

SECTION 5A - WELL CONSTRUCTION, DEVELOPMENT, AND TESTING

5A-01 GENERAL

5A-01.01 DESCRIPTION OF SCOPE

- A. This specification shall be used for the construction and development of ___ reverse rotary water production wells to be placed on the site(s) described on the construction plans.
- B. Contractor shall furnish all equipment, labor, materials and incidentals necessary for the drilling, installation, development and testing of the production wells by reverse rotary methods. The production well will be located as shown on the attached drawings.
- C. Each well shall be drilled using the reverse rotary process in which the walls of the drill hole are held in place at all times with an approved circulating fluid which shall be washed out during and following the placing of the gravel. The work shall be performed with equipment that is adequate to complete all phases of well construction. If, in the opinion of the Engineer, the Contractor's equipment is not capable of satisfactorily performing the work provided for in these Specifications, the Contractor, at his own expense, shall substitute equipment satisfactory to the Engineer.

5A-01.02 DRILLING ORDER AND PRIORITY - The well shall be drilled in the following order:

Well []

5A-01.03 ADD OR DEDUCT BID ITEMS - Each of the [number] [] well sites shall contain all the components described in the attached specification except that:

- A. **Deduct:** A spinner tube assembly is required on Well []. A separate *deductive bid item* for the spinner tube assembly is included in the Bid Proposal.

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- B. **Add:** The site Safety Officer will test all fluids and cuttings in accordance with the approved health and Safety Plan. Should the test results show levels of contamination above the safe limits defined in the Health and Safety Plan, the Contractor shall stop work immediately. Should the test results show low levels of contamination that are within the safe limits defined by the Health and Safety Plan, the Contractor shall haul all cuttings to an Engineer-approved storage site for cleanup. **The cost of such storage and cleanup will be paid for by the Engineer.** If the test results show nondetectable limits of contamination, the cuttings shall be hauled to an SBMWD site for disposal. **The disposal site is located at the Engineer's Lytle Creek Plant, which is in close proximity to the well sites.** An *Additive bid item* is included in terms of cost per cubic yard of haul material.
- C. **Add:** Additional annular seals may be required based on the results of the geophysical logging. Additional seals will be constructed per paragraph 5A-03.13 of this Specification. A separate *Additive bid item* is included in the bid schedule for annular seals and shall include cost in terms of length of seal, depth of seal, and length of additional [] bore.

5A-01.04 WELL LOCATIONS

- A. The production well will be located as shown on the attached drawings. Contractor shall be responsible for accurately identifying the well location.

5A-01.05 ACCESS TO WELL SITES

- A. Contractor shall be responsible for clearing, cutting and providing physical access to the well site.

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5A-01.06 DRILLING SCHEDULE AND NOISE CONTROL

- A. Well drilling and construction shall be permitted on a 24-hour basis Monday through Sunday. Other site work shall be done only during the hours of 7:30 a.m. to 4:30 p.m., or longer if local ordinances permit, Monday through Saturday. Contractor shall provide noise control measures for 24-hour site work.

5A-01.07 WORK INCLUDED

- A. This section covers the work necessary to drill, construct, develop, and test [] gravel-packed water production well[s]. The Contractor is responsible for providing all the labor and equipment necessary to drill, construct, develop, and test the well[s]. A drawing of the water well and associated details are shown on the plans. The work shall include, but not be limited to, the following:

_____ WELL NO. 1

1. Drilling a ____-inch diameter borehole to a depth of ____ feet.
2. Providing and installing a ____-inch diameter conductor casing and sanitary seal to a depth of ____ feet.
3. Keeping a written log of strata encountered during drilling and a written daily record of work progress, crew present, and equipment and materials used.
4. Collecting cuttings representative of strata encountered by the drilling at least every 10 feet and at major lithology changes or as directed by the Engineer.

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5. Drilling a ____-inch pilot hole to a depth of ____ feet.
6. Running geophysical (electric) logs in the pilot hole.
7. Reaming a ____-inch diameter borehole to a depth of approximately ____ feet (or as specified by the Engineer) using the direct or reverse rotary drilling method.
8. Providing and installing approximately ____ feet of ____-inch diameter wire-wrap, double strength stainless steel well screen and appurtenances in the well (slot size to be determined from sieve analysis results).
9. Providing and installing approximately ____ feet of ____-inch stainless steel and ____ feet of mild steel ____-inch casing, with appurtenances, in the well.
10. Providing and installing approximately ____ feet of 3-inch gravel feed tube and ____ feet of 2-inch stainless steel pipe for automatic level measuring devises.
11. Providing and installing approximately ____ feet of gravel pack in the well (gradation of gravel pack will be determined from sieve analysis results).
12. Providing and installing approximately ____ feet of annular cement-bentonite grout seal in the well.
13. Developing the completed well by mechanical surging with double-surge block and simultaneous air lifting.
14. Providing and installing a pump for development and test pumping.

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15. Further developing the well by pumping with a test pump to be supplied by the Contractor.
 16. Separating drill cuttings and development sediments from associated liquids and properly disposing of them.
 17. Providing for the transport of development water to a discharge point as approved by the Engineer.
 18. Performing an 8-hour step-drawdown and 24-hour constant rate test on the completed well.
 19. Capping the well.
 20. Restoring the well site to its original condition.
 21. Furnishing logs and daily records to the Engineer.
- B. The intent of these Specifications is to provide a domestic water production well that, when the appropriate pump is installed, will be capable of production at a continuous rate of about _____ gallons per minute (gpm). A well depth of about _____ feet, and _____ feet of well screen for Well No. 1 has been selected by the Engineer for use by the Contractor in determining its base bid quotation. The Engineer reserves the right to change materials and quantities specified in the following documents based on conditions encountered in the field. In addition, the Engineer reserves the right to discontinue the construction of the well if at any time the Engineer believes it is in the Engineer's best interest to discontinue. In such a case, the Contractor shall be paid at the prices bid for the actual work accomplished.

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5A-01.08 SUBMITTALS DURING CONSTRUCTION

- A. Submittals during construction shall be made in accordance with Section 1.0 of the SBMWD Standard Specifications. In addition, the following specific information shall be provided:
1. Electric logs from the pilot hole.
 2. Sieve analyses of five (5) drill cutting samples from the pilot hole.
 3. Drawings and design data on the well screens and casing.
 4. Chemical composition of the well screen and casing.
 5. Sieve analysis of one sample of the gravel pack material prior to delivery to the site.
 6. Aquifer and pump test data for the well.
 7. Geologic logs of the well.
 8. Daily drilling reports for the well.
 9. Other data as specified.

5A-01.09 NOTIFICATION TO THE ENGINEER

- A. The Contractor shall be responsible for giving the Engineer 24-hour advance notice prior to performance of specific operations as follows:
1. Starting drilling operations at the site.
 2. Geophysical.
 3. Installation of well screen and casing.
 4. Placement of gravel pack and the annular grout seal.

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5. Development of the well.
 6. Step-drawdown and constant rate pumping tests.
- B. These minimum advance notification requirements are based on the normal sequence and schedule of work assuming no unusual delays. If delays or interruptions should occur, the Engineer shall be given as much advance notification as possible of the restart of work on the project.

5A-01.10 STANDARDS, SPECIFICATIONS, AND CODES

- A. The well shall be constructed in conformance with the State of California Water Well Standards as described in the Department of Water Resources Bulletins No. 74-81, dated December 1981, and 74-90, dated June 1991. The requirements of San Bernardino County shall also be observed in construction of the well. The Contractor shall be responsible for filing the permits and well logs required by the state, and county agencies.

5A-01.11 SITE PROTECTION

- A. Throughout the period of construction, Contractor shall keep the work site free and clean of all rubbish and debris. Protective barriers and other safety protection necessary to protect the public and workers shall be provided by the Contractor. The Contractor shall protect all existing fences, walls, buildings, trees, and landscape during the progress of work. In the event of damage to such property, the Contractor shall, at his own expense, immediately restore the property to a condition equal to its original condition and to the satisfaction of the Engineer. This provision includes damage to surface and subsurface utilities. After completion of the work, Contractor shall remove from the premises and work areas all materials, tools, debris, and

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drill cuttings from the drilling and pump installation operations. At the completion of the well, the site shall be cleared of all materials and left in a condition acceptable to the Engineer.

5A-01.12 LOST HOLES

- A. Holes Abandoned For Cause: If the Engineer determines that for reasons beyond the control of the Contractor it is necessary to stop drilling, or the hole is lost before the objective or desired depth is reached and further attempts to save or complete the hole are not practical, the hole will be ordered abandoned for cause. The Contractor shall fill and plug the hole according to the most restrictive city, county, state and/or federal regulations. The Contractor will be reimbursed for the footage drilled and other operations and for moving to an alternative location.
- B. Defective Holes: If the Engineer determines that the hole is lost due to negligence, incompetence, or malpractice on the part of the Contractor or his personnel, or to the use of defective or unsuitable equipment, he will immediately notify the Contractor in writing of his decision and order the hole abandoned. If a hole does not meet the requirements set forth herein, or if the Contractor fails to drill a hole to the depth specified by the Engineer within the scope of the Subcontract, the hole will be declared abandoned. Any hole that cannot be corrected to the required tolerance for alignment will be declared abandoned. The Contractor, at its own expense, shall fill and plug the hole(s) according to the most restrictive city, county, state and/or federal regulations. The Contractor shall drill a new hole at an alternate site in the immediate

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area approved by the Engineer. The Contractor will not be paid for any footage drilled or for other operations performed in any hole abandoned because of defects.

5A-02 MATERIALS

5A-02.01 FABRICATED MATERIALS - The spinner (camera) pipe, shallow and deep screen sample pipe, and gravel make-up pipe shall be referred to as "peripheral piping". The well casing, well screen, conductor casing, and peripheral piping shall be fabricated in accordance with these Specifications and the details shown on the plans. All welding shall be performed in accordance with American Welding Society Standards. The Contractor shall submit certified test reports to the Engineer to show compliance with the physical and chemical properties of the steel specified.

5A-02.02 CONDUCTOR CASING - The conductor casing shall be fabricated from new steel (domestic only) plates of the size and thickness shown on the construction drawings. The plates used in the manufacture of the pipe shall conform to the requirements of the "Specifications for Low and Intermediate Tensile Strength Carbon Steel Plates of Structural Quality" (ASTM Designation A283) Grade B, or "Specifications for Electric-Fusion (Arc-Welded Steel Pipe, Sizes 2-Inch and Over" (ASTM Designation A139) Grade B, or approved equal.

The conductor casing shall be factory assembled in minimum 20-foot lengths, and shall contain not more than one longitudinal seam parallel to the longitudinal axis of the conductor. Not more than one circumferential seam shall be butt-welded from the exterior. The welding shall be done against copper-faced mandrels with shield-arc electrodes to protect the weld metal from atmosphere while cooling, and to assure full fusion with parent metal and complete penetration. The ends of each section of conductor casing shall be machine-beveled perpendicular to the

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longitudinal axis of the conductor to ensure the straightness of multiple assembled sections. One end of each assembled section shall be fitted with either a 6-inch wide collar welded to the pipe so that the collar will be equally spaced on either side of the joint, or shall be swaged to form a bell and spigot joint to be lap welded in the field.

- 5A-02.03 PERIPHERAL PIPING - The peripheral piping shall be fabricated from new steel (domestic only) plates of the size and thickness shown on the construction drawings. The plates used in the manufacture of the pipe shall conform to the requirements of the "Specifications for Low and Intermediate Tensile Strength Carbon Steel Plates of Structural Quality" (ASTM Designation A283) Grade B, or "Specifications for Electric-Fusion (Arc) - Welded Steel Pipe, Sizes 2-Inch and Over" (ASTM Designation A139) Grade B, or approved equal.

The peripheral piping shall be of the size shown on the construction drawings. A slip-on welding flange and blind flange shall be attached to the end of each pipe. Each pipe shall be installed outside the well casing in accordance with these specifications and as shown on the construction drawings.

The final position of the peripheral piping and its orientation to the discharge head is critical and must be inspected prior to placement of the surface annular seal.

- 5A-02.04 WELL CASING AND WELL SCREEN

- A. Fabricated well casing and well screen shall conform to the requirements of paragraph 5A-02.02 and be of the size specified on the construction drawings. Plates used in the manufacture of casing shall conform to the requirements of ASTM A139 Grade B, Roscoe Moss 0.20 percent copper bearing 5/16" structural steel. Machine-perforated well screen shall have a free perforation opening of 35 to 45 square inches per

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lineal foot. The bottom shall be fitted with a 10-foot long section of blank casing and a bottom plate as shown on the construction drawings.

- B. Well screen shall be Roscoe Moss Company "Ful-Flo." For field assembly by welding, ends of casing sections shall be furnished with collars in accordance with the following standards.

Collars shall be of the same thickness and have the same physical and chemical properties as the corresponding casing section, shall be 5-inches minimum in width, shall be rolled to fit the outside diameter, and shall be welded to the casing section. The inside edge of the collars shall be ground or sufficiently scarfed to remove sharp edges or burrs. Section ends shall be machined flat, perpendicular to the axis of the casing, and shall not vary by more than 0.010-inch at any point from a true plane at right angles to the axis of the casing. Three 1-inch by 3/8-inch alignment holes shall be provided in each collar to insure proper matching of the sections.

- C. Width of perforation opening shall be subject to change following completion of pilot bore, logs, and examination of materials encountered.

5A-02.05 BENTONITE SAND MIX - The bentonite sand mix shall consist of a 60-40 mixture by volume of bentonite chips and clean, well-washed gravel in accordance with paragraph 5A-02.07.

5A-02.06 CEMENT - All cement used on the work shall be a standard brand Portland Cement conforming to the "Specifications for Portland Cement" (ASTM C150) Type II, mixed at a rate of two parts sand to one part cement, by weight. This is equivalent to a "10.3 sack mix."

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5A-02.07 GRAVEL - All gravel for packing shall be hard, water worn particles washed clean of silt, sand, dirt, and foreign matter. It shall be well rounded, graded and selected, and shall conform to the following sieve analysis adjusted as recommended by the Engineer for the particle sizes in the strata encountered during drilling.

GRADATION OF GRAVEL

U. S. SIEVE NUMBERS	PERCENT PASSING
4	100
6	85-95
8	65-75
12	30-40
16	10-15
18	2-7

Gravel pack material shall be produced by Colorado Silica, Silica Resources, Lone Star, Livingston Graham, All American Aggregate, or approved equal. Samples and sieve analysis of the gravel shall be submitted for review by the Engineer before delivery to the site. The gravel, if stockpiled at the well site, shall be kept free of all foreign matter.

5A-02.08 DRILLING FLUID

- A. For drilling by the reverse rotary method, water alone shall be employed as drilling fluid. No clays or other binding materials shall be used without the Engineer's approval except as specified in the drilling of the pilot bore.

- B. The Contractor shall provide his own aboveground fluid sumps for handling the drilling fluids. The fluid sump must possess sufficient surface volume to effectively separate cuttings, sand, and solids, and shall be equipped with a shale shaker and desander/desilter equipment.

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- C. The fluid and cutting containment equipment shall be watertight. The Contractor shall allow for, within the bid proposal, proper and legal disposal of both well drilling fluids and well drilling cuttings in accordance with the approved Health and Safety Plan.
- D. Drilling mud to be placed in the pilot bore for geophysical logging shall conform to the following specification:
- Sodium Bentonite mud
 - Weight less than 9 lbs per gallon
 - Viscosity 28-30 seconds
 - Sand content less than 10 percent

5A-02.09 SPINNER TUBE TRANSITION ASSEMBLY - Shall be Rosco Moss camera/sounding tube connection or approved equal.

5A-03 CONSTRUCTION OF WELL

5A-03.01 CONDUCT OF DRILLING - Once reaming of the well has commenced, the Contractor shall provide for continuous nonstop construction to the completion of the gravel pack installation and washing, except where otherwise provided.

5A-03.02 HANDLING OF VOLATILE ORGANIC CHEMICALS - The fact that volatile organic chemicals may exist in all soil and groundwater deeper than []-feet from the surface, must be considered in the bids. The testing for, and handling of, all volatile organic materials shall be done in accordance with the Health and Safety Plan.

5A-03.03 ENVIRONMENTALLY SENSITIVE AREA - (NOT USED)

5A-03.04 CONDUCTOR CASING - Conductor casing shall be set in a reamed hole not less than the diameter indicated on the attached construction drawings. The casing shall be securely anchored to prevent movement during the placement of concrete. Estimated casing depth is

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indicated in the bid schedule; however, the Engineer may order the setting at a lesser or greater depth contingent upon field conditions.

Each section of the conductor casing and peripheral piping shall be joined to another section by welding.

Suitable steel centering guides or spacers shall be provided in order to center and hold the conductor casing in its proper position until the cement has been placed. Field welding of the conductor shall be performed by welders certified in accordance with Appendix 11 of the American Standard Code for Pressure Piping ASA B31-1, and in such a manner as to cause no warping. Special care shall be exercised to ensure a straight and plumb casing.

The casing shall be installed in conformance with the alignment requirements as outlined in Section 5A-03.16 of this Specification.

Once the conductor casing location and orientation are set and checked for vertical alignment, they shall be cemented in place by filling the annular space with concrete slurry mix pumped through a tremie tube. The placement of all concrete slurry shall be done in the presence of the Engineer.

After cementing operations are complete, the pump base and conductor casing slurry shall be allowed to cure undisturbed for a minimum of 24-hours.

- 5A-03.05 PILOT BORE - The Contractor shall drill a pilot bore centered within the conductor casing. This bore shall have a minimum diameter of 8-inches and be to the approximate depth indicated on the design drawings. The pilot bore shall be logged and sampled to provide an indication and classification of geological formations encountered. The exact depth of the pilot bore shall be determined by the Engineer during the drilling process. The Contractor shall take all measures necessary to protect the pilot bore from caving or raveling.

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At each change of formation and at 10-foot intervals between changes in formation, the drilling Contractor shall take a representative sample of the interval or new formation, and shall label and preserve each sample in a sealable plastic bag. The samples will remain at the well site until the SBMWD requests their removal.

Once the pilot bore is within 100-feet of the final depth determined by the Engineer, the driller shall add drillers mud in sufficient quantity to hold the hole open for the required 24-hour period and to improve the reliability of the geophysical information. The minimum concentrations of drillers mud have been provided in paragraph 5A-02.05 of this specification. Additional mud may be added as needed to maintain the pilot bore during geophysical sampling.

5A-03.06 GEOPHYSICAL SAMPLING - The Contractor shall gather the following geophysical information from the completed pilot bore:

- Spontaneous Potential Log
- 16 and 64 Normal Resistance Log
- Point and Guard Resistance Log
- Natural gamma Log

All geophysical information shall be gathered with cooperation and direction from the Engineer. These logs, along with the driller's log and soil samples, shall be reviewed by the Engineer, and/or the Engineer's consultant, for determination of the final well configuration. The Contractor shall provide the Engineer with copies of all geophysical logs in electronic (ASCII and CAD) as well as in hard copy format.

Within 48-hours of completing the geophysical logs, the Engineer will advise Contractor regarding design of the well casing, the placement of the well screen, the configuration of the gravel pack, and any annular seals. If the geophysical data indicates that the completion of the well is not warranted, the Engineer reserves the right to terminate all further work on

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the well. In such an event, the Contractor will be paid for the value of his work completed to that time on the basis of the unit prices stated in Contractor's Proposal.

- 5A-03.07 PILOT HOLE REAMING - Following the completion of the final well design by the Engineer's consultant, the pilot bore shall be reamed to the diameter indicated in the Bid Schedule. The exact depth will be determined by the Engineer, with adjustment made for any added or deducted footage in accordance with the Bid Schedule. Continuous construction shall be maintained once reaming is commenced through development. If the reamed hole is allowed to remain unattended for more than 12-hours, the Engineer may require rereaming by the Contractor at no extra cost to the Engineer.

Upon completion of the reaming operation for the well, the Contractor shall perform a caliper survey of the well bore to ensure the specified diameter is achieved. If the bore is not large enough, corrective measures shall be made, and the bore shall be caliper surveyed again, at no cost to the Engineer.

- 5A-03.08 INSTALLATION OF WELL CASING AND THE PERIPHERAL PIPING - When the reaming operation is satisfactorily completed, the blank and perforated casing sections and the peripheral piping shall be installed at locations directed by the Engineer.

The casing installation must be plumb and centered in the hole. All field joints shall be properly welded during installation with a minimum of two passes per circumference. Welding shall be as specified in Section 5A-02.01 and 5A-02.02, consisting of a minimum of three steel centralizers, attached to the casing at intervals of not more than 60-feet, shall be provided in order to center and hold the casing in its proper position until the gravel is in place. Guides shall be fabricated and placed in accordance with shop drawings provided by the Contractor and preapproved

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by the Engineer. The casing shall be suspended in tension from the surface by means of clamps constructed and installed in accordance with shop drawings provided by the Contractor and preapproved by the Engineer. The bottom of the casing shall be at a sufficient distance above the bottom of the well bore to ensure that none of the casing is supported from the bottom.

If for any reason the casing cannot be landed in the correct position, at a depth acceptable to the Engineer or suitable for pump installation, the Contractor shall construct another well immediately adjacent to the original location and complete this well in accordance with the Specifications and Drawings at no additional cost to the Engineer. The abandoned hole shall be filled in accordance with the requirements of the agency having jurisdiction.

All work required to be repeated and all additional materials, labor, and equipment furnished as a result, shall be done at the expense of the Contractor and no claim for additional compensation shall be made or be allowed, except as specifically provided for herein.

The peripheral piping shall be installed with spacers to provide a minimum 2-inch space between the borehole wall and the peripheral piping and a 2-inch space between the well casing and the peripheral piping within all intervals of the well that are to be sealed.

5A-03.09 WELL SCREEN - The location of well screen sections in the well casing shall be determined by the Engineer after a study of the geophysical analysis. The anticipated approximate well screen sections are as follows:

- Section one starting at a depth of []-feet and extending to a depth of []-feet.
- Additional blank sections may be placed in these sections.

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- 5A-03.10 PIEZOMETER AND GRAVEL PACK - The second or shallow piezometer shall be attached periodically to the outside of the well casing during construction as shown on the design drawings. Once the piezometer is placed, it shall be welded to the well casing at the well head for permanent use.
- 5A-03.11 GRAVEL MAKE-UP PIPE - The gravel make-up pipe shall be filled no more than 20-feet above gravel envelope. Gravel in the gravel make-up tube shall be sounded in the presence of Engineer.
- 5A-03.12 INSTALLATION OF GRAVEL ENVELOPE - The installation of gravel envelope shall be in the general location shown on the design drawings. In all areas where a gravel envelope is required, the annulus between the casing and the walls of the reamed hole shall be completely filled with gravel. Gravel shall be placed by means of a tremie pipe (minimum diameter of 3-inches) with the bottom maintained within 20-feet of the top of the gravel pack as the gravel is being placed. The gravel shall be disinfected during its installation at a rate of 1/4-lb. to 1/2-lb. of calcium hypochlorite per ton of gravel, in accordance with AWWA Standard C654-97.

After the gravel has been placed, a swab shall be worked opposite all perforated sections of casing while circulating with clear water in order to consolidate the gravel. As the gravel settles, more shall be added. This operation shall be continued until there is no further settlement of the gravel and the gravel has been washed clean and is 20-feet above the bottom of the permanent tremie pipe.

- 5A-03.13 ADDITIONAL ANNULAR SEALS - Should the Engineer determine from the geophysical analysis that a bentonite annular seal is required between perforations, the gravel placement shall be as follows:

After the gravel is placed, the gravel tremie shall be emptied of all material. The well shall then be resounded in the presence of the Engineer. The tremie

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shall be placed in the hole to a depth of 10-feet above the gravel. A bentonite sand mix as described in paragraph 5A-02.05 shall be pumped through the tremie as the tremie is raised until the depth specified by the Engineer is achieved. The well shall then be resounded in the presence of the Engineer.

- 5A-03.14 SUBSURFACE ANNULAR SEAL - After the gravel has been placed, annular space between reamed wall and the well casing shall be sealed off by pumping first a 10' layer of transition sand and then a bentonite and sand mixture in accordance with paragraph 5A-02.05. The mixture shall be pumped through a temporary tremie tube placed as near to the bottom of the annular space as possible without binding the pump. Sealing material shall conform to the Department of Water Resources Bulletin No. 74, Part 2, Section 9d, except that "puddled clay" shall not be used. Thickness of the seal shall conform to Section (e) of said Bulletin 74.

The Contractor shall place the entire space in one continuous lift.

- 5A-03.15 SURFACE ANNULAR SEAL - After the subsurface annular seal has been placed, the well casing shall be sealed off by filling the annular space between reamed wall and the well casing by pumping a cement slurry, weighing approximately 115-pounds per cubic foot, through a temporary tremie pipe placed as near the bottom of the annular space as possible without binding the concrete pump. Construction of the sanitary seal shall be in accordance with the requirements of the State of California, Department of Water Resources, Bulletin No. 74, Part 2, Section 9. The seal shall be constructed to a depth shown on the attached construction drawings, or as instructed by the Engineer, and methods used shall be subject to approval by the State of California, Department of Public Health. Sealing material shall conform to the Department of Water Resources Bulletin No. 74, Part 2,

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Section 9d, except that "puddled clay" shall not be used. Thickness of the seal shall conform to Section (e) of said Bulletin 74.

The surface annular seal shall be placed in no less than 80-foot lifts. The Contractor shall place the final 120-feet in one continuous lift. Once the surface annular seal is in place, it shall be left undisturbed for a period of not less than 12-hours.

- 5A-03.16 PLUMBNESS AND ALIGNMENT OF WELL - Contractor shall guarantee that all holes shall be constructed and all casing and liners set round, plumb, and true to line. Contractor shall test, by accepted methods, for plumbness and alignment after completion of the well construction. The top 100-feet of casing shall not deviate more than 3-inches, and the remainder shall not deviate more than 6-inches per 100-feet of hole. Deviations shall be continuous in one direction within the foregoing rates per 100-feet, and have not more than 1/4 turn of spiral.

Should the well fail to meet the requirements of this subsection, the plumbness and alignment shall be corrected by the Contractor at no expense to the Engineer.

- 5A-03.17 VOLUME MEASUREMENTS - The total volume of gravel, sand, cement, and bentonite (bentonite volume shall be estimated assuming some expansion) used shall be not less than the calculated volume of the annular space between the casing and wall of the hole based on caliper survey. The Contractor shall supply the Engineer with calculations. The Contractor shall supply the gravel measuring devices required.

- 5A-04 WELL DEVELOPMENT PROCEDURES

(NOTE: CONTRACTOR SHALL BE RESPONSIBLE FOR FURNISHING AND INSTALLING TEMPORARY DISCHARGE PIPING, SUFFICIENT IN LENGTH AND DIAMETER, TO SUCCESSFULLY TEST AND DEVELOP WELLS):

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A temporary drain line may be required for each of the wells. The attached plans provide a schematic drawing of the existing drain line facilities available to the Contractor for fluid disposal. Within five (5) days of the notice to proceed, the Contractor shall provide the Engineer with a plan for discharge of fluids and cuttings in compliance with the sampling and disposal Section 5A-04.01 below.

5A-04.01 SAMPLING AND DISPOSAL

The Contractor shall test all fluids, cuttings, and ambient environment to insure that an unsafe work environment does not exist at any time during the construction process and that all construction is compliance with the Health and Safety Plan.

The Contractor shall further test all well cuttings to insure that they meet the criteria and conditions as outlined in "Attachment A to Resolution No. R8-2002-0044, Specific Types of Discharges for which Waste Discharges Requirements are Waived" - See Appendix [] including but not limited to the following:

- i) Cuttings determined not to be considered as hazardous waste, and
- ii) Cuttings disposed of or used in a manner so as to not affect water quality or beneficial uses.
- iii) Implementation of the project shall not create a nuisance or pollution as defined in the California Water Code.
- iv) The project shall not cause a violation of any applicable water quality standard for receiving waters adopted by the Regional Board or the State Water Resources Control Board, as required by the Clean Water Act.
- v) The discharge of any substance in concentrations toxic to animal or plant life is prohibited.

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The Contractor shall guarantee to the Engineer in writing that all fluids be disposed of such a manner so that the disposal fluids do not contain constituent concentrations in excess of the following limits:

- Total Petroleum Hydrocarbons100.0 ug/l
- Benzene1.0 ug/l
- Toluene10.0 ug/l
- Xylene10.0 ug/l
- Ethylbenzene10.0 ug/l
- Carbon Tetrachloride0.5 ug/l
- Chloroform5.0 ug/l
- Dichlorobromomethane5.0 ug/l
- Methyl Ethyl Ketone10.0 ug/l
- Methyl Isobutyl Ketone10.0 ug/l
- Naphthalene10.0 ug/l
- Tetrachloroethene (PCE)5.0 ug/l
- Trichloroethylene (TCE)5.0 ug/l
- 1,1- Dichloroethane6.0 ug/l
- 1,1-Dichloroethylene1.0 ug/l
- 1,1,1-Trichloroethane (TCA)5.0 ug/l
- Total Residual Chlorine0.1 mg/l
- Total Dissolved Solids (TDS)(ask con) 400.0 ug/l
- Total Inorganic Nitrogen (TIN)(ask con)12.9 mg/l
- Suspended Solids75.0 ug/l
- Sulfides0.4 mg/l
- Oil and GreaseNon Detect

At no time shall any fluids from this project reach receiving of the Santa River. In order to accomplish this, the Contractor may not be able to discharge fluids during inclement weather.

The Engineer will collect additional samples to submit to the Regional Board for compliance with the permits.

The Contractor shall provide the Engineer with written documentation of planned discharges, including estimated total volumes and discharge locations, seven

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(7) days in advance of the start of discharges and will provide the Engineer with written documentation of actual discharge volumes within five days of the end of each month.

Note: Any fluids that exceed the above constituent limits shall be disposed of used and alternate Engineer approved method.

5A-04.02 MECHANICAL DEVELOPMENT - After the grout seal has been placed and has set in accordance with the above Specifications, the Contractor shall notify the Engineer and make the necessary arrangements for conducting well development. The Contractor shall furnish all materials, equipment, and labor required to develop the well. Contractor shall develop the well in order to remove native silt and clay, any drilling fluid residues, and the finer fraction of the gravel pack and aquifer material. The objective of the development process is to assure maximum specific capacity and sand free water.

This first phase consists of using an open-ended, single-surge block tool (single swab) attached to the end of the drill pipe. This tool shall be moved up and down three or four times in each section of the well screen while airlift pumping. After working the tool to the bottom of the well, all sediment in the bottom shall be airlifted out. After single swabbing, the single swab shall be removed from the well and replaced with a double swab to perform the second phase of mechanical development.

The second phase shall be accomplished with a double-surge block tool consisting of a rubber packer assembly near each end separating an approximately 10 to 20-foot long perforated tubing for pumping intake. The down-hole end of the perforated tubing shall be capped.

Development shall begin at the uppermost screen section with simultaneous surging and airlifting of each successive 20-foot screen length until the

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discharge becomes reasonably clear as determined by the Engineer. Following such determination, the assembly shall be lowered to the next 20-foot interval of screen and the procedure repeated until all screen sections have been mechanically developed. It is anticipated that each 20-foot screen zone will require, on the order of, one hour of such simultaneous surging and airlifting.

While in each 20-foot screen section, the Kelly bar shall be used to move the tool assembly up and down three or four times within shorter sections of the respective 20-foot screen zone, while continuing to airlift; tool movement shall then cease for approximately 10-minutes, although airlifting will continue. When the discharge clears again, the tool assembly shall again be moved up and down while continuing to airlift. The process shall be repeated until water produced from the 20-foot screen section has cleared sufficiently to permit moving the entire tool assembly to the next 20-foot section.

The Contractor shall provide adequate air compressor capacity in both volume of 750-cfm and pressure of 125-psi to maintain the proper relationships between air pressure and air volume capacity and diameters and lengths of both drill pipe and air tubing in order to maintain airlifting efficiency during mechanical development.

Upon completion of mechanical development, the well shall be accurately sounded to determine the level of the accumulated sediment in the well. The sediment level shall be recorded in the driller's daily log.

If the sediment fill level is within the screened interval, this fill shall be removed by bailing prior to installation of the test pump. If the fill level is below the bottom of the lowermost section of the well screen, the Contractor may proceed with installation of the test pump.

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5A-04.03 TIME OF TEST - After the well has been completely constructed in accordance with these Specifications and drawings, the Contractor shall notify the Engineer and shall make the necessary arrangements for conducting the development by test pumping.

The time required for development and test pumping will be recorded to the nearest 1/2-hour. Recorded time for payment purposes shall commence when the equipment is placed in operation, and shall end when operations are directed to be terminated by the Engineer. No time will be recorded for delays resulting from stuck equipment, equipment breakdown, failure to conduct operations in a diligent and workmanlike manner, or arranging major drilling, pumping, or testing apparatuses.

5A-04.04 EQUIPMENT - The Contractor shall furnish all material, equipment, and labor necessary to conduct development operations and test pumping in accordance with these Specifications and directions of the Engineer. The pump furnished shall be of the deep-well type capable of pumping not less than []-gallons per minute against a total head of not more than []-feet, plus the friction loss in the discharge piping. Bowl setting shall not be in excess of []-feet in depth as directed by the Engineer. A satisfactory throttling device shall be provided so that the discharge may be reduced to []-gpm. The pumping equipment, complete with motive power for development and testing the well, shall be delivered to the site prior to finishing the swabbing operations. The Contractor shall provide the Engineer with the proposed equipment and noise abatement plan for review a minimum of 10 days prior to the start of development pumping in accordance with Section 5A-10 of these specifications.

5A-04.05 METERING - During development and testing operations, the Contractor shall provide metering facilities to accurately measure the rate of flow and totalize all water pumped from the well.

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5A-04.06 DEVELOPMENT OF THE WELL (MINIMUM 60-HOURS) - Within two days after completion of swabbing, consolidating, and cleaning of the gravel envelope, the Contractor shall commence the development of the well by pumping to clear the well of all additional accumulation of mud, sand, and sediment.

The quantity of water being pumped at the commencement of development shall be limited and gradually increased as the water clears. Every 10 to 15-minutes for the first hour and 20-minutes for every hour thereafter, the pump shall be stopped and the water in the pump column allowed to flow back through the pump bowls and through the perforations into the aquifers. These operations, with increasing pumping rates, shall be repeated as development of the well continues and shall be done in a manner satisfactory to the Engineer. The well shall be thoroughly developed so that it will produce a reasonable maximum capacity based on the consideration of depth and nature of the water bearing formations, and so that it will not produce an amount of fine sands in excess of the sand production limitations. Development of the well shall be continued until it produces not more than 5-parts per million of sand by volume within 20-minutes after surging at the design capacity of the well, and after, in the opinion of the Engineer, the aquifer has been completely developed. During the test, the rate of sand production shall be measured by a centrifugal sand-separating meter as described in the Journal of American Water Works Association, Volume 46, No. 2, February 1954. The centrifugal sand-separating meter shall be furnished by the Contractor.

If, during the development operations, there is any indication of settlement of the gravel envelope, it shall be consolidated and more gravel added as needed. Pumping and swabbing operations shall be alternated as necessary and until sand production has been reduced to a value not in excess of that specified.

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Upon completion of the development operations, the Contractor shall demonstrate, to the satisfaction of the Engineer, that the bottom of the well is clear of all sand, mud, and other foreign material. Development procedures, rate of flow, drawdown, yield, quantities, sand production, and gravel added shall be recorded in the driller's log.

The use of chemical additives, not specified, to assist in the development process must be approved by the Engineer.

Short duration step tests shall be run during and after development in order to estimate specific capacity and safe discharge rates.

Contractor shall dispose of all water during development and testing at a location designated by the Engineer. Contractor shall provide pipe for this discharge and provide an adequate means of separating gravel, sand, and silt from the discharge water stream. Waste material shall be disposed of off-site and in accordance with all applicable local, state, and federal environmental regulations. It is the Contractor's responsibility to properly dispose of the water, and prevent the waste discharge stream from damaging or eroding the site.

5A-05 PRODUCTION TEST PUMPING

5A-05.01 METERING - Rate of flow, totalization, and depth to water shall be measured throughout production test pumping. Totalized flow will be used to corroborate hourly running time.

All gauges, valves, meters, and other equipment required for the test shall be furnished and installed by the Contractor. All observations made during the tests shall be recorded by the Contractor and copies of the test data shall be furnished to the Engineer. The Contractor shall provide and install a down-hole transducer inside the well casing to monitor water levels to the nearest tenth (0.10) of a foot during all test pumping.

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5A-05.02 PRODUCTION TEST PUMPING - Not used in this Specification.

5A-05.03 YIELD AND STEP DRAW DOWN TEST 20-CONTINUOUS HOURS - Immediately following development pumping, the Contractor shall perform a complete pumping test of the well, as directed by the Engineer, utilizing the pumping unit employed for development. The pumping unit shall continue to meet or exceed the design capacity of the well at a maximum pump setting of []-feet.

The Engineer will prescribe at most, six (6) flow rates for the Contractor to use during the pump test. The Contractor shall not proceed with the next flow rate until three (3) consecutive water level readings are the same (defined as no more than .5 feet of change during a 30 minute period).

Contractor shall measure pump discharge and production, and recovery time at a minimum of 15-minute increments. Discharge shall be measured by an accurate measuring method approved by the Engineer. Pumping water level at each test point shall be continuously measured by an electric transducer with an accuracy of ± 0.1 feet. The discharge, in gallons per minute, shall range between zero and the specified maximum discharge or the maximum capacity of the well, whichever is less, and shall be measured only after the pumping water level has stabilized. Upon completion of test, Contractor shall provide the Engineer certified copies of the development and test records.

Unless specifically instructed otherwise by the Engineer, in writing, Contractor shall, after completion of test, remove all sand and debris from the bottom of the well.

The Contractor shall include 20 hours of step testing in his base bid and provide a per hour add or deduct price in the bid schedule for step testing that equals more or less than the 20 hours specified.

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5A-05.04 AQUIFER ANALYSIS CONSTANT RATE TEST - Immediately following the yield and drawdown test, the Contractor shall perform a 5 day (120 hours) complete pumping test of the well as directed by the Engineer, utilizing the pumping unit employed for development. The pumping unit shall continue to meet or exceed the design capacity of the well at a maximum pump setting of [] feet.

Contractor shall measure pump discharge, well drawdown, sand production, and recovery time at a minimum of 12-hour increments. Discharge shall be measured by an accurate measuring method approved by the Engineer. Pumping water level at each test point shall be directly measured by an electronic transducer with an accuracy of ± 0.1 foot. The Contractor shall continue to monitor recovery of the water level for a 24-hour period after the pump is shut down. Upon completion of test, Contractor shall provide the Engineer certified copies of the development and test records and the recorded data from the step-drawdown and constant rate tests in an electronic format (i.e., original ASCII text files recorded by the data loggers used).

The Contractor shall include five (5) days of test pumping in his base bid and provide a per day add or deduct price in the bid schedule for test pumping that equals more or less than the five (5) days specified.

5A-05.05 SPINNER (FLOWMETER) SURVEY TESTING FOR WELL - Just prior to completion of the constant rate pumping test for each well, a spinner (or flowmeter) survey shall be run throughout the entire length of the screened interval. The spinner survey shall be conducted by a company retained by the Contractor and approved by the Geohydrologist. The cost of the spinner survey shall be borne by the Contractor. There will be no additional payment for either rig time or standby time, while logging is being performed, or while the Contractor is waiting on his Subcontractor.

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The spinner survey shall be run by a company that is mutually agreed upon by the Geohydrologist and the SBMWD. The same pump used for the constant rate pumping test may be used during the flowmeter survey. Therefore, the Contractor shall ensure that the spinner tool will be able to go past the pump bowls.

Each spinner survey shall be conducted in the perforated section of the well. For the purpose of this Specification, the perforated interval is defined as the lineal distance between the top of the uppermost perforations to the bottom of the lowermost perforations. The spinner survey shall be continuous and shall traverse the complete perforated interval irrespective of the fact that in some cases, the perforated interval may contain embedded sections of blank casing.

The spinner survey shall be conducted with the pump operating at a constant discharge rate, as determined in the field by the Geohydrologist. The spinner survey shall consist of at least three "down-run" passes. Both static and dynamic tests shall be made from the bottom of the perforated interval to the top of the perforated interval. Each static (stop count) test shall consist of one minute readings made at 10 foot intervals. Each dynamic test shall be conducted at different line speeds (in feet per second), unless otherwise approved by the Geohydrologist. The record for each test shall indicate either meter speed or percentage of total meter speed with depth. The meter used for the survey shall be calibrated within the uppermost and lowermost sections of blank well casing.

The flowmeter survey shall become the property of the SBMWD at the time the survey is completed. The survey shall be run in the presence of the Geohydrologist. The Contractor shall provide six (6) copies of the survey to the Geohydrologist immediately upon completion, and one reproducible original, at no additional cost. The Contractor shall additionally provide interpretation and/or analysis of the spinner survey to the Geohydrologist within seven (7) days of

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conducting the survey. Flowmeter survey measurements shall also be provided in an ASCII electronic format on suitable storage media.

The Contractor shall be required to provide whatever assistance may be needed to accomplish the flowmeter survey. After the flowmeter survey, the Contractor shall remove all sediment from the bottom of the well and shall demonstrate that the well has been properly cleaned by measuring the depth of the well in the presence of the Geohydrologist.

5A-06 CAPPING OF WELL

The well shall be capped at all times when the casing is left unattended without drill tools or pump installed. Upon completion of all work in connection with development and test pumping, the well shall be capped by tack welding a 1/4-inch steel plate over the top of the casing.

5A-07 CLEANUP

After completion of all other work on the project, and before making application for acceptance of the work, the Contractor shall clean the site of his operations, including all areas under the control of the Engineer that have been used by the Contractor in connection with the work on the project, and shall remove all debris, surplus material, equipment, and all temporary construction facilities, of whatever nature, unless otherwise approved by the Engineer. Water or dust palliative shall be applied as required for the alleviation or prevention of dust nuisance during all phases of construction.

All drill cuttings from the well shall be removed from the site and properly disposed of by the Contractor.

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RECORDS

The Contractor shall prepare and maintain records regarding the well construction providing the following information:

A complete daily shift log and record of well construction shall be prepared. A copy shall be furnished to the Engineer upon request during construction operations.

A record of drilling progress, formations encountered, static water level, drilling techniques used, and problems encountered shall be included in the daily shift log prepared by the Contractor and submitted to the Engineer.

Upon completion of the well boring operations, the Contractor shall provide a caliper survey, witnessed by the Engineer, to verify size of the boring.

Measurements of plumbness and alignment shall be provided and recorded as specified.

A record shall be maintained showing any variation in the addition and amount of water required during drilling. The depths at which such changes are required shall be shown on the daily shift log.

A record of the quantity of gravel, bentonite, and cement slurry used for the annular space shall be provided.

Development and test records maintained at a minimum of 30-minute intervals showing production rate, static water level, pumping level, drawdown, production of sand, and other pertinent information concerning well development shall be recorded and furnished to the Engineer.

Driller's log shall be furnished that indicates well construction details including casing thickness and diameter, length of casing, type, size, and location

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of perforations, graduation of the gravel envelope, quantity of gravel installed, and other pertinent details.

Geophysical logs as defined in paragraph 5A-03.05.

5A-09 ABANDONMENT

The Contractor, based on his actions, or at the specific request of the Engineer, may be required to abandon the borehole or well.

5A-09.01 ABANDONMENT DUE TO ACTIONS OF CONTRACTOR - If abandonment of the drilled hole is by reason of any actions of Contractor, including, but not limited to, such causes as losing tools, damaging the well, misalignment, or any other cause attributed to careless or poor workmanship, the hole shall be completely filled with bentonite or other impervious earth materials in accordance with applicable state and county standards. No payment will be made for drilling and filling the hole so abandoned, and the Contractor shall drill a new hole within 50-feet of the same location, repeating the work so abandoned at no additional compensation.

5A-09.02 ABANDONMENT AT REQUEST OF ENGINEER - If abandonment of the drilled hole is specifically requested by the Engineer, including but not limited to such causes as total lack of potential aquifers, insufficient number of potential aquifers, or unacceptable quality, the hole shall be completely filled with bentonite or other impervious earth materials in accordance with applicable state and county standards. In this event, the Contractor will be paid for mobilization and demobilization, as well as for the footage of drilling completed.

5A-10 NOISE ABATEMENT

Due to the close proximity of each of the well sites to existing residences, the Contractor shall make every effort to minimize the nighttime noise generated from drilling and construction activities.

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For the purpose of this Specification, "Nighttime" hours shall be defined as 7:00 p.m. through 7:00 a.m.

The Engineer has established that the ambient nighttime noise level at each of the sites is 50-dB.

The Contractor will perform the following procedures to minimize nighttime noise levels:

1. All construction activity, including drilling of the pilot bore, shall be performed only between the hours of 7:00 a.m. and 7:00 p.m. unless otherwise specified within this document or authorized in writing by the SBMWD/Engineer.
2. The Contractor may, at his option, conduct the reaming and casing placement on a 24-hour per day schedule. However, the noise level, as measured at the property line of each of the well sites during the nighttime hours, shall at no time exceed 10-decibels above the previously established ambient noise level.
3. All development pumping shall be limited to the hours of 7:00 a.m. and 7:00 p.m.
4. For the five (5) days aquifer test, the Contractor shall provide the Engineer a noise reduction plan that includes operating guidelines, equipment type, and noise reduction equipment proposed to reduce the night time noise to a constant minimum nearly equivalent to the ambient noise level of 50 decibels.

5A-11 SITE INSPECTION

A mandatory job site inspection will be conducted at the date and time stated in the Notice Inviting Bids. Two sites are confined and may require extraordinary efforts in drilling and in placing equipment, portable mud tank, and drill pipe trailer.