CCA TREATED CORNER POSTS AT LEAST 5 INCHES IN DIAMETER.
3. LIVESTOCK FENCE AND GATES SHALL REMAIN IN PLACE AT COMPLETION OF PROJECT. TWO GATES, EACH AT LEAST 8 FEET IN LENGTH, SHALL BE INSTALLED AT ENTRANCE.

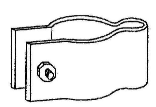
TYPICAL SITE LAYOUT
N.T.S.



GATEKEEPER
(TO HOLD GATE OPEN)

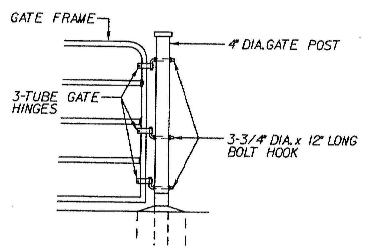


BOLT HOOK



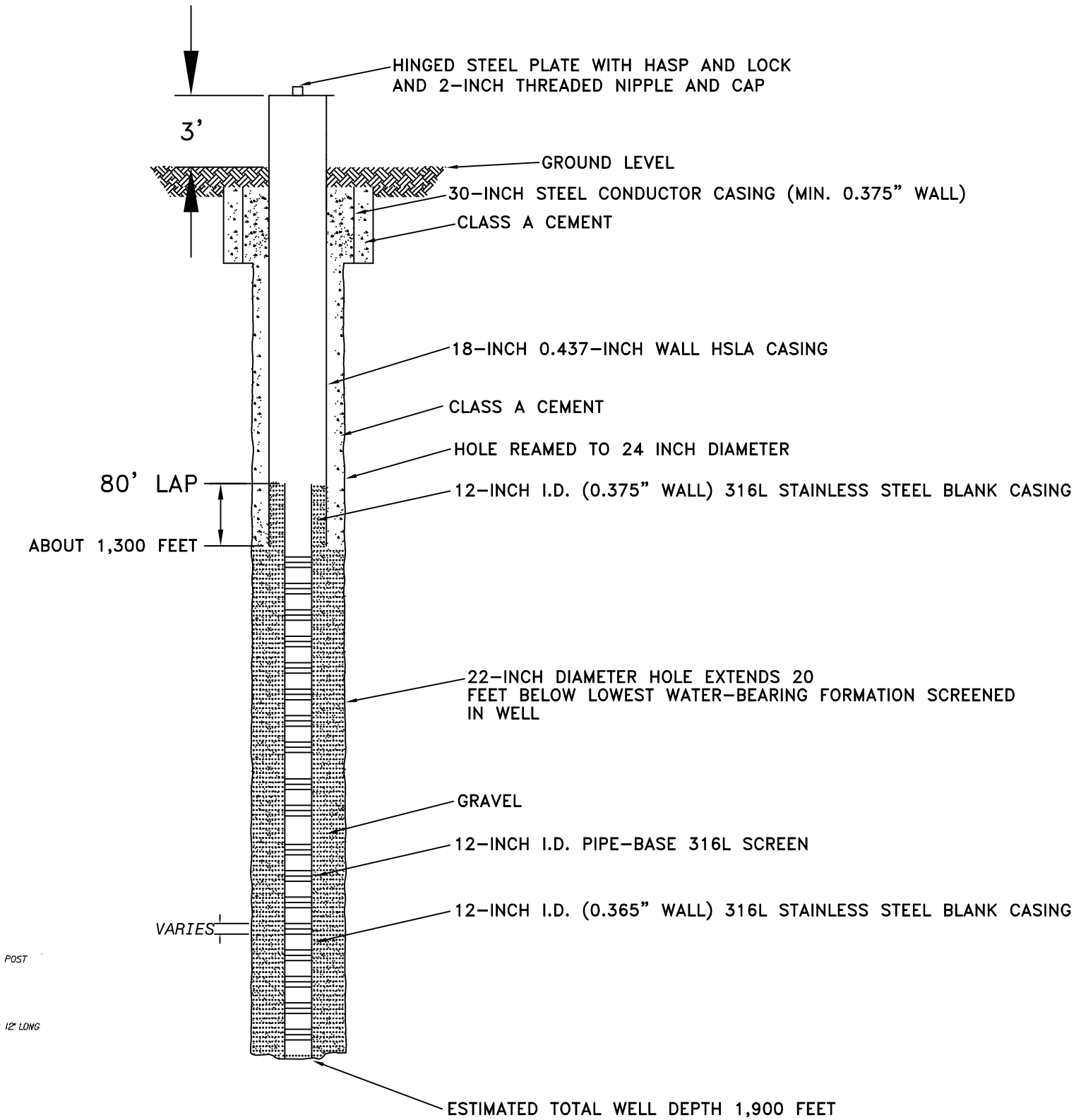
TUBE GATE HINGE

SWING GATE HINGE DETAILS



SWING GATE AT POST DETAIL

3 MISCELLANEOUS DETAILS



WELL SCHEMATIC (Not to Scale)

DATE	REVISIONS AND RECORD OF ISSUE
2019-04-02	ADDENDUM 2

WSP USA
1101 South Capital of Texas Hwy
Suite B-220
Austin, Texas 78746

SAN ANTONIO WATER SYSTEM
BGD-14 WELL CONSTRUCTION

SITE LAYOUT AND PRODUCTION WELL

DESIGNED:
DETAILED:
CHECKED:
APPROVED:
DATE: JULY 2013

PROJECT NO.

SAWS JOB NO.
19-8607

SHEET 2 OF 2

KLL 2/13/2019

FD177185

S:\Projects\SAWS\Water_Resources_Engineering_Contract\2018\Task 10 - Brackish Well 14
PW FILE: SITE_PLAN_well14.dwg

PRICE PROPOSAL

PROPOSAL OF _____ , a corporation _____

a partnership consisting of_____
an individual doing business as _____

THE SAN ANTONIO WATER SYSTEM:
Pursuant to Instructions and Invitations for Competitive Sealed Proposals, the undersigned proposes to furnish all labor and materials as specified and perform the work required for the project as specified, in accordance with the Plans and Specifications for the following prices to wit:

Schedule of prices for the BGD-14 WELL CONSTRUCTION will be in accordance with the Contract Documents. Respondent must complete entire schedule.

Notes:

1. Total price includes cost for furnishing all tools, equipment, materials, supplies and manufactured articles and furnishing all labor, transportation, and service, including fuel power, water and essential communication and performing all the work, or other operations required for the contract in strict accordance with the contract documents. Any item not specifically called out under each unit item shall be included under a unit item listed that is closely related to a missing item. CONTRACTOR is directed to the Measurement and Payment section of this document for a description of each unit item.

2.

LS = Lump sum	HR = Hour	Sack = Sacks	CY = Cubic yard
LF = Linear feet	CF = Cubic feet	EA = Each	SY = Square yard
LB = Pound	GAL = Gallon	TON = Tons	ACRE = Acre

Item No.	Description Unit Price to be written in Words)	Unit	Quantity	Unit Price (Figures)	Total Price (Figures)
Part 1: Production Well Construction (1 Well)					
1.	Drill Pilot Hole	LF	1,960	$_____	$_____
2	Pilot Hole Geophysical Logging Suite	EA	1	$_____	$_____
3.	Perform Nuclear Magnetic Resonance (NMR) Log	EA	1	$_____	$_____
4.	Post-Processing of Geophysical Logging Data When Nuclear Magnetic Resonance Log is Run	EA	1	$_____	$_____
5.	Install Temporary Well, Develop With Air and Test Pump for a Combined Total of 36 Hours, and Complete Water Sampling in a 300-foot Interval	EA	1	$_____	$_____
6.	Additional Development Pumping During Water Sampling Operations	HR	12	$_____	$_____
7.	Abandonment of Pilot Hole In the Well	LF	1,960	$_____	$_____
8.	Ream Pilot Hole to a Minimum Nominal 24-inch Diameter	LF	1,260	$_____	$_____
9.	Continuous Alignment Survey and Caliper Survey of Reamed Borehole	EA	1	$_____	$_____

Item No.	Description Unit Price to be written in Words)	Unit	Quantity	Unit Price (Figures)	Total Price (Figures)
10.	Furnish and Install 18-Inch nominal Diameter High-Strength, Low-Alloy (ASTM A606-04) Steel Casing	LF	1,300	$_____	$_____
11.	Furnish and Emplace API Class A Cement with Approved Additives	LF	1,300	$_____	$ _____
12.	Underream Pilot Hole to a Minimum Nominal 22-inch Diameter	LF	600	$_____	$_____
13.	Caliper Survey of Underreamed Borehole	EA	1	$_____	$ _____
14.	Furnish and Install 12-inch Nominal Diameter, Continuous-Slot, Wire-Wound, Pipe-Based, Stainless Steel Screen	LF	400	$_____	$ _____
15.	Furnish and Install 12-inch Nominal Diameter, Type 316L Stainless Steel Blank Pipe	LF	280	$_____	$ _____
16.	Furnish and Install Filter Pack	LF	680	$_____	$ _____
17.	Furnish, Install, and Remove Test Pump for Development and Testing	EA	1	$_____	$ _____
18.	Well Development, Constant Discharge Pumping Test And Recovery	EA	1	$_____	$ _____
19.	Furnish, Install and Remove, Temporary Piping, Booster Pumps, Valves, and Road Crossings to Convey Development Water and Pumping Test Waters to Irrigation Area 1	EA	1	$_____	$ _____
20.	Furnish, Install and Remove, Temporary Piping, Booster Pumps, Valves, and Road Crossings to Convey Development Water and Pumping Test Waters to Irrigation Area 2	EA	1	$_____	$ _____
21.	Furnish, Install and Remove, Irrigation System for Area 1	EA	1	$_____	$ _____
22.	Furnish, Install and Remove, Irrigation System for Area 2	EA	1	$_____	$ _____
23.	Operation of Irrigation System	HR	192	$_____	$ _____
24.	Water Quality Sampling and Analyses	EA	1	$_____	$ _____
25.	Well Disinfection	EA	1	$_____	$ _____
26.	Final Well Color Video Log	EA	1	$_____	$ _____
27.	Standby Time at the Direction of the ENGINEER	HR	24	$_____	$ _____
28.	Additional Hours of Pumping for Constant Discharge Pumping Test	HR	24	$_____	$ _____

SUBTOTAL (Part1) **$**_____

Item No.	Description Unit Price to be written in Words)	Unit	Quantity	Unit Price (Figures)	Total Price (Figures)
PART 2: Site Work					
1.	Site Clearing Pad Installation	EA	1	$_____	$ _____
2.	Erosion Control	EA	1	$_____	$ _____

SUBTOTAL (Part 2) **$**_____

LINE ITEM "A" - SUBTOTAL BASE BID (Parts 1, and 2) $_____
(Price in Figures)

MOBILIZATION LUMP SUM $_____

Mobilization lump sum bid shall be limited to a maximum 10% of the Line Item "A" Sub-total Base Bid amount. The Line Item "A" Sub-total base bid is defined as all bid items. **In the event of a discrepancy between the written percentage and dollar amount shown for Mobilization bid item the written percentage will govern**. **If the percentage written exceeds the allowable maximum stated for mobilization, SAWS reserves the right to cap the amount at the percentages shown and adjust the extensions of the bid items accordingly.**

TOTAL BID AMOUNT (Line Item "A" Base Bid (Parts 1 & 2), Mobilization)
$_____

_____**DOLLARS AND**

_____ **CENTS**

_____
RESPONDENT'S SIGNATURE & TITLE

_____
FIRM'S NAME (TYPE OR PRINT)

_____
FIRM'S ADDRESS

_____
FIRM'S PHONE NO. /FAX NO.

_____
FIRM'S EMAIL ADDRESS

The Contractor herein acknowledges receipt of the following:
Addendum Nos._____

The Respondent offers to construct the Project in accordance with the Contract Documents for the contract price, and to complete the Project within **180** calendar days after the start date, as set forth in the Authorization to Proceed. **The Respondent understands and accepts the provisions of the contract Documents relating to liquidated damages of the project if not completed on time.**
Complete the additional requirements of the Proposal which are included on the following pages.

Addenda Verification

The Respondent acknowledges receipt of the following addenda:

No. _____	Dated_____	Signed_____
No. _____	Dated_____	Signed_____
No. _____	Dated_____	Signed_____
No. _____	Dated_____	Signed_____

PROPOSAL CERTIFICATION

Accompanying this proposal is a Bid Bond or Certified or Cashier's Check payable to the Order of the San Antonio Water *System for* _____ *dollars ($*_____), which amount represents five percent (5%) of the total bid price. Said bond or check is to be returned to the bidder unless the proposal is accepted and the bidder fails to execute and file a contract within **10** calendar days after the award of the Contract, in which case the check shall become the property of said San Antonio Water System, and shall be considered as payment for damages due to delay and other inconveniences suffered by said San Antonio Water System due to the failure of the bidder to execute the contract. The San Antonio Water System reserves the right to reject any and all bids.

It is anticipated that the Owner will act on this proposal within **90** calendar days after the bid opening. Upon acceptance and award of the contract to the undersigned by the Owner, the undersigned shall execute standard San Antonio Water System Contract Documents and make Performance and Payment Bonds for the full amount of the contract within **10** calendar days after the award of the Contract to secure proper compliance with the terms and provisions of the contract, to insure and guarantee the work until final completion and acceptance, and the guarantee period stipulated, and to guarantee payment of all lawful claims for labor performed and materials furnished in the fulfillment of the contract.

It is anticipated that the Owner will provide written Authorization to Proceed within **30** days after the award of the Contract.

The work called for in this Contract shall commence on the date indicated in the SAWS written Authorization to Proceed Under no circumstances shall the work commence prior to the date provided for in the SAWS issued, written Authorization to Proceed. Work shall be completed in full within 180 consecutive calendar days.

The undersigned further acknowledges compliance with "Wage and Labor Standard Provisions" of this contract and the use of the Blue Book rental rates for establishment of equipment rental rates whether owned or leased during the course of this Contract.

In completing the work contained in this proposal the undersigned certifies that bidder's practices and policies do not discriminate on the grounds of race, color, religion, sex or national origin and that the bidder will affirmatively cooperate in the implementation of these policies and practices.

Signed: _____
Company Representative

_____
Company Name

_____

_____
Address

Please return bidder's check to: _____
Company Name

_____

_____
Address

SECTION 02634

WILCOX PRODUCTION WELL

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall construct, develop, pump test, and obtain water-quality samples for the production well. A production well shall be drilled at the site following the successful development of a drilling water supply at the site. Initially for a production well, the process will involve the drilling of a pilot borehole. Upon completion of drilling, geophysical logging of the pilot borehole will be performed. Based on lithology and the geophysical logs, the decision will be made to collect a water sample from a selected depth interval, ream and complete the borehole as a well or abandon the pilot borehole. This decision will be based on the completed well's anticipated ability to meet the project water quality and water production goals. The borehole then will be reamed to full diameter for well construction using either the direct mud rotary or air-assisted reverse rotary circulation drilling method. An installed well capacity of at least 800 to 1,200 gpm is anticipated. The WORK will include drilling, logging, water sampling if needed, reaming, construction, pump testing and water-quality sampling of the well, including all appurtenant work, complete and operable, all in accordance with the requirements of these Technical Specifications.

B. Sequence of Work: The test wells shall be constructed in accordance with the Specifications and Contract Drawings and as follows:

1. Set up drill rig at site.
2. Drill a pilot borehole through the Wilcox Formation.
3. Collect and deliver lithologic samples to the sieve laboratory and duplicate set to the ENGINEER.
4. Perform pilot borehole geophysical logging suite.
5. Perform water sampling of a selected depth interval, if needed.
6. Provide sieve analysis results and screen recommendations.
7. Ream the pilot borehole to minimum 24-inch diameter to the specified depth.
8. Perform continuous/alignment survey and caliper log on the reamed pilot borehole. Correct plumbness and alignment, as necessary.
9. Furnish and install well nominal 18-inch diameter surface casing assembly and cement casing into place.
10. Ream and underream the pilot borehole to minimum nominal 22-inch diameter to the specified depth.
11. Perform caliper survey of underreamed hole. Correct hole diameter and depth, as necessary.
12. Furnish and install nominal 12-inch diameter well screen assembly.

Install gravel pack to proper depth.

13. Conduct sizing alignment survey for final plumbness and alignment acceptance of well casing.
14. Develop the well by approved methods.
15. Perform pre tests and a 36-hour constant-discharge test.
16. Collect and analyze water samples for analyses after 36-hour constant-discharge pumping test.
17. Disinfect and seal the final casing with a blind flange cap at 3 feet above grade.
18. Perform a color borehole video log on the final well.

1.2 CONTRACTOR SUBMITTALS

A. Discharge and Settling Tank(s): The CONTRACTOR shall provide specifications of on-site sedimentation and infiltration basins which will be used during drilling, airlift development, and pumping development for the settling of sand and silt prior to discharge.

B. Water Quality Results: The CONTRACTOR shall submit to the ENGINEER four copies of the laboratory reports describing the results for analyses. These results shall be provided within two weeks of sample collection.

C. Drilling Log: A log of the formations encountered from surface to total depth, indicating the depth of each change in formation and including all difficulties and unusual conditions met during drilling shall be prepared by the CONTRACTOR. The drilling log shall be available for inspection at the site at all times. The CONTRACTOR will supply an operational drilling rate recorder (Geolograph® or equal) log to the ENGINEER at the end of each 24-hour period of drilling activity. A record of drilling mud properties as applicable at 4-hour intervals showing fluid density, Marsh funnel viscosity, sand content, pH, drilling fluid losses, filtrate rate, mud cake thickness, all additions of water or manufactured products to the drilling mud, and the drilling depth at the time of the additions shall be provided to the ENGINEER. Legible forms covering the previous day suitable for photocopying shall be submitted to the ENGINEER on a daily basis.

D. Final Well Completion Log: The final well completion log shall consist of a diagram showing the following details: diameter, wall thickness, depths and lengths of casings installed; borehole diameters; cemented conductor casings; depths and thickness of annular seals; and all other pertinent details. The CONTRACTOR shall submit five copies of the final log to the ENGINEER within 30 days of well completion.

E. Well Completion Report: A Water Well Report as required by Texas Administrative Code, Title 30, Part 1, Chapter 290, Subchapter D, Rule §290.41 Environmental Quality, Texas Commission on Environmental Quality, Public Drinking Water, Rules and Regulations for Public Water Systems, Water Sources shall be filed with the Texas Department of Licensing

and Regulation and copies submitted to the ENGINEEER within 30 days of well construction completion.

F. Formation Sample Sieve Analyses: A sieve analysis of representative formation samples shall be performed by a Certified Testing Laboratory approved by the ENGINEER. The sieve analysis shall be performed on a rapid turn-around basis, with the final results available to the ENGINEER no later than 48 hours after completion of the pilot borehole geophysical logging. Sieve analyses will be performed on up to sixty (60) samples per well, as specified by the ENGINEER during drilling operations.

G. Casing Centralizer Design: The CONTRACTOR shall submit documents to the ENGINEER detailing the design of casing centralizers. These documents shall include dimensioned engineer's drawings, materials descriptions, and digital photographs of the casing centralizers and will also include a description of installation procedures. This submittal shall be made to the ENGINEER not later than five working days prior to casing installation for ENGINEER approval.

H. Orifice Plate Certification: The CONTRACTOR shall submit documents to the ENGINEER certifying the calibration of orifices and related measuring equipment that will be used in the orifice weir during pumping tests. Additionally, the meter calibration certificates for all flow meters will be submitted to the ENGINEER prior to the commencement of pumping tests.

I. Tally of Casing and Screen: The CONTRACTOR shall submit to the ENGINEER, a tally of casing and screen to be installed in the well at least 24 hours prior to the installation.

1.3 QUALITY ASSURANCE

A. Gravel Filter Pack Material: A Certified Testing Laboratory (approved by the ENGINEER) shall submit a sieve analysis of the delivered material.

B. Geophysical Logs: Geophysical logs shall be performed by a qualified service company acceptable to the ENGINEER and experienced in water well logging and the performance of such logs, such as Schlumberger™ or Baker-Atlas™. The operator shall be knowledgeable in the interpretation of logs, to the degree that he can make decisions regarding the accuracy and validity of the logs and the sensitivity of the instruments, while using a geophysical logging system capable of producing logs in digital format. The resolution and precision of each instrument shall be adequate for the interpretation of the formation properties being studied, calibration standards independent of the logging equipment will be used, and calibration and quality control information can be presented on the logs. Each log shall be recorded using a depth measurement that is accurate to within 0.1 foot using a resolution of approximately $1/50^{th}$ of the greatest deviation of the quantity measured over the entire log. Each log shall include a repeat section at a depth determined by the ENGINEER. Each logging tool shall be calibrated in the presence of the ENGINEER. The CONTRACTOR shall

require the geophysical logging subcontractor to provide data post-processing services as directed by the ENGINEER. Details of the logging formats and required post-processing services are described in the Supplement to 02634.

PART 2 – PRODUCTS

2.1 CASING, SCREENS, AND APPURTENANCES

A. Conductor Casing: The conductor casing shall be minimum 30-inch outside diameter (OD) with a minimum wall thickness of 0.375 inch and shall be mild steel meeting the requirements of ASTM A 53, grade B, or ASTM A 139. The conductor casing shall be factory assembled in not less than 20-foot lengths and be set at a depth not less than 40 feet below grade. The ends of each joint shall be machine beveled perpendicular to the casing axis to ensure the straightness of each assembled section. Casing joints shall be welded in accordance with ANSI/AWS D1.1 and AWS D10.9. All conductor casing material shall be new and unused.

B. Well Casing: The well casing shall be 18-inch nominal diameter with a minimum wall thickness of 0.437 inches. The CONTRACTOR will be required provide line item prices for casing. SAWS will make the casing material selection based upon the bids received. The following casing materials are acceptable:

1. High-strength, low-alloy (HSLA) steel casing meeting the requirements of ASTM A 606 Type 4 and constructed in accordance with ASTM A139 or other comparable proposed casing with approval of ENGINEER. The well casing shall be 18-inch nominal diameter with a minimum wall thickness of 0.437-inches and factory assembled in sections of not less than 20 feet in length. Smaller lengths of 5 and 10 feet may be used upon approval of the ENGINEER to accommodate the final well design. Casing joints shall be welded in accordance with ANSI/AWS D1.1 and AWS D10.9.

   The casing shall be either

   a) Plain end, and beveled for welding, or

   b) Fitted welding collar installed at the factory. Collars shall be high strength, low alloy steel meeting the requirements of ASTM A 606-04, of the same type and thickness as the corresponding casing section, 2-inches minimum in width, rolled to fit the outside diameter, and welded to the casing section. The inside edge of the casing collars shall be ground or sufficiently scarified to remove sharp edges or burrs. Section ends shall be machined flat perpendicular to the axis of the casing and shall not vary more than

0.010 inch at any point from a true plane at right angles to the axis of the casing.

B. Well Casing Guides: Materials shall be compatible physically and chemically with the well casing. Casing centralizers shall be fitted on all steel casing using Halliburton Company or equal centralizers with "bow-spring" straps at 0, 90, 180, and 270 degrees around the casing at each position or using steel plate bowed and placed at 0, 90, 180 and 270 degrees. Centralizers shall be attached to steel casing with steel straps or welded and made of the same material as the casing. Casing centralizers shall meet the requirements of API Specification 10D.

C. Production Casing: The production casing shall consist of stainless steel wire wrapped screen sections and stainless steel blanks in between screen sections.

1. Traditional pipe-based, wire-wound, continuous-slot screen well screen shall be used. Where specified, the well screens or any pipe base shall be 12-inch nominal diameter and manufactured of AISI Type 316L stainless steel. The well screens shall be Weatherford Johnson® Screens or equal. The well screens shall be designed and manufactured to withstand tensile and collapse pressures for typical installation to the depths of their settings. Provide data on the collapse pressure and tensile strength of the screen. The well screens shall utilize the continuous slot, pipe-based, wire-wrapped design with V-type wire to provide maximum inlet area consistent with strength requirements. Screened intervals may include blank sections of casing, no less than ten (10) feet in length. The blank casing intervals shall utilize AISI Type 316L stainless steel casing meeting the requirements of ASTM A 312. The blank casing shall be 12-inch diameter with a minimum wall thickness of 0.375-inch, factory assembled in sections of not less than 20 feet in length. Well screen assembly shall include a 10-foot sump consisting of blank, AISI Type 316L stainless steel casing meeting the requirements of ASTM A 312. The diameter and wall thickness of any screen pipe base shall be same as that of the blank casing between screens.

For bidding purposes, a screen slot size ranging from 0.020 to 0.045 inch should be assumed. Actual slot size and screen length will be reviewed by the ENGINEER based on the sieve analyses from the pilot bore hole.

If screens are supplied in lengths less than 20 feet, they shall be manufactured with AISI Type 316L stainless steel with weld rings optional and attached to each end. The weld rings shall be standard available lengths as requested by the CONTRACTOR and approved by the ENGINEER. The screen section ends shall be square to 1/16-inch over the first two feet of the assembly and the assembly straight to within 1/8-inch over any 10 foot length of screen. If well rings are not

used, the screen section ends shall be plain end beveled.

2.2 SEALING MATERIAL

A. Cement: Material used in sealing of the surface casing and borehole annular space shall consist of API Class A cement with 6 percent by weight bentonite. The cement slurry shall be mixed to a density of 13.5 lb/gal. The CONTRACTOR shall provide certificates from the commercial cementing company verifying that Class A cement with the required percentage of bentonite gel is provided.

2.3 GRAVEL FILTER PACK MATERIAL

A. Final selection of gravel filter pack materials will be based on the sieve analyses from pilot borehole sieve analyses.

B. All material for the stabilizing gravel filter pack shall be hard, well rounded, water-worn sands or gravels composed of at least 90 percent silica, washed clean of silt, dirt and foreign matter; crushed rock will not be accepted. The gravel selected by the Contractor shall be one of or a mixture of water well gravels furnished and processed by Pioneer Sands at Brady, Texas; Unimin Corporation, or approved equal. A sample and sieve analysis of filter packing materials to be delivered to the site must be submitted to the ENGINEER for review and acceptance at least five days prior to anticipated placement of the material in the well annulus. A Certified Testing Laboratory (approved by the ENGINEER) shall submit a sieve analysis of the delivered material to verify conformance with the approved sample. Failure to meet gradation of approved sample shall be grounds for rejection of the material. The gravel filter pack, if stockpiled at the well site, shall be kept free of all foreign matter.

PART 3 – EXECUTION

3.1 GENERAL

A. Drilling Method: The following drilling methods are acceptable for construction of the wells in the Wilcox Formation.

1. Direct Circulation, Mud-Rotary Method. The CONTRACTOR may propose production well construction using this method. In an effort to minimize drilling fluid invasion of the formation, the CONTRACTOR must achieve optimum viscosity with minimal drilling fluid unit weight. The CONTRACTOR may utilize a drilling fluid comprised of either a polymer-based “mud” or a bentonite “gel”-based mud. In the case of a “gel”-based mud, the material must be a high-yield, 200-mesh sodium bentonite (typically Baroid Quik-Gel® or CETCO Super Gel-X®) or equal. A bentonite viscosifier only meeting the requirements of API Standard 13A is considered insufficient for the applications

required in this project. All "mud" components shall be NSF Approved. The drilling fluid shall possess such characteristics as are required to adequately condition the walls of the hole to prevent caving of the walls as drilling progresses, and to permit recovery of representative samples of cuttings. The CONTRACTOR shall provide and operate portable laboratory equipment for monitoring basic drilling fluid properties such as fluid density, viscosity, pH, and filtrate rate. Drilling fluid properties shall be monitored by the CONTRACTOR and recorded in the Daily Report every 4 hours.

a. Water and Additives: Only safe sanitary water from the designated source with a minimum chlorine residual of 0.5 mg/L, or water from an on-site source of aquifer water with a minimum chlorine residual of 0.5 mg/L, shall be used in formulating drilling fluids whether employed alone or in combination with drilling additives. The CONTRACTOR shall use all new materials in the formulation of drilling fluid at each well site. Used drilling fluid materials shall not be reused at subsequent well sites. Any other drilling additives to be used shall require approval of the ENGINEER. SAWS shall provide access to a water well for water supply in the project area, as designated by the ENGINEER. The CONTRACTOR shall be responsible for maintaining the quality of the drilling fluid to assure protection of the water bearing formations exposed in the borehole to adequately maintain the walls of the hole to prevent caving of the walls as drilling progresses, and to permit recovery of representative samples of cuttings. The use of soda ash for pH control is authorized.

b. Control: The CONTRACTOR shall maintain complete control over drilling fluid characteristics during the entire operation of well construction. The CONTRACTOR at its expense, shall retain or employ an experienced, qualified drilling fluids service to help supervise drilling fluids formulation and maintain drilling fluid characteristics.

c. Holding Tanks: The CONTRACTOR shall provide holding tanks for handling the drilling fluid. The excavation of small reserve pit (60 ft x 60 ft) shall be allowed for temporarily storing drilling mud and cuttings. The reserve pit shall not be excavated more than two feet below natural grade. The CONTRACTOR shall provide adequate protection for the public at all times. Upon completion of the drilling, drilling mud and cuttings from the well shall be removed from the site and disposed of by the CONTRACTOR in accordance with State and Local regulations. The ground surface shall be restored to its original condition.

B. Depths and Lengths: The estimated diameters for boreholes and casings are shown in the construction drawings, and depths and lengths of boreholes and casings will be based on the actual lithology found in the pilot hole of the respective well. Payment will be based on actual quantities furnished,

installed, or constructed, in accordance with the schedule of values.

C. Repeat Work: All work required to be repeated, resulting from the CONTRACTOR's performance, including all additional materials, labor and equipment required, shall be furnished at the expense of the CONTRACTOR and no claim for additional compensation of construction time shall be made or be allowed therefore, except as specifically provided herein.

3.2 CONDUCTOR CASING

A. The CONTRACTOR shall set a minimum nominal 30-inch O.D. conductor casing to a depth not less than 40 feet below grade or as determined by the CONTRACTOR and approved by the ENGINEER. The conductor casing shall have a wall thickness of 0.375 inch. The borehole for the conductor casing shall not be less than 36 inches in diameter.

B. The CONTRACTOR shall initially excavate the site of the conductor casing installation to a depth of not less than 3 feet below grade and a radius of 2 feet from the borehole prior to drilling. This step is necessary to adequately determine the absence of unmapped underground utilities at the site.

C. All field joints shall be welded during installation by qualified welders in accordance with the requirements of AWWA C206. Three steel centralizers, attached near the base, middle, and top of the casing, shall be provided to center and hold the casing in the proper position until the grout seal is in place. The conductor casing shall be cemented in place to surface with "neat" cement. "Ready-mix" type cements with additives will not be authorized.

D. When the conductor casing does not require daily access, the CONTRACTOR shall place a metal plate tack welded to the opening of the casing.

3.3 PILOT HOLE

A. Drilling: The pilot hole shall have a nominal diameter of a maximum of 9.875 inches. The CONTRACTOR shall utilize a drill bit size of not less than 7.87 inches and not more than 9.875 inches in diameter. Pilot borehole diameters outside of this range are not authorized and no payment will be made for pilot borehole drilling if this drill bit size range is exceeded. The CONTRACTOR will submit a full description of the Bottom Hole Assembly, drill collars, and drill pipe string to the ENGINEER for approval prior to the commencement of drilling. Drill bits shall be of a tri-cone roller-bit type and shall not utilize carbide nozzles. The removal of the nozzles may be necessary to prevent high

velocity fluid from "washing out" the diameter of the pilot borehole and thus degrading the quality of the borehole geophysical logs. The CONTRACTOR shall take all measures necessary to protect the top portions of the test hole from caving.

B. Cuttings Collection: The first sample shall be taken at a depth of 400 feet below existing ground surface and additional samples taken at every increment of 10 feet drilled in sands. Additional samples shall be taken at every change of formation regardless of where encountered. To ensure the most representative formation samples during drilling, the pilot borehole penetration rate shall not exceed the ability of the mud system to condition the mud. The ENGINEER reserves the right to request the CONTRACTOR to slow or temporarily halt pilot hole drilling to allow for representative cuttings collection, including sand collection. Cuttings shall be circulated to surface and discharged into a container of adequate volume to ensure collection of fine formation sediments. Each sample shall be clearly labeled to indicate the depth from which the sample was taken and preserved in cloth sand sample bags and securely tied. All sample bags shall be stored in sturdy storage containers in a manner to prevent damage, loss, or breakage. Drilling shall occur while a desander and shale shaker are in use as part of the rig mud system. The CONTRACTOR will deliver geological samples from each well to ENGINEER within 10 days of well completion.

C. Maintenance of Open Hole: The CONTRACTOR will maintain the straightness of the borehole and prevent sloughing and collapse of the borehole during geophysical logging of the pilot hole. The CONTRACTOR shall circulate and condition the pilot borehole for a minimum of 2 hours following the achievement of total depth (T.D.). Borehole geophysical logging shall commence within 8 hours following the achievement of T.D. If there are problems with the straightness of the borehole or sloughing or collapse, the CONTRACTOR shall submit a plan to the ENGINEER for review and approval for correcting the problem. The corrective work shall be performed at no additional cost to SAWS and it shall not extend the length of the contract.

D. Abandonment of Pilot Borehole Below Production Zone: Upon completion of the pilot borehole drilling the CONTRACTOR shall abandon the borehole to a depth determined by the ENGINEER after a study of the driller's log, the geophysical logs, and the formation samples. The CONTRACTOR shall plug the borehole by filling it with neat cement, and abandon the borehole in accordance with Texas Water Well Driller's rules

3.4 PLUMBNESS OF PILOT BOREHOLE AND REAMED HOLE

Tests to determine the plumbness of the pilot borehole and reamed hole shall be made by the CONTRACTOR. To ensure the drilling of the wells to plumbness specifications, The CONTRACTOR shall furnish and employ a self-checking

mechanical drift indicator to measure hole deflection. Drift indications shall be taken at intervals of not more than 32 feet during the drilling of all pilot holes and reamed holes. The mechanical drift indicator shall be an "Eastman-type" mechanical drift indicator, or equal. A 3-degree unit shall be used with the indicator. The drift from vertical shall be not more than 0.75 degree for any reading. If the test does not meet the above criteria, the CONTRACTOR, at his expense shall correct the plumbness.

An analysis of the drift indicator record shall be made periodically by the CONTRACTOR and will be made as part of the drilling log record. Four copies of the alignment test results for each well shall be provided to the ENGINEER, during drilling

3.5 DOWNHOLE GEOPHYSICAL SURVEYS

A. The pilot geophysical logging firm with experience in the Wilcox Formation, and proposed by the CONTRACTOR will be subject to acceptance by SAWS and ENGINEER prior to drilling of the pilot hole. SAWS and ENGINEER shall be notified a minimum of 24-hours prior to the time when the survey will be run to witness the performance of the survey. Borehole geophysical logging shall commence within 8 hours of the time that pilot hole T.D. is achieved. In the event that the CONTRACTOR's primary geophysical subcontractor is unavailable to meet this requirement, the CONTRACTOR will have a previously designated (and approved by SAWS) secondary geophysical subcontractor to conduct the geophysical survey of the pilot hole. There will be no additional payment for rig time or standby time while the geophysical surveys are being performed.

1. The CONTRACTOR shall condition the borehole from the base of the casing to the total depth of the borehole prior to performing geophysical logs. It shall be the responsibility of the CONTRACTOR to maintain the integrity of the borehole during logging.
2. The survey response curves shall be recorded to show adequate deflections for evaluation of the penetrated formations.

B. Pilot Borehole Geophysical Logging Suite: Within 8 hours of pilot hole completion, the CONTRACTOR shall commence the test well pilot hole geophysical logging suite. The pilot hole geophysical logging suite will include the following logs at a minimum:

- Natural gamma ray spectroscopy;
- High-resolution induction resistivity;
- Compensated neutron formation density with gamma ray
- Caliper. Minimum caliper diameter 26 inches.

C. Reamed Borehole Surveys: A continuous alignment survey and caliper log will be run prior to installation of the well casing and screen. The caliper log shall include a total borehole volume indicator.

D. Completed Well Surveys: The CONTRACTOR shall conduct a color video log run inside the casing and screen prior to the CONTRACTOR demobilizing from the well. The color borehole video camera will be disinfected prior to running the log.

3.6 WATER SAMPLING

A. At the option of SAWS, water samples will be taken in the pilot hole from

sand zones selected after the pilot hole is drilled. SAWS shall be allowed a total of three working days to decide if water samples shall be taken and to inform the Contractor. Disinfection of equipment, gravel and test hole to be in accordance with ANSI/AWWA C6554-87.

B. Equipping Hole and Water Sampling Procedure:

1. After the geophysical logs are run, SAWS shall select the zone or zones in the pilot hole from which it desires water samples if SAWS deems them needed. The hole below the lowest zone selected for water samples then shall be filled with a mixture of selected sand and gravel by use of a tremie pipe and/or a cement plug if selected by SAWS. The Contractor shall then ream the pilot hole to a minimum diameter of 12 inches to the bottom of the zone selected for water sampling and shall construct a temporary gravel-packed well with screen approved by the SAWS and set opposite the deepest zone to be sampled.
2. Upon completion of reaming, the Contractor shall set 5-inch I.D. minimum diameter line pipe casing and minimum 0.237 inch wall thickness casing with up to 40 feet of 5-inch I.D. minimum diameter and 15 percent open area well screen. The Contractor shall provide a tally of the length of each joint of casing and screen set for the water sampling operation. The casing and screen shall be of sufficient strength to be retrieved from the well upon completion of water-sampling procedures in order to allow construction of a production well. The screen slot size shall retain at least 90 percent of the gravel pack material used for this temporary well. The bottom of the screen shall be fitted with a set nipple and back pressure valve or a bull plug. The annulus between the casing and screen and the outer edge of the hole shall be filled with drilling mud to the land surface, and then with selected sand and gravel by use of a tremie pipe, set initially below the top of the screen, to a point at least 30 feet above the top of the screen. Water samples shall then be pumped from inside the casing. After this water-sampling operation is completed to the ENGINEER's satisfaction, the casing and screen shall be pulled from the hole. Then the hole shall be filled by use of a tremie pipe with sand and gravel to the bottom of the second deepest zone from which water samples are desired in this hole. Then a second temporary gravel-packed well shall be made, with screen opposite this zone, following the same procedure and specifications as in the sampling of the zone below. Following the sampling of the second deepest zone, the next deepest zone shall be sampled, and so on until water samples have been obtained from all the zones from which the ENGINEER desires such samples. Following all water-sampling procedures, the pilot hole shall again be cleaned out to its bottom during subsequent drilling operations should a well be constructed.

C. Development: After the materials are set in place for a water-sampling operation, the screened section shall be developed by washing with clear water

and by agitating with air-lift pumping using an air compressor with a minimum capacity of 300 cfm at 200 psi until the test well is fully developed and producing water which is clear and free from drilling fluid. If development with air fails to produce sufficient yield, Contractor shall continue development with surge plunger, jetting tool, or other agitating equipment as required to achieve a sustained yield acceptable to the ENGINEER.

D. Pumping:

1. When the test well has been satisfactorily developed and when the water from the well is clear and acceptable to SAWS, the air development line shall be removed and a submersible pump shall be installed to a depth of up to 300 feet. The submersible pump shall have the capacity of at least 25 gallons per minute at 400 feet of head. Provision for water level measurement by electrical measuring line or steel tape shall be made. Water level recordings shall be taken before, during and after pumping.
2. The test well shall then be again pumped continuously with the submersible pump until the water is clear and acceptable to SAWS, but in no case shall the well be pumped for less than a total of 36 hours at any zone (section) sampled by airlift pumping and submersible pump pumping combined. The pumping rate shall be measured every 30 minutes during airlift and submersible pump pumping periods.
3. A record of development and pumping time shall be maintained by the CONTRACTOR. Development and pumping time shall start only after a satisfactory seal above the screen is obtained, the air line for pumping is installed, and water is being produced from the formation. Time spent on rig, tool or equipment repairing, and waiting time for tools or equipment shall not be logged as pumping time. Should the seal fail to hold until all water sampling operations and water level measuring operations are completed as determined by the ENGINEER, none of the preceding pumping time shall be charged to or paid for by SAWS.

E. Water Samples:

1. Samples of the water shall be collected from each zone when the minimum pumping period has elapsed and the water produced is acceptable to SAWS. The CONTRACTOR shall not stop pumping the pilot hole until the ENGINEER authorizes the pumping to be stopped. The rate of pumping shall be measured and recorded together with the time of pumping. The temperature, pH and conductivity of the water pumped shall be measured and recorded.
2. The CONTRACTOR shall cooperate and provide assistance during the collection of water samples for chemical analyses. The ENGINEER will collect the water quality samples and deliver them to the laboratory contracted by the CONTRACTOR. The water quality laboratory shall be certified by the State of Texas Department of Health to perform all required analyses by Texas Administrative Code, Title 30, Part 1, Chapter 290, Subchapter D,

Rule §290.41 Environmental Quality, Texas Commission on Environmental Quality, Public Drinking Water, Rules and Regulations for Public Water Systems, Water Sources and shall be acceptable to SAWS and the ENGINEER. A list of the minimum water analyses is in the following table.

WATER QUALITY ANALYSES DURING CONSTRUCTION

Suite[1]	Parameter[2]	MCL (mg/l)	EPA Method	Detection Limit
Primary Metals	Arsenic	0.01	ML/EPA 200.8	2 µg/L
	Barium	2.0	ML/EPA 200.8	100 MFL
	Beryllium	0.004	ML/EPA 200.8	1 µg/L
	Chromium	0.1	ML/EPA 200.8	10 µg/L
	Selenium	0.05	ML/EPA 200.8	5 µg/L
Secondary Metals	Aluminum	0.05-0.2	ML/EPA 200.8	50 µg/L
	Copper	1.0	ML/EPA 200.8	50 µg/L
	Iron	0.3	ML/EPA 200.7	100 µg/L
	Manganese	0.05	ML/EPA 200.8	20 µg/L
	Silver	0.1	ML/EPA 200.8	10 µg/L
	Zinc	5.0	ML/EPA 200.8	50 µg/L
	Potassium	None	ML/S3111 B	1.0 mg/L
	Calcium	None	ML/S3111 B	1.0 mg/L
	Sodium	None	ML/S3111 B	1.0 mg/L
Minerals, Etc.	Sulfate	300	ML/EPA 300.0	0.5 µg/L
	Total Sulfide	None	EPA 376.2	0.100 mg/L
	Chloride	300	ML/EPA 300.0	1 mg/L
	Fluoride	2.0	ML/EPA 340.2	0.1 mg/L
	pH	6.5-8.5	ML/SM 4500H	0.001
	Nitrate	10.0	ML/EPA 300.0	2 mg/L
	Nitrite	1.0	ML/EPA 300.0	400 µg/L
	Total Dissolved Solids	1,000	SM 2540 C/E160.1	10 mg/L
Misc. Analytes	Turbidity	None	ML/EPA 180.1	0.050 NTU
	Color	None	ML/S 2120 B	3 ACU
	Threshold Odor	None	ML/S 2150 B	1.0 TON
	Hydrogen Sulfide	None	EPA 376.2	0.100 mg/L dissolv
	Free Carbon Dioxide	None	ML/S2320 B	0.001 mg/L
	Temperature	None	SM2550	+/- 0.5 degrees
	Specific Conductivity	None	ML/S 2510 B	4 µmho/cm
	Dissolved Oxygen	None	SM4500O-B	+/- 0.5 mg/L
	Oxidation-Reduction Potential	None	SM2580B	N/A
	Total Alkalinity	None	ML/S2320 B	2.0 mg/L

	Carbonate	None	ML/S2320 B	0.001 mg/L
	Bicarbonate	None	ML/S2320 B	0.001 mg/L
Radio-logical	Gross Alpha a	15 pCi/L	SM7110B	NA
	Gross Beta	50 pCi/L	SM7110B	NA
	Radium -228	5 pCi/L	SM7500-Ra B/C/D	NA

Note 1: The list of water quality analyses is for interim approval. Water quality analyses for final well approval may include additional analyses. The list is based upon that presented in the *"Public Well Completion Data Checklist for Interim Approval"* of the Texas Commission on Environmental Quality, Water Supply Division, Utility Creating and Plan Review Team, March 2018 or the most current version.
Note 2: Iron samples will be analyzed as a total and soluble iron. The sample for soluble iron will be filtered to remove any iron precipitate.

a) Samples to be kept at 4 degree centigrade in an ice cooler with appropriate preservatives during transport to the analytical laboratory.
b) Provide three copies of results of all analyses to the ENGINEER along with the QA/QC data.

F. Water Level Measurements: Measurements of water levels inside the test well casing shall be made and recorded during the test well pumping period and for 2 hours after pumping has been stopped. The water level measurements are to be made at intervals not exceeding 15 minutes each and the exact time of each measurement is to be recorded. The measurements shall be made with a steel tape or electric measuring line to the nearest one-hundredth of a foot, and the exact position of the measuring point at the surface shall be described.

G. Lost Materials in Hole: After the water level measurements are made, the Contractor shall remove the sampling materials consisting of casing, screen and other fittings from the pilot hole. In the event the Contractor is unable to remove all materials from the pilot hole, the Contractor, and not SAWS, shall

be responsible for those materials lost in the hole and no extra payment shall be due to the Contractor for such loss. Further, if SAWS so requires, the Contractor shall take such measures as may be necessary at his own expense to remove the lost materials, or the Contractor shall drill, at his own expense, another hole at the site to replace the hole lost as the result of the loss of these materials. In the event it is necessary for the Contractor to drill another hole at the site, SAWS will require the Contractor to plug the abandoned hole, entirely at the Contractor's expense.

H. If after water sampling operations and removal of the water sampling construction casing and screen, gravel and sand remain in the borehole above the depth of the total depth of the planned monitoring well, they shall be removed. Removal shall be by washing or reaming the hole with a bit to the desired depth for the well. A separate pay item is included for the removal of

gravel and sand fill in the borehole.

3.7 CONTRACTOR'S EVALUATION

A. After completion of the pilot hole according to and meeting all these Specifications, the CONTRACTOR shall present a written report to SAWS giving its recommendations for satisfactory completion of a production well meeting these Specifications and required guarantees. The report shall include the sieve analyses of the formation samples, chemical analyses, results from any water sampling operations, the material settings recommended by the CONTRACTOR, the size of the screen openings that has been selected by the CONTRACTOR based on the character and sieve analyses of the formation samples, and the type and grading of gravel that the CONTRACTOR has selected for the well. The report shall also include a written analysis of the geophysical logs with regard to indication of natural gas and uranium rich zones by the logging company professional analyst acceptable to SAWS. Samples of the gravel and sieve analyses of the gravel and the gravel company's certificate shall be delivered to SAWS for approval at the time the CONTRACTOR submits his evaluation of the pilot hole. SAWS approval of the gravel or any other part of the CONTRACTOR's recommendations, however, shall in no way relieve the CONTRACTOR of meeting all the well performance guarantees required by these specifications and other contract documents.

3.8 OWNER INSTRUCTIONS TO PROCEED

A. Termination of Work: If information indicates that the completion of a well at the pilot borehole site is not warranted, SAWS reserves the right to terminate all further work at the site.
   1. The CONTRACTOR shall be required to abandon the pilot borehole as directed by SAWS in accordance with regulations formulated by governmental agencies having such jurisdiction.
   2. SAWS reserves the right upon termination of work at the site to have the CONTRACTOR move to another site selected by SAWS within the project area, and to drill another pilot borehole.

B. Proceed with Work: If information indicates that completion of a well at the pilot borehole site is warranted, the ENGINEER shall instruct the CONTRACTOR to proceed with reaming the pilot borehole.

C. Waiting Period: SAWS reserves the right to wait three days after the pilot borehole, geophysical surveys, and sieve analyses are completed/ submitted to the ENGINEER before instructing the CONTRACTOR to proceed with the work. No standby time will be paid for this period while SAWS interprets the information.

3.9 WELL CONSTRUCTION

A. Reamed Borehole: The borehole for the 18-inch nominal diameter well casing shall be drilled and reamed to a diameter not less than 24 inches and to a depth indicated in the Construction Drawings, or as determined by the ENGINEER. The CONTRACTOR will utilize a reaming bit configured with a pilot bit.

B. Caliper Log: After the borehole has been reamed to not less than 24 inches for the 18-inch casing, a GeoCam or equal Section Gauge Log shall be made of the reamed hole. If the section gauge log shows that the diameter of the reamed hole is less at any place than the diameter selected of 24 inches, the CONTRACTOR at its expense, if required by SAWS, shall increase the diameter to the required amount and show that this has been done by one or more additional GeoCam or equal Section Gauge Logs made at the CONTRACTOR's expense.

C. Alignment Survey:

1. After reaming and before the casing is installed, the alignment of the hole shall be checked by a Baker-Hughes INTEQ or Gyro Data continuous alignment survey, or approved equal, with readings at intervals no larger than 16 feet from the land surface to the proposed depth of the 18-inch casing. The surveying instrument shall be held in the center of the hole with guide or guides. The outside diameter of the guide shall be no more than 2 inches smaller than the nominal diameter of the hole, and the length of the guide shall be at least 16 feet. The alignment survey shall be interpreted and plotted at the well site by the well surveying company before the casing is placed in the hole. Two copies of the data and interpretive graphs shall be furnished to the ENGINEER and SAWS.
2. For any 300-foot or shorter section of the hole surveyed, the center line of the hole shall not vary or deviate more than 10 inches from a straight line connecting the two center points of the hole at the ends of the section; and a straight line connecting the two center points of the hole at the ends of any 100-foot section shall not vary or deviate from a vertical line through one of these points by more than 18 inches in the 100-foot section. If the alignment survey shows that a straight line connecting the two center points of the hole at the ends of any 100-foot section varies or deviates from a vertical line through one of these points by more than 18 inches in the 100-foot section, or if the alignment survey shows that the center line of the hole varies or deviates more than 10 inches from a straight line connecting the two center points of the hole at the ends of any 300-foot or shorter section, the Contractor shall correct the alignment and show by another alignment survey that it is corrected, or abandon and plug the hole and drill another hole at the site, all at the CONTRACTOR's expense.

D. Well and Screen Assembly: The 18-inch diameter well casing and 12-inch diameter casing and screen assembly shall be lowered into the borehole and the weight of the casing shall be supported by the drilling rig.

E. Casing Installation: The casing and screen shall be lowered into the borehole

and the weight of the casing shall be supported by the drilling rig. The hook load of the drilling rig must exceed the maximum casing weight to be encountered during the construction of the well. In the case of threaded and coupled casing, all casing tongs and associated power equipment will be supported by the drilling rig. The lower end of the surface casing shall be fitted with a standard combination float and guide shoe. Alternative methods of casing installation may be proposed by the CONTRACTOR by submitting the proposed method to the ENGINEER for approval. The CONTRACTOR will leave 36 inches of casing protruding above ground at the completion of the well installation.

F. Centralizers: All casings in each well shall be centralized in the borehole using bow-spring-type centralizers or solid flat metal bowed steel installed at intervals along the pipe at 0, 90, 180 and 270 degrees around the casing at each position. The four centralizers spaced at 90 degrees around the casing constitute a centralizer group.

1. Conductor Casing: Centralizer groups in conductor casing will be placed as follows:
   a. One group at the bottom end of the casing.
   b. One group within 30 feet of the surface.
2. Production Casing: Centralizer groups in production casing shall be aligned to permit passage of the gravel tube to the bottom of the production interval. The centralizer shall be placed as follows:
   a. One group five feet from the bottom end of the casing.
   b. One group across five feet below the top of the production casing.
   c. One group every 80 feet.

G. Cementing:

1. The surface casing shall be cemented in place with a minimum of 3 inches of cement grout around the outside of the casing from bottom to top. Following setting of the casing and placement of the cementing pipe, circulation of drilling fluid through the float shoe and out in the annulus outside the casing shall be established for at least 30 minutes prior to starting the cementing operation. The cement shall be placed by a standard Halliburton cementing method, involving pumping from the bottom inside of the casing up the outside of the casing in a continuous operation, and by a well cementing company approved by the ENGINEER. The cement and gel shall be mixed with water to have a slurry weight of 13.5 or more pounds per gallon. The slurry shall be weighed with a standard mud balance and the slurry weight shall be maintained as specified during the cementing operation. A reserve of at least 30 percent over the calculated volume of cement required for the cementing shall be stocked on location as a safety factor to fill washouts in the hole. The cement after placement shall be allowed to set for a period of not less than 36 hours, after which the plug at the bottom of the

casing may be drilled. The drilling fluid shall then be treated to eliminate all cement contamination prior to beginning any other drilling operations.

H. Underreamed Hole Below the Surface Casing:

1. Method of Reaming, Diameter, and Section Gauge Log: The hole below the surface casing shall be reamed and underreamed to the required diameter not less than 22-inch for the screened interval to a depth at least 20 feet below the lowest water-bearing formation to be screened in the well. The underreaming shall be done with a Baker hydraulic underreamer or approved equal. After the hole has been underreamed to the total depth, the wall of the underreamed hole shall be scraped through its entire length with a Baker hydraulic underreamer or approved equal. A Schlumberger, Baker-Hughes or Halliburton Section Gauge Log shall be made of the underreamed hole after the underreamed hole is scraped. If the section gauge log shows that the diameter of the underreamed hole is less at any place than the diameter selected for the underreaming, the Contractor, if required by the ENGINEER, shall increase the diameter to the required amount and show that this has been done by one or more additional Schlumberger for equal Section Gauge Logs made at the Contractor's own expense. Also, if required by the ENGINEER, the wall of the underreamed hole shall again be scraped through its entire length with a Baker hydraulic underreamer or approved equal after any additional underreaming.
2. Desander: A desander shall be provided to remove sand from the drilling fluid during the underreaming of the hole below the conductor casing. The sand content in the drilling fluid being pumped through the drill pipe shall be less than 4 percent during the underreaming operations for the well.

I. Material Settings:

1. The lengths of the several components of the screen and blank pipe in the production casing and the positions at which the several components of the production casing shall be set in the well have been estimated as shown by the base lengths given in the Price Proposal and on the plans. The exact material settings will be selected after the pilot hole has been completed.
2. Blank sections of production casing between aquifer sands screened shall not exceed 35 feet. A five-foot section of screen shall be set and alternate with each 35-foot section of blank production casing set opposite clays.
3. The bottom end of the production casing shall consist of 20 feet of blank pipe, fitted with a back pressure valve, wooden wash plug and set nipple.
4. The top of the blank pipe in the production casing in the completed well shall be 80 feet above the bottom of the surface casing.

J. Filter Pack Installation:

1. Graveling Operation: After the production casing is in place, the annular space between the production casing and the face of the underreamed hole and between the production casing and the conductor casing shall be filled with selected gravel to about 5 feet below the top of the liner in the well. The graveling operation shall be continuous until the top of the gravel is at the required position. The gravel shall be placed in the well through a gravel line which shall first be set at the bottom of the well and gradually withdrawn as the deposited gravel rises. All of the gravel shall be pumped from the surface through the gravel line. The amount of gravel placed in each 100 feet of the underreamed hole shall be measured and recorded and the record maintained concurrently with the gravelling operation. Measurements shall be made in a manner acceptable to the ENGINEER and shall be accurate within 10 percent. A wash line shall be set inside the liner to the bottom of the production casing, and at the Contractor's option the well shall be washed through the back pressure valve during the graveling operation. A quantity of gravel amounting to at least 30 percent more than the calculated volume of the annular space between the underreamed face of the well and the outside of the liner, plus the annular space between the liner and the conductor casing, shall be stocked on location before the graveling operation is started. The gravel shall be protected from contamination with soil. After development, testing and completion of the well, the gravel shall be checked and returned to the above required level. The gravel volume installed shall be at least 70 percent of the measured reamed borehole volume as calculated from the reamed borehole caliper log. If this minimum gravel volume is not installed, then the CONTRACTOR at his expense must remediate the installation in order to install the minimum amount of gravel.
2. Disinfecting Gravel: The gravel shall be disinfected by mixing granulated calcium hypochlorite or sodium hypochlorite with the gravel during placement in the well.

K. Failure to Complete: If the casing and screen cannot be landed in the correct position or at a depth approved by SAWS, the CONTRACTOR shall construct another well immediately adjacent to the original location and complete this well in accordance with the Contract Documents at no additional cost to SAWS. The abandoned hole shall be plugged for its total depth and sealed in accordance with all State of Texas regulations. The CONTRACTOR shall submit a plan in writing to the ENGINEER for the construction of a replacement well including a schedule for the work, all subject to the review and approval of the ENGINEER and SAWS.

L. Collapsed Casing: If the casing or screen should collapse for any reason prior to well completion, it shall be withdrawn and replaced at the CONTRACTOR's expense.

3.10 WELDING OF WELL CASING AND STAINLESS STEEL SCREEN

A. The standards of the American Welding Society, Structural Welding Code

(AWS D1.1) shall apply for all welded joint casing and accessories. All welds shall conform to the latest revision of ANSI B31.1.

B. All welded casing joints shall be made by welders certified in the State of Texas.

C. All welders and welding operators shall be qualified at the CONTRACTOR's sole expense by a qualified testing laboratory before performing any welding under this section. Qualification tests shall be in accordance with Section IX, Article III of the ASME Boiler and Pressure Vessel Code. Welders and operators shall be qualified for making groove welds in carbon steel pipe in position 6G for each welding process to be used.

D. Qualification tests may be waived if evidence of prior qualification is approved by the ENGINEER. The CONTRACTOR shall retest any welders at any time the ENGINEER considers the quality of the welder's work substandard. When the ENGINEER requests the retest of a previously qualified welder, the labor costs for the retest will be at SAWS's expense if the welder successfully passes the test. If the welder fails the retest, all costs shall be at the CONTRACTOR's expense.

E. There shall be a minimum of three weld passes on pipe sizes 6 inches and greater. Welded joints shall be allowed to cure for not less than 15 minutes before weld is placed in contact with water.

F. Weld Reinforcement: Weld reinforcement shall be as specified by the AWS code. Upon completion of welding, all weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance, with uniform weld contours and dimensions.

G. Welding Rod: The welding rod or wire shall match the material being welded and shall be approved by SAWS.

3.11 PLUMBNESS/ALIGNMENT TESTING OF INSTALLED WELL CASING

Tests to determine plumbness/alignment of the 18-inch nominal diameter casing shall be made by the CONTRACTOR after the well has been completed and before its acceptance. Plumbness and alignment of the well shall be tested by lowering a metal dummy no more than 1-inch smaller in diameter than the inside diameter of the 18-inch casing. The dummy shall be 40 feet long and shall pass freely through the casing.

3.12 WELL DEVELOPMENT

A. After the well has been completely constructed in accordance with the requirements of the Contract Documents, the CONTRACTOR shall notify the ENGINEER and shall make the necessary arrangements for conducting the well development, and the production tests. The CONTRACTOR shall

commence well development activities on each well within 48 hours following the ENGINEER'S declaration that the well has been completely constructed in accordance with the requirements of the Contract Documents. This requirement is intended to minimize the well development effort. Development shall be executed using the following development techniques, or other techniques proposed by the CONTRACTOR and subject to the approval of SAWS. Approved mud dispersing chemicals may also be used for well development. Development shall continue until the CONTRACTOR has determined that the well will meet or exceed the minimum well acceptance criteria as described in Paragraph 3.13 of this section.

B. Development by Airlifting:

1. Airlifting shall commence in the screened interval and proceed upward or downward using an educator pipe. Upon reaching the lowermost portion of the well, airlifting shall continue from that point until such times as the CONTRACTOR deems the process to be completed.
2. The CONTRACTOR shall be responsible for providing an on-site tank or tanks of sufficient size and construction to accommodate development discharge from the well. The purpose of the tank is to minimize area flooding during direct airlifting activities. The tank shall be constructed with baffles to encourage sediment settlement prior to pumping from the tank to the designated discharge point. The CONTRACTOR shall furnish, install, operate, provide fuel and remove a pump of sufficient size and horsepower to continuously pump stored discharge water as required from the tank(s) to the discharge point. This discharge point shall be designated by the ENGINEER at distances up to 5,000 feet from BGD-14. The CONTRACTOR shall furnish, install, operate, provide fuel, and removed a pump of sufficient size and horsepower to continuously pump stored discharge water as required from the tank(s). The CONTRACTOR shall install the discharge piping for the pumping unit of sufficient size and length to conduct water to the discharge points or areas. The CONTRACTOR shall prevent any site flooding or erosion, which might be caused by the discharge. Any necessary crossings over the discharge piping for vehicular traffic shall be constructed and maintained by the CONTRACTOR.

C. Development by Pumping: Within 72 hours after development by airlifting, swabbing, and bailing, the CONTRACTOR shall commence well development by pump surging using the test pump.

1. The CONTRACTOR shall furnish, install, operate, and remove a deep-well turbine pump for developing the well. The pump and driving unit shall have a capacity of 1,800 gpm at 475 feet of total dynamic head with a pump suction inlet setting at a depth of approximately 500 feet. The prime mover shall be a variable-speed type internal combustion

engine.

2. The CONTRACTOR shall furnish and install discharge piping for the pumping unit of sufficient size and length to conduct water to tank and then to discharge points given in the drawings as approved by SAWS, together with an in-line meter with 6-digit, straight reading totalizer, registering in units of 100 gallons, together with a rate of flow indicator dial, which reads in units of gallons per minute and is suitable for the expected flow range. The CONTRACTOR shall also furnish and install a circular open ended orifice weir as described in Driscoll (1987). The CONTRACTOR shall furnish and install a throttling valve downstream of the flow meter. The CONTRACTOR shall prevent any site flooding or erosion, which might be caused by the discharge. The CONTRACTOR shall install the discharge pipe to the point of discharge selected by the ENGINEER. Any necessary crossings over the discharge piping for vehicles weighing up to 50 tons shall be constructed and maintained by the CONTRACTOR.
3. The initial pumping rate shall be restricted, and as the water clears, shall be gradually increased until the maximum rate is reached. At intervals the pump shall be stopped and the water in the pump column shall be allowed to surge back through the pump bowls. The cycle of pumping and surging shall be repeated until the discharge water is clear of sand, silt, and mud and until there is no increase in specific capacity (gallons per minute per foot of drawdown) in the well, as determined by the ENGINEER. The well shall be thoroughly developed so that it will produce a reasonable maximum capacity based on the consideration of the depth and nature of the water-bearing formations, and so that it will not produce a composite amount of fine sands in excess of 5 parts per million.
4. During pumping development, the rate of sand production shall be measured by a Rossum® centrifugal sand-separating meter as described in the Journal of American Water Works Association, Volume 46, No.2 February 1954, or equivalent. Development procedures, quantities, sand production, and times shall be recorded in the CONTRACTOR's log. At the end of development the water well should have sand production not greater than 5 parts per million at any time after 20 minutes of pumping. Rossum sand measurements shall **not** be averaged over the pumping cycle. The first measurement will be the sand accumulated from 20 minutes after pumping begins.

3.13 PUMPING TESTS

A. "Pre-tests" and 36-hour constant-discharge test. The CONTRACTOR shall conduct pumping tests on all wells. These tests include at a minimum, a 36-hour constant-discharge test for the purpose of determining the performance characteristics of the well. When the CONTRACTOR determines that sufficient development has occurred to achieve the well acceptance criteria, he may proceed with a short-term "pre-test" consisting of a minimum of 20 hours of pumping at rates approved by the ENGINEER to verify that the well is

developed. There will be no additional payment for rig time or standby time during periods of "pre-testing". When the CONTRACTOR determines that the well is adequately developed to achieve the acceptance criteria, he may request from the ENGINEER authorization to proceed with the 36-hour constant-discharge test. Authorization to proceed with the constant-discharge test does not entitle the CONTRACTOR to additional compensation should the minimum well efficiency not be achieved. The anticipated discharge rate for the test will be approximately 1,000 gpm or a rate determined by the ENGINEER.

Following a minimum period of 24 hours for well recovery after the "pre-testing", each well shall be pumped continuously for 36 hours at a constant discharge which will be determined by the ENGINEER. The selected discharge rate shall be maintained throughout the test ±5 percent. If the discharge rate is not maintained within 5 percent of the initial rate, the test will be repeated with no additional compensation to the CONTRACTOR.

The constant-discharge test shall include water-level measurements from the pumping well and one monitoring well, if available, to monitor the effect of pumping on local groundwater levels. All water-level measurements shall also be recorded using pressure transducer/datalogger devices and manually. Equipment requirements for these devices are described in "Measurement Equipment" in this Paragraph. During the constant-discharge test, the pumping water level shall be measured based on the schedule presented below. Should the measurements during any portion of the aquifer testing not be made at the times specified, the actual time of each measurement shall be recorded. Upon completion of pumping, recovery measurements shall also be made by the CONTRACTOR for 24 hours according to the schedule below.

Maximum Recommended Time Intervals for Aquifer Test Water Level Measurements

Pumping Test Lapsed Time For Pumping or Recovery	**Data Collection Interval**
0 to 10 minutes	Every 1 minute
15 to 60 minutes	Every 5 minutes
70 to 120 minutes	Every 10 minutes
150 minutes to 36 hours	Every 30 minutes

The pump will remain in the well for a minimum period of 24 hours after pumping has been terminated to permit accurate measurement of recovery data.

B. Minimum Well Performance Criteria: The target efficiency for well

completion shall be 75 percent. The determination of final well efficiency will be made based on the completion of the 36-hour constant-discharge pumping test using calculated transmissivity. The straight-line method presented by Cooper and Jacob (1946) will be used with data from the pumping well to compute the theoretical well drawdown. The ratio of the theoretical drawdown at the limits of the reamed hole to the measured drawdown in the pumped well will determine well efficiency.

C. Sand Production Criteria: The sand production shall be measured during the constant discharge test using the methods and at the intervals described in Section 02633, paragraph 1.5.E. The measured sand production shall meet the sand production criteria of Section 02633, paragraph 1.5.E.

D. Pumping Equipment: The CONTRACTOR shall provide/operate a pump and prime mover that is capable of discharging at least 1,200 gpm with a minimum 475-foot lift. The prime mover shall be a variable-speed type.

E. Measurement Equipment: The CONTRACTOR shall provide up to two operable pressure transducers/dataloggers for collection of water-level data during all pumping tests. Additionally, the CONTRACTOR shall install, program, and retrieve all water-level recorders. There will be no additional payment for additional pumping tests that are required as a result of equipment failures/ operator errors that may occur during the required tests. These transducers/ dataloggers shall be InSitu® Level-Trolls® and have the following ratings:

· Production Well – 300 psi

The CONTRACTOR shall furnish and install a temporary 1.5-inch ID PVC or steel drop pipe in the pumped well to accommodate an electronic water-level measurement transducer. The pipe shall be approximately 500 feet in length. The CONTRACTOR shall furnish an electrical depth gauge, capable of indicating depths to water to the nearest $1/100^{th}$ foot. Additionally, the pumping equipment and pump setting shall be the same as used for development pumping. The CONTRACTOR will provide discharge measurement equipment that is capable of accurately measuring well discharge in the range of 500 gpm to 1,500 gpm. The equipment will include, at a minimum, a circular orifice weir as described in Driscoll (1986) and an in-line flow measurement device (propeller meter or ultrasonic meter) with an in-line meter with 6-digit, straight reading totalizer, registering in units of 100 gallons, together with a rate of flow indicator dial, which reads in units of gallons per minute and is suitable for the expected flow range.

The CONTRACTOR shall furnish and install a throttling valve downstream of the flow meter. The CONTRACTOR'S pump and prime mover will be capable of pumping the well at the discharge rates described above.

F. Water Sample: Prior to the completion of the constant-discharge pumping test,

the water quality samples shall be collected from the test flow near the end of the pumping period for state and federal water quality regulation analyses. The CONTRACTOR shall furnish and install a sample tap with valve for connection of in-line analytical probes. The CONTRACTOR shall follow proper chain-of-custody requirements and deliver the water to a laboratory certified by the Texas Commission on Environmental Quality.

G. Sediment Removal: After the test pump has been removed, the CONTRACTOR shall remove any accumulated sediment from the well.

3.14 WATER QUALITY SAMPLING

The CONTRACTOR shall retain the services of a water quality laboratory to analyze water quality samples from the completed well during the constant rate pump test. The laboratory shall collect the water samples near the end of the 36-hour pumping test. The water quality laboratory shall be certified by the Texas Commission on Environmental Quality as per 30 TAC 290.41 (c)(3)(G) to perform all required analyses by 30 TAC 290.104 and shall be acceptable to SAWS and ENGINEER. Each sample shall be labeled with the well number, date, time of collection, pumping rate, temperature of water, depth of screen setting, and name of collector. The qualified laboratory shall take the necessary samples and make a complete chemical and radiological analysis of the water to include determination of all constituents included in an analyses of public drinking water by the TCEQ, as listed in the latest version of TCEQ Chapter 290 Subchapter F, for drinking water, including:

1. Inorganic compounds
2. Synthetic Organic contaminants
3. Volatile Organic contaminants
4. Radionuclides: Gross Alpha, Gross Beta, Radium-226, Radium-228, Total Uranium and Radon-222
5. Secondary Standards
6. Lead and Copper
7. Total Dissolved Solids
8. Turbidity
9. Additional constituents: Sodium, potassium, calcium, carbonate, bicarbonate, silica, nickel, total hardness, Langelier index, total sulfide, nitrate, hydrogen, sulfide, temperature at time of sampling, dissolved oxygen, oxidation-reduction potential, ammonia, silicate, phosphate, total organic carbon, dissolved organic carbon, biological oxygen demand, heterotrophic plate count, dissolved hydrocarbon gases and oil and gas.

The analyses for pH, hydrogen sulfide, and free carbon dioxide shall be performed in the field by the laboratory at the time of water sampling.

Contractor is responsible for all additional pumping, equipment and water sample analyses and all related costs that are necessary to repeat the water sampling, if the water sampling and analyses are not completed as specified.

9. Samples to be kept at 4 degree centigrade in an ice cooler with appropriate preservatives during transport to the analytical laboratory.
10. Provide three copies of results of all analyses to ENGINEER and SAWS along with the QA/QC data.

3.15 DISINFECTION

A. The CONTRACTOR shall provide for disinfection of the wells immediately after test pumping of the wells has been completed. The CONTRACTOR shall carry out adequate cleaning procedures immediately preceding disinfection where evidence indicates that normal well construction and development work have not adequately cleaned the wells. All oil, soil, and other materials shall be removed from the wells including formation mud or drilling mud in any of the holes drilled in the pipe base for the well screens.

1. Disinfection: The wells shall be disinfected in accordance with the requirements of ANSI/AWWA C654 and AWWA A100-97, except as modified herein. The method of chlorination to be used shall consist of treating the water in each well casing to provide a chlorine residual of approximately 50 mg/L; circulating the chlorinated water within each well casing and pump column; and pumping each well to waste to remove chlorinated water. The quantity of chlorine compounds required to produce a chlorine residual of 50 mg/L may be calculated by multiplying the appropriate quantity shown in ANSI/AWWA C654, Appendix A, Table A.1 by the appropriate factor. Discharging water shall be dechlorinated to a chloride level of less than 3 mg/l prior to discharge from the well site.
2. Bacterial Evaluation: The disinfected wells shall be tested for the presence of coliform in accordance with ANSI/AWWA C654 and 30 TAC 290.41 (c) (3) (F). The results shall be submitted to the ENGINEER.

   If bacterial evaluation fails, disinfection and testing shall be repeated until the results indicate a pass at the CONTRACTOR's expense.

3.16 CAPPING OF WELL

Upon completion of all work in connection with construction, development, testing, disinfection and bacteriological evaluation, the well shall be capped by installation of a threaded steel cap with a hasp and lock welded to the cap and 16-inch casing. The casing shall extend 3 feet above ground level.

3.17 DISPOSAL OF WASTES

The CONTRACTOR shall provide all facilities, equipment, and materials required for the removal of drilling wastes, excess development materials, and construction debris from the well site.

3.18 DISPOSAL OF DEVELOPMENT AND TEST WATER

A. The CONTRACTOR shall provide all temporary pipeline, temporary sedimentation and infiltration basins, pumps and fuel and facilities for discharging pumped water approximately up to 5,000 feet from the well. The CONTRACTOR shall design the system so that no erosion results from the discharge. The erosion control methods can include rip rap or other acceptable methods reviewed and approved by the ENGINEER. The CONTRACTOR shall conform to all waste discharge requirements imposed by the appropriate regulatory agencies.

B. The CONTRACTOR shall be required to provide and operate an irrigation system to pump water from the well to Potential Irrigation Areas 1 and/or 2. The irrigation system shall include all pumps, mainline and lateral piping to discharge water at rates up to 1,200 gpm. The Contractor can propose an irrigation system that includes gated pipe or gated flexible hose that shall distribute the water evenly and effectively over the irrigated areas. The method proposed by the Contractor is subject to review and acceptance by SAWS and the ENGINEER. Irrigation water shall be applied to land and retained on land owned by SAWS.

   The Contractor also may propose an irrigation system that utilizes sprinklers or large-volume guns with flexible hose to distribute irrigation water. A sprinkler system shall operate at a minimum pressure of 25 psi at the sprinkler and of 60 psi at any large volume gun.

C. The CONTRACTOR can propose an alternate irrigation method that shall distribute the water evenly and effectively over the irrigated areas. The method proposed by the CONTRACTOR is subject to review and acceptance of SAWS and the ENGINEER. Irrigation water shall be applied to the land and retained on land owned by SAWS.

D. Irrigation piping may cross Mathis Road through the culvert shown in the Drawings. The CONTRACTOR shall be responsible for obtaining all permits from Bexar County for this crossing.

E. CONTRACTOR shall provide silt barriers and removal of discharged sand upon completion of the job.

F. CONTRACTOR to submit a development and test water disposal plan to include discharge location and end treatment to prevent erosion. Disposal plan shall include materials such as rip-rap, temporary structures to dissipate water energy and other disposal techniques subject to approval by SAWS.

G. CONTRACTOR shall provide silt barriers and removal of discharged sand upon completion of the job.

H. CONTRACTOR shall remove all temporary piping, valves and pumps within 30 days of completion of pumping tests of the wells.

3.19 REMEDIAL WORK

If remedial work becomes necessary on the well to make the well acceptable and be completed as required by the specifications because of accident, loss of tools, defective material, or for any other cause, the CONTRACTOR shall propose a method and recovery plan schedule correcting the problem, in writing. Suggested methods shall be reviewed and approved by the ENGINEER before work proceeds. Such work will be performed at no additional cost to SAWS and it shall not extend the length of the contract. The CONTRACTOR is notified that all specifications must be met, including setting depths for casing as designated by the ENGINEER.

END OF SECTION