CITY OF SEDONA

SEDONA, ARIZONA

CLASS A+ RECLAIMED WATER

INJECTION TEST WELL

Project # COS 2012-118

VOLUME 2 OF 2
TECHNICAL SPECIFICATIONS

FINAL SUBMITTAL

February 2013

carollo in association with: HSI HydroSystems Inc. and ASR SYSTEMS

4600 EAST WASHINGTON, SUITE 500 • PHOENIX, ARIZONA 85034 • P. 602.263.9500 • F. 602.265.1422

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City of Sedona WWRP
Effluent Injection Well No. 1
Air Rotary Drilling

Technical Specifications

Prepared for:

City of Sedona

19655 Highway 89A
Sedona, Arizona 86336

In Association with:

Carollo Engineering

6400 E. Washington Street, Suite 500
Phoenix, Arizona 85034

Prepared by:

HydroSystems, Inc.

9831 South 51st Street, Suite E-122
Phoenix, Arizona 85044
P: 480.517.9050 F: 480.517.9049
e-mail: info@hydrosystems-inc.com
website: www.hydrosystems-inc.com

Expires 12/31/2013

January, 2013

12-660

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1.0 GENERAL

1.1 Scope of Work

The work to be accomplished under the following technical specifications consists of drilling and casing of one treated-effluent injection well (injection well) for the City of Sedona (**City**) at the City's Waste Water Reclamation Plant (WWRP) located adjacent to Highway 89, about 6 miles west of downtown Sedona. The location of the WWRP is shown in *Figure 1*. Carollo Engineering (**Engineer**) has contracted HydroSystems, Inc. (**Hydrologist**) to develop a conceptual well design, technical specifications, and to oversee the drilling and testing of the injection well.

The injection well shall be installed in accordance with the conceptual well design presented in this technical specification document. All materials including casing and cement grout shall be supplied and purchased by the **Contractor**. Engineering data covering all equipment and fabricated materials, which will become a permanent part of the work under this contract, shall be submitted to **Engineer**.

The **Contractor** shall follow the conceptual well design for the drilling and casing of the well that will be adjusted according to the actual site hydrogeologic conditions at the direction of the **Hydrologist**. The conceptual well design is shown in *Figure* 2. In general, this is the sequence of events for this well: Drill and install drilling protection/conductor casing to 50 feet, and install a surface seal. Drill air-foam-rotary 6-8-inch diameter borehole to approximately 1,200 feet, run geophysical logs in the open borehole, then ream the borehole. The bottom portion of the borehole from 600 to 1,200 feet will be reamed to a diameter of 12 inches, and the upper portion of the borehole from the land surface down to 600 feet will be reamed to a diameter of 16 inches. After the borehole has been reamed, 8-inch diameter PVC casing and screen will be installed from 600 to 1,180 feet and 10-inch diameter PVC casing will be installed from the land surface to 600 feet, with an umbrella packer installed at the base of the 10-inch diameter PVC casing. The annulus from 600 feet to the surface will then be sealed either with grout or with alternating layers of sand and bentonite, ensuring the final 50 feet is grouted to surface. The well will then be developed by air lift and pump development, and the well will then undergo an aquifer test, followed by a short-duration and then a long-duration injection test.

The injection valve shall be supplied by the **City**. Water for drilling shall be supplied by the **Contractor**. The water produced during development shall be stored onsite in above-ground tanks and will be used for the injection during development and an initial short-term injection test (as described in detail below). Water for longer-term injection testing will be reclaimed water provided by the **City** from a nearby reclaimed water pipeline as shown in *Figure* 3. The **Contractor** shall be responsible for all pipe assemblies and connections as shown in *Figures 3 and 4*. The **Contractor** shall prepare a cost estimate for the work by completing *Bid Schedule 1*. The quantities shown on *Bid Schedule 1* are approximate, based on the current understanding of the hydrogeology of the site.

1.2 Local Geology and Hydrology

The Sedona Wastewater Reclamation Plant is located near the southern edge of the Colorado Plateau physiographic province in north-central Arizona, about 6 miles southwest of the City of Sedona. Groundwater is accessed from the Supai Formation (the lower part of the

Coconino aquifer, or 'C-aquifer'). The sedimentary formations expected to be encountered at depth during drilling are, from top to bottom, a thin surface layer of alluvial material (<50 feet), basalt (approx. 50-150 feet), the lower part of the Supai Formation (approx. 150-900 feet), and the Redwall Limestone (approx. 900-1,200 feet). Groundwater is expected to be encountered at a depth of approximately 450 feet within the Supai Formation. It is possible that parts of the Redwall Limestone may contain solution cavities of unknown size.

1.3 Permits

The **Contractor** shall apply for the required Notice of Intent (NOI) to Drill and pay the permit fee to the Arizona Department of Water Resources (ADWR).

1.4 Licenses Required

The **Contractor** shall hold a current Arizona Well Driller's License issued by ADWR in the rotary drilling category. The **Contractor** shall also hold a current Arizona Registrar of Contractor License, Type A, A-4, A-16, or L-53. The **Contractor** shall provide the **City** copies of these licenses prior to the start of the project, as part of the bid.

2.0 METHOD OF DRILLING

The **Contractor** shall furnish all labor, equipment, materials, and services for the construction of the injection well using the air rotary drilling method. The **Contractor** must have drilled at least three boreholes within the last 10 years exceeding 1,000 feet in similar types of formations. The **Contractor** shall perform all of the work required to complete this project according to these technical specifications. All work is subject to the approval of the **City** and **Hydrologist**. As part of the bid, the **Contractor** shall include information documenting similar project experience, which shall include contact information for relevant former projects.

3.0 DRILLING FLUID CONTROL PROGRAM

The **Contractor** shall submit a copy of the drilling fluid control program to the **Hydrologist** prior to mobilization. This shall include copies of the Material Safety Data Sheets (MSDS) describing all of the drilling additives to be used during drilling. The drilling fluid control program is subject to approval by the **City** and **Hydrologist**.

4.0 REPORTS, LOGS, RECORDS and SAMPLES

4.1 General

The **Contractor** shall keep accurate and legible daily logs and records of all drilling and construction, showing all geologic materials encountered during drilling, the depth at which changes in formation occur and all difficulties or unusual conditions encountered. The daily logs and records shall also show the completion details of the well including but not limited to, the length of blank casing, slotted intervals (if applicable), formation stabilization materials, and cement grout installed and the depth of installation. The **Contractor** shall submit the drilling penetration rate log, the daily driller's report, and the driller's log to the **City** and **Hydrologist**.

The Contractor shall prepare and submit the Well Completion Report to ADWR and to the **City** after completion of the well. Prior to drilling, the **Contractor** shall submit a work plan for the installation of the casing, umbrella packer, and annular seals from 600 feet to surface. This is to include annular material types, grout lifts, installation methods, and methods to prevent material migration further down the well. This is to include the catalog cuts of the proposed umbrella packer, or an alternate method submitted for approval by the **Hydrologist**. Prior to drilling, the **Contractor** shall also submit the plan for the method of installing the 12-inch and 8-inch casings. This plan shall include the transition between the two casing sizes. The **Contractor** shall estimate the amount of overlap required for the swedge, or provide an alternate approach for review and approval by the **Hydrologist**.

4.2 Penetration Rate Log

A penetration rate log shall be kept showing the actual penetration time required to drill the well borehole in either feet-per-hour or minutes-per-foot. The **Contractor** shall also record any fast-drill intervals and voids encountered. The log shall be available for review throughout the drilling program and shall be delivered to the **Hydrologist** upon completion of the well, or as requested by the **Hydrologist**.

4.3 Daily Drillers' Report

A detailed daily driller's report shall be maintained and provided for review on a daily basis to the **Hydrologist** at the well site. The report shall provide a complete description of all formations encountered, the number of feet drilled, the number of hours on the job, any shutdown time due to breakdown, the feet of casing set, and other such pertinent data as requested by the **Hydrologist**. The **Contractor** shall submit the completed log to the **Hydrologist** for approval at the end of each day.

4.4 Drillers' Log

The **Contractor** shall prepare and keep a complete log that sets forth the reference point for all depth measurements, the depth at which each change of formation occurs, the depth at which groundwater is first encountered, the depth at which each stratum is encountered and the thickness of each stratum. The **Contractor** shall also identify in the log the material of which each stratum encountered during drilling was comprised, including color, if the material is loose, tight, angular or rounded, and the depth interval from which each formation sample is taken. The **Contractor** shall provide a copy of the log to the **Hydrologist** and submit a copy of the log with the Well Completion Report to ADWR and to the **City**.

4.5 Drilling Fluid Record

A daily log of all drilling water used during drilling shall be maintained by the **Contractor**. The drilling fluid log shall be available for review by the **Hydrologist** throughout the course of drilling activities. This log shall be furnished to the **Hydrologist** upon completion of the well, or as requested by the **Hydrologist**.

4.6 Cutting Samples

The **Contractor** shall collect and preserve for the **Hydrologist**, one set of cutting samples collected at each 5-foot depth interval from the initiation of drilling to the bottom of the

borehole (including the uppermost 40 feet from the land surface). The **Contractor** shall make every effort to collect a sample that is as representative as possible of the entire 5-foot interval, and not simply a sample of the last of the cuttings emerging from the discharge. Since the rock in the subsurface is a fracture-controlled aquifer we are very interested to understand what, if any, material lines or fills the fractures. Therefore, if some cuttings appear lighter or darker in color than the majority of the cuttings the **Contractor** shall make every effort to collect some of these cuttings as well and place them in the same pile as that interval's cuttings. The samples shall be placed in cloth sacks furnished by the **Contractor**, which shall be marked by the **Contractor** with the well identification and the depth represented. In addition, as an on-site visual record of the borehole stratigraphy, a sample for each interval shall be laid out in descending order in the specified sample storage area on a waterproof tarp or ground cloth. The storage area and ground cloth must allow samples to be maintained in sequence, unmixed with surface material or other samples, until such time as they have been examined and logged by the **Hydrologist**. The storage area is subject to approval by the **Hydrologist** prior to the start of drilling.

5.0 PERFORMANCE OF WORK

The **Contractor** shall employ only competent employees for the execution of work. The drilling, installation, and completion of the well shall comply with the *ADWR Statutes and Rules Governing Minimum Well Construction Standards and the Licensing of Well Drillers (2011).*

If the **Hydrologist** determines that, for reasons beyond the control of the **Contractor**, it is necessary to stop drilling or if the borehole is lost before the objective or desired depth is reached, and further attempts to save or complete the borehole are not practical, a written order to abandon the borehole shall be issued. The **Contractor** shall be compensated on a time and material basis for attempts to save the borehole subject to approval by the **City** and **Hydrologist**, and subject to the provisions of General Conditions Section 47. The **Contractor** shall abandon the well in accordance with A.A.C. Article 8, R12-15-816 as applicable to well abandonment. The **Contractor** shall be reimbursed for the footage drilled and other costs incurred and for moving to an alternate location, subject to the provisions of General Conditions Section 47 and the **City's** decision to proceed.

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If the **Hydrologist** determines that the borehole is lost due to negligence, incompetence, or malpractice on the part of the **Contractor** or his personnel, or due to the use of defective or unsuitable equipment, the **Hydrologist** shall immediately notify the **Contractor**. The **Hydrologist** will provide written documentation of this decision within 24-hours and order the borehole abandoned. The **Contractor** shall not be paid for any footage drilled or for other operations performed in the abandoned borehole and shall be responsible for replacing any lost casing in accordance with these specifications. The **Contractor**, at his own expense, shall abandon the borehole in accordance with A.A.C. Article 8, R12-15-816 as applicable to well abandonment. The **Contractor** shall drill a new borehole at an alternate site in the immediate area as approved by the **City**.

If any work delays are caused by failure of the **Contractor** to comply with any item of these specifications, then the **Contractor** shall bear the burden of additional expenses directly resulting from the non-compliance, including reimbursement of the **Hydrologist** fees to the **City**.

6.0 SCHEDULING

The specific schedule of the drilling program described herein will be coordinated among the **City**, the **Hydrologist**, and the **Contractor** prior to the start of drilling. It is imperative that all project personnel strictly adhere to the schedule, once it has been established. The **Contractor** shall provide at least a 48-hour notice of work commencement to the **Hydrologist** and to the **City** for the start of all major activities. Once the Notice to Proceed has been issued the **Contractor** shall have 14 days to begin work. The **Contractor** shall have 80 days to complete the work (drilling, constructing, and airlift development), not including pump install, pump development, testing, and pump removal. Drilling, development, and testing will occur during daylight hours. Special 24-hr access for will be granted for well casing/seal construction and long term injection testing.

7.0 PROTECTION OF PROPERTY

7.1 General

The **Contractor** shall take all necessary precautions to preserve the landscape and vegetation, as nearly as practical, in their present condition. The **Contractor** shall be responsible for replacing any damaged items. Off-road driving and other activities will be restricted to that which is essential for access to the well location and for the efficient operation of drilling and testing equipment. All litter and debris shall be cleaned up daily and disposed of off-site in an environmentally friendly manner by the **Contractor**. Plastic tarps shall be placed under all drilling and support equipment during the entire time the equipment is onsite to protect the site against oil or hydraulic fluid spills or leaks.

The **Contractor** shall neatly pile the drill cuttings at the site as directed by the **City** and **Hydrologist**. The **Contractor** shall later dispose of the cuttings by transporting them about 2,000 feet to the southwest corner of the WWRP to the stockpile on the south side of the Wetland basins. After completion of the work, the **Contractor** shall remove all debris, waste, trash, and unused materials or supplies and shall obliterate all signs of temporary construction facilities such as temporary work areas, temporary structures, and stockpiles of excess or waste materials. The **Contractor** shall restore the well location, as nearly as possible, to its original condition.

7.2 Site Access

The **City** shall provide the **Contractor** access to the well site. Contractor access is shown in *Figure 3*. The **Contractor** shall repair any and all damage to the access roads caused by the **Contractor's** equipment, and shall restore them as close as possible to their original (pre-project) conditions. The **Contractor** shall also be responsible for the clearing (grubbing) of small shrubs (1 to 3 feet tall) in order to access the drill site.

8.0 UTILITIES

8.1 Water

The **Contractor** shall provide potable water as needed for drilling operations. Construction water may be available from a fire hydrant located approximately 5 miles from the work site. The **Contractor** shall be responsible for all conveyance and coordination with the **City**, or responsible agencies, for the use and cost of the construction water. The **City** shall provide access to Class A+ reclaimed water for the injection test. Access to the reclaimed water will be via a 6-inch-diameter pipeline with an access point located approximately 250 feet southeast of the drill site (see *Figure 3*). The Contractor shall be responsible for conveying the water from the pipeline to the drill site. The pipeline is pressurized (approximately 50 psi) and a capped stub out is provided to which the **Contractor** may connect temporary piping. The contractor shall be responsible for protecting the pipe at all road crossings.

8.2 Electricity

The **Contractor** shall provide temporary independent power-generation units for all operations that require electricity associated with the drilling and testing of the well, as applicable. A power source will be required to provide power to the flow-control valve during the long-duration injection test, to the booster transfer pump, and also to the backwash pump.

8.3 Underground Utilities

The **Contractor** is responsible for locating and marking all underground utilities as documented in the Arizona Revised Statutes (ARS), Chapter 2, Article 6.3, Sections 40.360.21 through 40.360.31 as related to the Arizona Blue Stake Law. The locating and marking of utilities also includes pipelines that cross or pass near the drill site prior to the start of drilling. Should any of these utilities or pipelines be damaged during the drilling process, the **Contractor** shall be responsible for the repair or replacement of the utilities and/or pipelines to the satisfaction of the **City**, at no additional cost to the **City**.

8.4 Miscellaneous

The **Contractor** is responsible for all lighting, sanitary toilet(s), and secure storage onsite.

9.0 DRILLING MOBILIZATION and DEMOBILIZATION

The **Contractor** shall furnish and maintain, in safe and efficient working condition, all equipment necessary to perform the specified work, including a drill rig capable of performing the specified operations to the specified depths, sampling, and auxiliary equipment as specified or required to complete the described tasks. Prior to mobilization of drilling equipment to the property and upon request of the **Hydrologist**, the **Contractor** shall decontaminate the drill rig and downhole tools by steam cleaning and rinsing critical pieces of equipment. All living and other expenses to perform this project should be included in this task. This project consists of

one mobilization and demobilization of the drilling rig and associated drilling equipment to and from the site. The line item specifically excludes the long-duration injection test so that this item may be paid before the end of the test. A separate line item is established pump installation, pump development, pump testing, and injection testing (*Bid Schedule 1, Item 11*). Drilling mobilization and demob shall be paid as a lump sum (LS) (*Bid Schedule 1, Item 1*).

10.0 BOREHOLE DRILLING, CASING and GEOPHYSICAL LOGGING

The casing lengths offered in these technical specifications are approximate. Final casing schedule, screen slot size, and seal depths will be provided upon completion of the pilot borehole and geophysical logging. Bid line items shall allow for a 25% over/under usage before price re-negotiation is initiated. At a minimum, the well shall have an18-inch surface casing extending from 1 foot above land surface to a depth of 50 feet, 10-inch diameter PVC casing extending from a minimum of 2 feet above the ground surface to a depth of 600 feet, and 8-inch diameter PVC casing extending from 600 feet to 1,180 feet below the surface. The conceptual well design is shown on *Figure 2*.

10.1 Conductor Borehole Drilling and Casing

The conductor borehole shall have a nominal 24-inch diameter to a depth of approximately 50 feet. The depth of the surface alluvium should be approximately 50 feet, below which is hard basalt. The goal is to install the conductor casing into stable formation, so the actual depth of the conductor borehole may be deeper depending on the stability of the formation. Once the conductor borehole has reached its final depth a 18-inch LCS steel conductor casing shall be installed. Four (4) centralizers will be placed at the base of the conductor casing only, placed equidistant, and provide a minimum standoff of 2-inches. The **Contractor** should have at least 100 feet of 18-inch diameter casing to cover this contingency. The conductor casing shall stick up above the land surface a minimum of 1 foot. The **Contractor** shall place a cement grout surface seal to completely fill the space between the 18-inch casing and the 24-inch conductor borehole wall, to the ground surface, meeting the minimum ADWR surface seal requirements (R12-15-811). The cement grout for the surface seal may be tremmied or installed with a method approved by the **Hydrologist**. The neat cement shall consist of Portland cement conforming to ASTM C150, Type I or II, and potable water. No more than 6 gallons of water shall be mixed per each 94-pound sack of cement. Calcium chloride may be utilized as a curing accelerator during installation of the surface casing only, but shall not exceed more than two percent of the total volume of neat cement. The method of installation is subject to approval by the **Hydrologist**. The conductor borehole drilling shall be paid by the linear foot (LF) (*Bid Schedule 1, Item 2*).

10.2 Pilot Hole Drilling

After the conductor borehole has been drilled and the 18-inch casing grouted into place, the **Contractor** shall drill a 6-8-inch diameter pilot borehole to a depth of 1,200 feet utilizing the rotary method with air and foam, using a percussion hammer bit. The final depth of the open borehole may be adjusted by the **Hydrologist**. Pilot hole drilling shall be paid by the linear foot (LF) (*Bid Schedule 1, Item 3*).

10.3 Geophysical Logging

After the pilot hole drilling is complete the **Contractor** shall then run a full suite of geophysical logs in the open borehole from the surface to the bottom of the borehole, including gamma-neutron, resistivity (all), SP, temperature, sonic, deviation, and optical televiewer. Once the geophysical logs are run the **Contractor** shall allow for up to four (4) days while the **Hydrologist** determines the final well design and for approval from ADEQ. Geophysical logging shall be paid by the lump sum (LS) (*Bid Schedule 1, Item 4*).

10.4 Ream Borehole

After the geophysical logs have been run, and at the direction of the **Hydrologist**, the pilot borehole shall be reamed in the following manner: the interval from the surface to a depth of 600 feet shall be reamed to a diameter of 16 inches; the interval from 600 to 1,200 feet shall be reamed to a diameter of 12 inches. Borehole reaming shall be paid by the linear foot (LF) (*Bid Schedule 1, Item 5*).

10.5 Caliper Log

Once the borehole has been reamed to the desired diameters the **Contractor** shall run a caliper log of the borehole. Caliper logging shall be paid by the lump sum (LS) (*Bid Schedule 1, Item 6*).

10.6 PVC Casing and Installation

The **Contractor** shall install 8-inch diameter PVC casing from 600 feet to 1,180 feet, or to within 20-feet of the bottom of the borehole should the drilling be stopped short of 1,200 feet. The casing shall be installed in the following manner: blank 10-inch PVC casing from surface to 600 feet; blank 8-inch PVC casing from 600 to 620 feet; slotted 8-inch PVC casing from 620 to 800 feet, blank 8-inch PVC casing from 800 to 820 feet slotted 8-inch PVC casing from 820 to 1,160 feet, and blank PVC casing from 1,160 to 1,180 feet. The blank casing shall be Certa-Lok PVC plastic pipe, SDR 17, with integral bell joints. The slotted casing shall be Certa-Lok PVC plastic pipe, SDR 17, with integral bell joints. Perforations shall consist of 0.032 inch, horizontal, machine cut slots. Casing joints shall be flush threaded. The blank cellar pipe shall be Certa-Lok PVC plastic pipe, SDR 17, with an integral bell upset joint, and an end cap. All casing materials shall be new. Pipe and couplings shall be made from unplasticized PVC compounds having a minimum cell classification of 12454, as defined in ASTM D1784, and shall meet the test requirements set forth in ASTMF480. White pipe shall be supplied. The PVC casing shall be hung in suspension and centered within the borehole with stainless steel centralizers spaced no further than 80 feet apart and attached with stainless steel banding strips along the 10-inch diameter PVC casing from the surface down to 600 feet. The **Contractor** shall then install 10-inch diameter blank Certa-Lok PVC casing from 600 feet to 2 feet above the ground surface. The **Contractor** shall install a swedge joining the 8-inch and 10-inch diameter casings to provide a smooth transition between the two casing diameters. An umbrella packer shall also be installed within the annulus at the base of the 10-inch diameter PVC casing (at approximately 600 feet) to block grout from falling below this depth. The PVC casing and the installation shall be paid for by linear foot (LF) (*Bid Schedule 1, Item 7A, 7B, and 7C*).

10.7 Installation of the 50-600-foot Seal

When drilling and construction of the well is completed, the **Contractor** shall seal the annular space between the 10-inch diameter PVC casing and the 16-inch diameter reamed borehole wall. The **Contractor** shall install a 20-foot thick layer of bentonite on top of the umbrella packer and allow sufficient time for this to hydrate before installing other materials on top. The purpose of the basal bentonite layer is to prevent the weight of the annular materials placed on top from caving through the umbrella packer down below 600 feet. After the bentonite layer has been installed, the **Contractor** shall install the remainder of the annular seal. This may be done either by placing alternating layers of bentonite (40-feet thick) and sand (60-feet thick) from approximately 600 feet to 50 feet, or by placing a neat cement grout to completely fill the annular space. The final 50 feet will be completed with a grout seal. If sand and bentonite are used the contractor shall ensure that no gaps or bridges exist in the material. After the installation of each layer the top surface shall be tagged and the depth recorded, along with the calculations of the volume of the materials used in each interval. If cement grout is used, it must be installed using a tremmie pipe and in small enough quantities/intervals so that the heat of crystallization of the cement in no way compromises the integrity of the PVC casing. The neat cement shall consist of Portland cement conforming to ASTM C150, Type I or II, and potable water. No more than 6 gallons of water shall be mixed per each 94-pound sack of cement. Calcium chloride may be utilized as a curing accelerator during installation of the surface casing only, but shall not exceed more than two percent of the total volume of neat cement. The method of installation is subject to approval by the **Hydrologist**. Installation of the surface seal shall be paid by lump sum (LS) (*Bid Schedule 1, Item 8*).

11.0 WELL DEVELOPMENT

11.1 Airlift Development

The **Contractor** will develop the well initially by airlifting at the completion of drilling for a period of 6 hours after installing the PVC casing, using a perforated cylinder tool placed at the bottom of the borehole and swabbed/raised in increments of 20 feet up to 600 feet depth for a duration of 1 hour at each depth or until the water is clear. Well development will proceed slowly until the water produced is clear and free of sediment. As mentioned above, the developed water shall be discharged into the above-ground 20,000-gallon tank. At the end of airlift development, material that has accumulated at the bottom of the well shall be removed. Suspended solids shall be separated, allowing the decant water to be routed to the storage pond. Airlift development shall be paid by the hour (HR) (*Bid Schedule 1, Item 9*).

*The **Contractor** will be issued a new and separate Notice to Proceed (NTP) for the pump installation, site setup, well-pump development, and testing. There may be an extended delay between mobilization of the drilling equipment and the beginning of pump development and testing, in order to procure the final permits. The **Contractor** shall begin work within 14 calendar days of the new NTP. All work, including the initial 30-day injection test, shall be complete within 80 calendar days. Extended testing options will add to the total work time under the new NTP.*

11.2 Pump Development

The **Contractor** shall then furnish and install a submersible pump, check valve, two transducer tubes (one shall be 1 ¼ inch diameter and the other shall be 1-inch diameter), two

flow meters, a V-Smart injection valve and hydrologic lines (provided by the **City**), and 4-inch diameter steel column pipe to an approximate depth of 570 feet with the possibility of going to a maximum depth of 650 feet (see *Figure 4*). Sounding tubes will be installed to a minimum depth of 580 feet, or a maximum depth of 630 feet, with the base open, and the lower 10 feet perforated with either factory or field perforations. This will incur approximately 90 feet of friction loss at a pumping rate of 550 gpm. The 1 ¼-inch diameter sounding tube shall be available for a manual sounder. Within the smaller 1-inch diameter sounding tube the **Contractor** shall install a pressure transducer installed to a depth of 570 feet with the possibility of going to a maximum depth of 630 feet. The contractor shall provide a pressure-transducer-type water level measurement, display, and data recorder for use during all well development and testing. Continued use of the equipment for the extended injection testing options will be included in the reference option. The equipment shall be a LevelTroll 500, or an equivalent device with equivalent or better accuracy and memory storage. The transducer shall be a differential pressure-sensing module nested below the water level in the well. The transducer cable shall be set to a depth of 580 feet below land surface. The transducer shall be calibrated for the 200 to 300 psi range. The Data recorder shall allow for periodic data storage variable from 1 to 100 minutes, capable of storing 3,200 lines of data to include date, time, and level corrected to feet below land surface. Instant reading shall be accessible at the wellhead at all times through a display module (display is anticipated to be in sleep mode during times of non-use). Software and hardware required to download data will be provided to the **Hydologist**. All data downloads will be conducted by the **Hydologist**.

The **Contractor** shall provide a motor-driven generator sufficiently sized to operate the submersible pump for 8-hours of continuous pumping. Also included in this pump string will be a rented V-Smart valve, control unit, and hose, all three of which shall be provided by the **City**. Once the pump string is in place the well will be pumped continuously for 4 hours prior to surging the well using the V-Smart valve. If the well experiences fouling, defined by a significant decrease in the injection capacity, the Contractor shall use a hand pump to insert a slug of NSF 61 grade, 12.5% sodium hypochlorite through the top of the well head. The **Contractor** should plan on having a 50-gallon container of sodium hypochlorite onsite. A filter (5 microns) (provided by the **Contractor**) shall be placed between the WWRP effluent and the well head to filter the effluent (not the drilling water). A second 5-micron filter shall be installed in parallel as a redundant filter (see *Figure* 4) which is to be used when the first filter clogs and needs to be replaced. The **Contractor** shall have at least two clean filters onsite at all times so that the subsequent injection test will not be prematurely ended in order for the **Contractor** to order new filters. In *Figure 4* note the location of the tap for the sand tester near the wellhead on the waste side of the tee, and the water-sample bib at the wellhead.

The **Contractor** will provide a pump capable of producing approximately 500 gallons per minute (gpm) of water from a depth of approximately 600 feet, set to approximately 600 feet. During pump development, pumping will be followed by varying lengths and rates of injection at successively higher rates with periods of recovery between each injection step. Pumped water shall be stored in the above-ground water tank. This water shall be used as the injection water. When the tank is full the remainder of the water can be routed to a basin (pond) described below and shown in *Figures 3 and 4*. This will proceed for up to 24 hours. If the **Hydrologist** judges that the well is not adequately developed, then the pumping and injection process may be repeated until the well is completely developed, but not to exceed 48 hours. At the end of pump

development, material that has accumulated at the bottom of the well shall be removed. Pump development shall be paid by the hour (HR) (*Bid Schedule 1, Item 10*).

11.3 Pump Installation and Removal

The **Contractor** shall provide the pump used for development and testing. The **City** shall provide the injection valve. In the event that the **City** is unable to provide the V-Smart valve, and at the direction of the **City** the **Contractor** shall provide the valve and apparatus necessary to run it properly. In this instance, a bid item is provided for this item as a lump sum (LS) (*Bid Schedule 1, Item 11*).The **Contractor** shall install both the pump and the valve and furnish and maintain, in safe and efficient working condition, all equipment necessary to perform the specified work, including a pump capable of performing pump development, the short-duration injection test, and the long-duration injection test, as applicable. Because the pump may remain within the well for an extended period of time, this bid item is listed here separately so that it does not prevent payment of the other items before its completion. At the end of testing the **Contractor** shall have 30 days to place the site back as close to its pre-project condition as possible and demob all equipment offsite. This 30 days is not included in the long-duration injection test time period. Mobilization and demobilization (for testing) shall be paid as a lump sum (LS) (*Bid Schedule 1, Item 12*).

12.0 AQUIFER TESTING

The **Contractor** shall conduct a continuous rate pumping test for approximately 8-hours. The pump discharge line and injection supply line shall both have flow meters for determining the discharge and the injection rate of the well. The measuring device is subject to approval by the **Hydrologist**. The pipe configuration shall be connected as shown in *Figure* 3. The pump shall be installed below the V-Smart valve, and separated from it by a check valve that allows water to flow upward only. The discharge line shall contain a "T" with one path leading to a 20,000-gallon above-ground tank and the other path (labeled as "Discharge to Basin" in *Figure* 4) leading to the lined basin located about 300 feet north of the drill site (see *Figure 3*). The **Contractor** shall provide the piping or hose to convey the water to the basin. Water produced from the well during development and most of the aquifer test will be discharged into the basin. Near the end of the test, and at the direction of the **Hydrologist** and/or the **City**, a portion of the water shall be discharged into a clean, above-ground storage tank. This water will be used in the subsequent short-duration injection test. A pump capable of 550 gpm shall be installed between the above-ground tank and the manual valve in order to provide sufficient flow rates for injection. Additionally, at the discretion of the Hydrologist, a filtration system may be installed on the effluent supply line. This is anticipated to be a canister filter unit using 5-micron cartridge of sock filters. The unit shall be sized such that the head loss across the clean unit is less than 5 psi at 550 gpm. The **Contractor** shall supply the above-ground storage tank, the pump, and all pipes and fittings necessary to construct the assembly shown in *Figure 4*. All above-grade piping shall be 6-inch diameter, although the flow meters may be reduced to 4-inch diameter. The V-Smart injection valve shall be supplied by the **City**. The **Contractor** shall be responsible for valve malfunction or damage caused by **Contractor** negligence, as determined by the **Hydrologist**. The cost of the tank rental and pipe assembly shall be paid by lump sum (LS) (*Bid Schedule 1, Item 13*).

The entire pumping test period must continue without interruption. If equipment failures or lack of fuel interrupt the test, the entire test must start over until an uninterrupted test has been accomplished. The anticipated pumping rate is estimated to be 550 gpm. The **Hydrologist** may adjust this rate based on the performance of the well if necessary.

The **Contractor** is responsible for collecting water level drawdown, discharge rate, and sand production at 30-minute intervals during the pumping period. The **Contractor** must leave the pump, V-smart valve, and sounding tubes in the well after the completion of the pumping test for the injection testing. The **Hydrologist** will notify the **Contractor** when the recovery portion of the test has been completed and the injection test can begin. The aquifer test shall be paid by the hour (HR) (*Bid Schedule 1, Item 14*).

13.0 INJECTION TESTING

The injection test involves two components: (1) a short-term injection test, and (2) a longer-term injection test. The purpose of the short-term test is to confirm the effectiveness of the injection well as a disposal method for the effluent. The conceptual piping assembly shown in *Figure 4* shall be constructed by the **Contractor** before the aquifer test is conducted. During the initial short-term test, groundwater stored in the above-ground water tank will be used for injection. The Contractor will convey the effluent supply to the well site which is located approximately 300 feet southeast of the drill site (see *Figure 3*).

13.1 Short-Duration Injection Test

The duration of the short-term test is estimated to last between one (1) and three (3) hours. The V-Smart valve is operated via hydraulic hoses with a hydraulic pump at the surface. Normal 110-volt power for the hydraulic pump shall be supplied by the **Contractor**. The **Hydrologist** and/or the **City** shall be responsible for adjusting the V-Smart valve as well as the manual valves on the piping assembly. The **Contractor** shall be responsible for measuring water level mounding, discharge rate, and water pressure on the well head.

If the injection well performs efficiently during the short-term test, then a longer-term injection test will occur using Class A+ reclaimed water from the WWRP. The V-Smart valve shall regulate the flow rate of reclaimed water into the well once the manual valve on this line is opened as directed by the **Hydrologist**. At the end of the short-duration injection test the well shall be pumped for 2 hours to help clear any clogging that may have occurred during the injection test. The water produced during this pumping shall be discharged in the above-ground tank for sediment settling, and further decanted to the storage pond. The short-duration injection test shall be paid by the hour (HR)(*Bid Schedule 1, Item 15*)

13.2 Long-Duration Injection Test

The **City** is considering three options for the longer-term injection test: (1) 30 days, (2) 60 days, and (3) 90 days. The actual duration is not yet decided and will be decided by the **City**. If additive alternate(s) are awarded, the **City** reserves the right to deduct the work from the contract at any point during the Injection Testing, subject to the provisions of General Conditions Section 30.

The **Contractor** shall provide support services during the long-term aquifer injection testing. This will include, at a minimum, weekly site checks and well backwashing (pumping the well to waste for 30 minutes); equipment maintenance and refueling; and emergency response (estimate 4-times per month for long term testing). Any time the **Contractor** visits the well site, critical operation data is to be documented. This is to include the current disposition (off, pumping, injection), and operating parameters, to include water level, injection flow rate, injection meter totalizer, well head psi, filter hi/lo pressures, and any strange observations related to the well. Date and time of each reading is to be noted. Current operating data will be documented before the well is stopped for maintenance. The **Contractor** shall record well response data during each and every pump cycle. This is to include recording the pre-start static water level, and the water level at 5-minute intervals during pump operation; the water level, flow rate, wellhead pressure, sand content, turbidity/observed color, and observed air, noting any valve/pipeline restrictions, adjustments, or throttling. The **Contractor** shall record the pump-to-waste flow-meter totalizer before pumping activities each day, and at the end of pumping activities each day. The **Contractor** shall record the same information noted for pumping activities for injection slugs and short-term injection tests, using the same 5-minute collection interval, and obtaining injection flow-meter totalizer values at the start and end of each day. For the long-term injection tests, anytime the well is started back into injection service, the **Contractor** shall first record the pre-start injection flow-meter totalizer and the static water level, then record the water level, flow rate, wellhead pressure, and filter hi/lo pressures. Measurements will be taken at 5 minute intervals to 30 minutes after injection startup. Field information will be recorded on a consistent form and submitted to the **Hydrologist** within one (1) business day (fax, PDF, etc.). The **Hydrologist** will provide the contractor a sequential procedure for starting injection or pumping operations, based upon the contractor-provided equipment and final setup. This procedure will include specific instructions for operation of the borehole injection flow control valve and backwash pumping operations, as they are determined. For bidding purposes, it should be estimated that weekly backwash operations will be conducted to include existing site operation data collection; 4 hours of backwash pumping; one hour of filter maintenance and cleaning; and one hour for injection startup and data collection.

The long-duration injection test shall be paid on a lump sum (LS) basis. For bidding purposes the first month shall be bid as one item, and each additional month shall be added sequentially. For example, "Bid Alternate 1" in the *Bid Schedule* includes the first month plus an additional month, for a total of two months. "Bid Alternate 2" includes the first month plus two additional months, for a total of three months: 1-month test (*Bid Schedule 1, Item 16*); 2-month test (*Bid Schedule 1, Item 17*); and 3-month test (*Bid Schedule 1, Item 18*).

14.0 PLUMBNESS AND ALIGNMENT

The **Contractor** shall guarantee that the well is straight and plumb enough to allow the installation of a submersible pump and injection valve to a depth of 810 feet.

15.0 WELL CAPPING

At the completion of all the work in connection with construction and final injection testing, the **Contractor** shall temporarily cap the well by placing a full-circumference weld using

3/8-inch thick steel plate over the top of the well casing. The well cap shall include a 1 ½-inch threaded nipple cap in order to provide access to the well to collect water level measurements. Well capping shall be paid by each (EA) occurrence (*Bid Schedule 1, Item 19*).

16.0 DRILLING SITE SECURITY

The **Contractor** is responsible for securing the well and well site until the work is complete and accepted by the **Owner**. Although the project is located on the property of the Sedona WWRP the drill site is immediately adjacent to a publicly accessible wetlands, so there will likely be people and pets nearby, particularly to the south of the drill site. The **Contractor** shall install temporary fencing around the work site. The fencing shall be a minimum of No. 11 gage galvanized steel wire, two (2) inch square mesh, and shall be a minimum of 6-feet high when installed. All posts shall be temporary and capable of being removed at the end of the project. Posts shall be made of material that is sound and durable enough to support the fencing and withstand a minimum of two hundred (200) pounds of horizontal pull to keep intruders from entering and being harmed in the work and equipment storage areas. The fencing shall be provided with a double hinged, full frame access gate assembly with a locking device for a padlock. Upon completion of the work at each site, the fencing shall be removed and any post hole constructed shall be properly backfilled and compacted. The **Contractor** shall select and implement any additional security measure or measures to protect the wells from damage, acts of vandalism, and to ensure public safety. The **City** and **Hydrologist** are not responsible for any lost or damaged equipment at the drilling site. Drilling site security shall be paid as a lump sum (LS) (*Bid Schedule 1, Item 20*).

18.0 WELL ABANDONMENT

If well abandonment is necessary, the **Contractor** shall follow the requirements of ADWR's August 22, 1997 "Statutes and Rules Governing Minimum Well Construction Standards and the Licensing of Well Drillers" (A.C.R.R. R12-15-816).

19.0 VISITATION AND INSPECTION

The **City** and **Hydrologist** are entitled to review the **Contractor's** facilities, program operations, transactions, and records, which pertain to this scope of work and contract, at any reasonable time during the term of work. The **Contractor** further agrees to include in all its subcontracts hereunder, if any, a provision that the Subcontractor agrees that the **City** or **Hydrologist**, or any of their authorized representatives, shall have access to the Subcontractor facilities and have the right to examine any books, documents, and records of the Subcontractor involving transactions related to the subcontract.

20.0 LOST CIRCULATION

During the drilling operations, if Lost Circulation conditions occur the **Contractor** shall notify the **Hydrologist** immediately and the **Hydrologist** shall notify the **City.** Lost Circulation conditions shall be described as a loss of drilling fluid to the formation that exceeds the

maximum available discharge rate of drilling fluid into the borehole. It also includes the extent to which the fluid level in the annulus outside the drill pipe can not be maintained to a level above the surface casing for at least one (1) hour, due to no fault of the **Contractor**.

The **Contractor** is responsible for maintaining the integrity of the borehole, documenting the times of lost circulation, the types and quantities of lost circulation materials used, and the circumstances of the lost circulation conditions for each occurrence.

Image Source: All Topo Pro 7

Legend

- Highways
- Sedona WWRP

NOTICE OF EXTENDED PAYMENT PROVISION:

(PER ARS 32-1129.01) THIS CONTRACT ALLOWS THE OWNER TO MAKE PAYMENT WITHIN 15 DAYS AFTER CERTIFICATION AND APPROVAL OF BILLINGS AND ESTIMATES FOR PROGRESS PAYMENTS, WITHIN 15 DAYS AFTER CERTIFICATION AND APPROVAL OF BILLINGS AND ESTIMATES FOR RELEASE OF RETENTION AND WITHIN 15 DAYS AFTER CERTIFICATION AND APPROVAL OF BILLINGS AND ESTIMATES FOR FINAL PAYMENT.

0 1.5 3 6 Miles

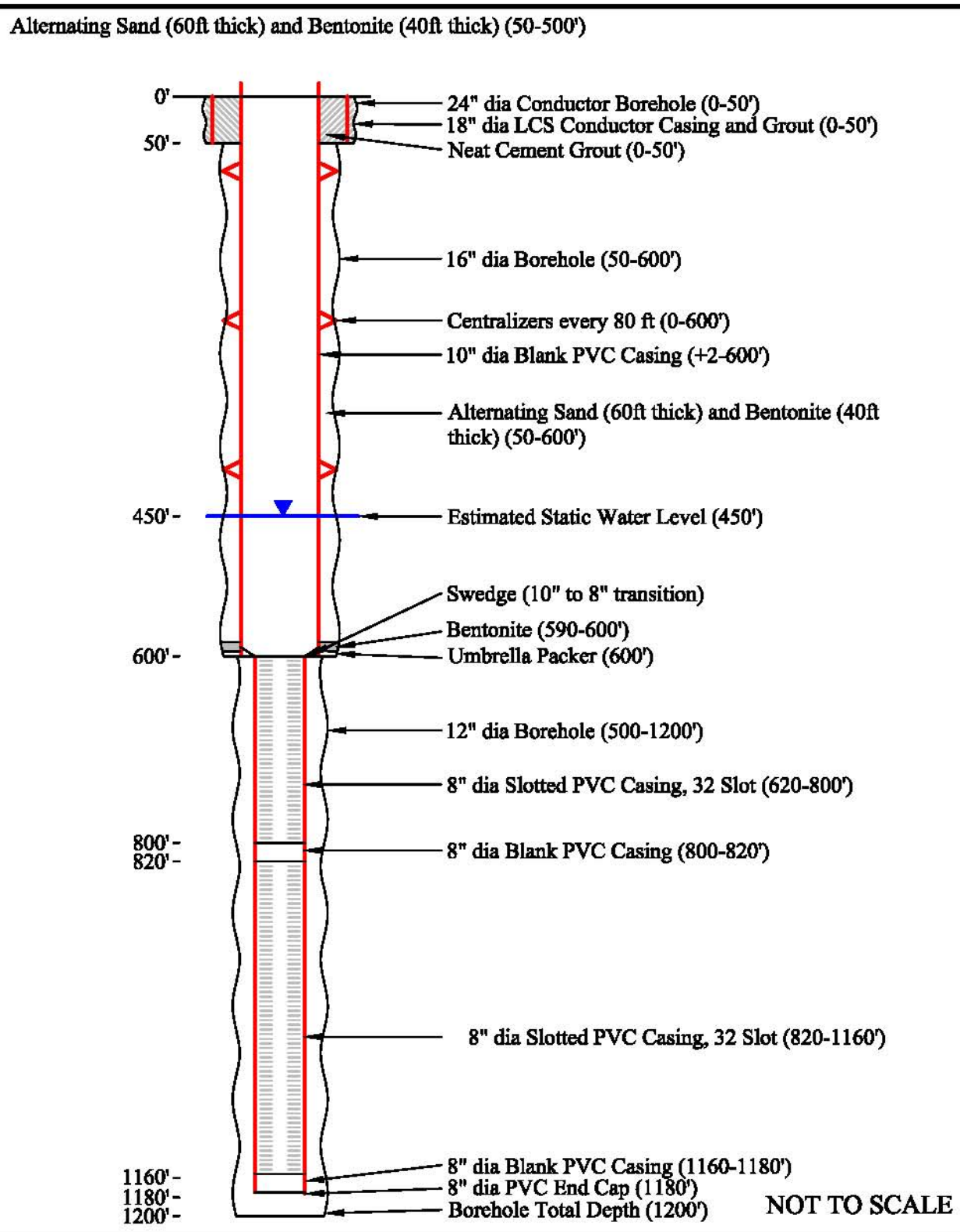
N

HydroSystems Inc.

Injection Well No. 1
WWRP Location Map
City of Sedona

Figure 1

R:\12-660 Carollo Injection Test Well\Field Tasks\Technical Specs\Figure Workspace\Figure 1 WWTP Location Map REVISED 130208.mxd 2/8/2013



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HydroSystems Inc.

City of Sedona WWRP
Injection Well No. 1
Conceptual Design (3)

Figure 2

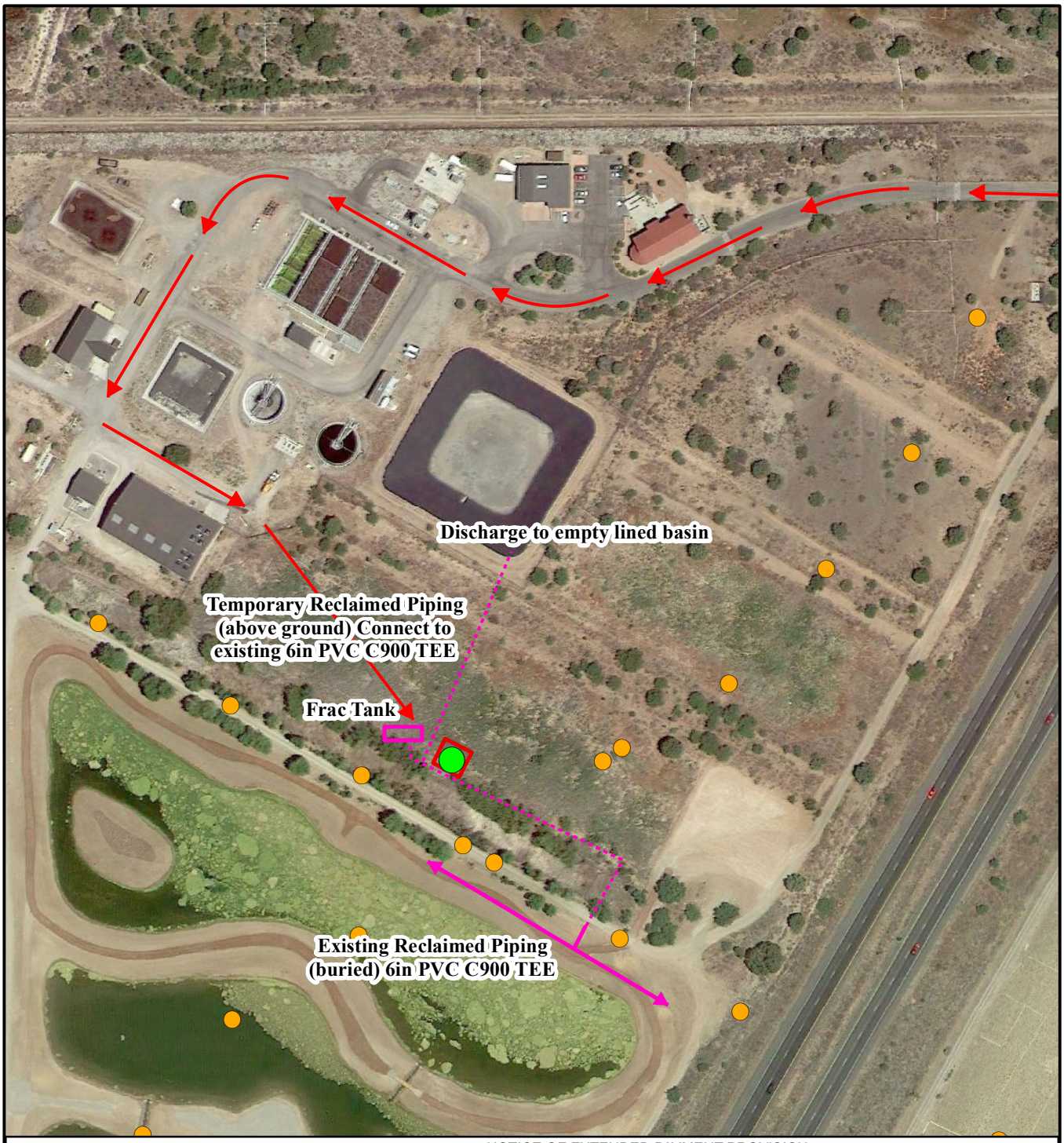


Image Source: Google Earth Pro

Legend

- Proposed Well Site
- CSAMT Station Locations
- Limits of Construction
- Site Access

NOTICE OF EXTENDED PAYMENT PROVISION:

(PER ARS 32-1129.01) THIS CONTRACT ALLOWS THE OWNER TO MAKE PAYMENT WITHIN 15 DAYS AFTER CERTIFICATION AND APPROVAL OF BILLINGS AND ESTIMATES FOR PROGRESS PAYMENTS, WITHIN 15 DAYS AFTER CERTIFICATION AND APPROVAL OF BILLINGS AND ESTIMATES FOR RELEASE OF RETENTION AND WITHIN 15 DAYS AFTER CERTIFICATION AND APPROVAL OF BILLINGS AND ESTIMATES FOR FINAL PAYMENT.

0 150 300 600 Feet

N

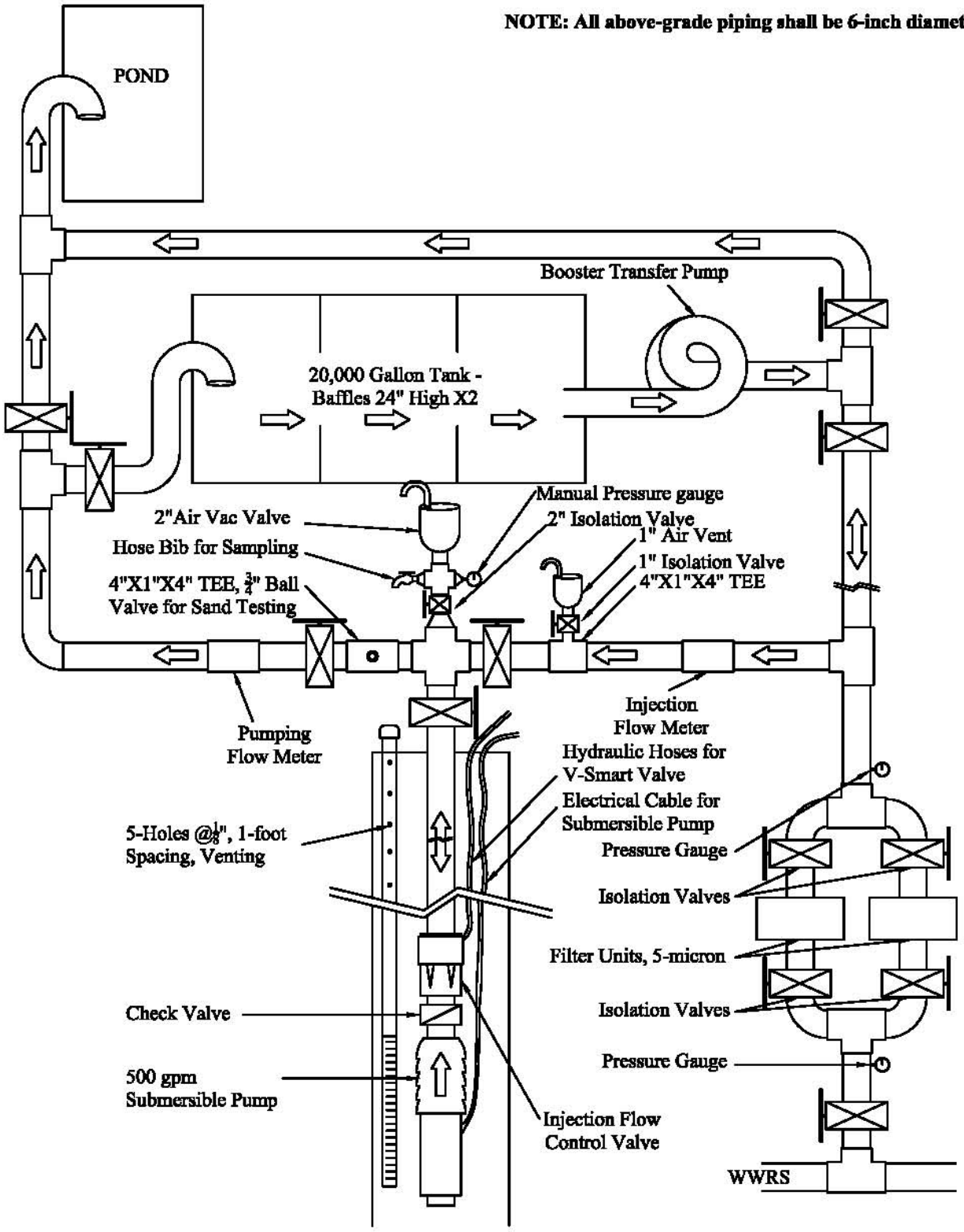
HydroSystems Inc.

Injection Well No. 1
Site A Location Map
City of Sedona

Figure 3

Path: R:\12-660 Carollo Injection Test Well\Field Tasks\Technical Specs\Figure Workspace\Figure 3 Site A Location Map REVISED 130208.mxd 2/8/2013

NOTE: All above-grade piping shall be 6-inch diameter



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HydroSystems Inc.

City of Sedona WWTP
Conceptual Piping Layout
Injection Well No. 1

Figure 4

R:\12-660 Carollo Injection Test Well\Field Tasks\Technical Specs\Figure Workspace\Figure 4 Conceptual Piping Layout REVISED 130207.dwg, 2/12/2013 6:45:27 AM

SECTION 15131

BORE HOLE INJECTION FLOW CONTROL VALVE
(LEASE SPECIFICATION)

PART 1 SCOPE

1.01 SUMMARY

A. Monthly lease to include injection valve, control lines, control units, support services, and all other items for a complete and functional injection valve system as specified herein.

B. Submit the following information with the Bid Documents. The first month lease shall be listed in the Bid Schedule.
   1. First Month Lease: _____
   2. Additional months: _____
   3. Option to Purchase (attach details): _____
   4. Vendor: _____
   5. Head Loss at 500 gpm: _____

PART 2 BORE HOLE INJECTION CONTROL VALVE:

2.01 The contractor shall supply, install, operate, remove and return, upon request, a bore hole injection control valve and associated appurtenances for injection development and testing. The valve will be located in the pump string, mounted just above the pump and column check valve units. The valve shall provide full shut off and variable injection rate control, as operated from a control unit located at land surface. The contractor, as part of the bid package, will provide the name of the bore hole injection valve vendor to be used.

A. Bore hole Injection valve Leasing Services:
   1. The contractor will be responsible for securing and maintaining the lease on the bore hole injection valve. It is anticipated the valve will take 4 months for manufacturing and delivery. The contractor will be provided the order, if this option is selected, to lease the specialty valve upon completion of the pilot borehole drilling and geophysical logging. This should allow lead time necessary for securing the valve for installation with the test pump unit identified in Section 11.0.
   2. Notice to proceed for installation of the test pumping unit, identified in Section 11.0, will be withheld until validation of a firm delivery date of the bore hole injection valve to the work site. Failure to provide the specialty valve on schedule will not warrant extensions of time, unless negotiated otherwise with the Hydrologist.
   3. The leasing service shall provide all materials and components to properly operate the bore hole injection valve system, as well as, provide vendor support as necessary for the installation and operation of the unit. At a minimum this is expected to include vendor oversight during the surface testing, installation, and final position testing of the bore hole injection valve.

Additional vendor support services shall be noted on a per day basis to include all labor, travel and expenses.

2.02 Bore Hole Injection Valve Vendors

A. Only two bore hole injection valves are proven in industry as acceptable for the application. Contact information for the vendors is noted.

Baski Inc. Hank Baski	In-Flex Bladder Injection Valve 303-789-1200 info@baski.com
ASR Resources / Cactus Controls Rob Tribble	V-Smart Sleeve Injection Valve 702-525-0250 Rob.tribble@me.com

2.03 Bore Hole Injection Valve Criteria

A. The following information represents the design criteria for estimating the type and size of bore hole injection valve:

Parameter	Specification	Comments
Casing Size	8 inch ID	PVC
Column Size	4-inch ID	Steel
Mount Location	Above pump	Above column check valve
Mount depth	640 feet max	Allow 20 feet surface lines
Pump Type	Submersible	Power cable size unknown
Pump Rate	500 gpm	620 feet max lift
Injection Rate	300 gpm	350 gpm maximum
Static Water Level	450 feet	Below surface
Average WL Rise	160 feet	Weekly injection before backwash
Max WL Rise	300 feet	Serve clog well issue
Available Pressure	25 psi	Booster pump, effluent supply line

2.04 Bore Hole Injection Valve Design

A. The bore hole injection valve shall be manufactured by Baski, Inc., or ASR Resources, or an equivalent vendor as approved by the Engineer. Driving media for the valve shall be acceptable for use in potable water wells. The valve shall be constructed of 304 stainless steel components at a minimum. The valve shall have full range flow adjustment ability from 50 gpm to 350 gpm. The valve shall provide a near leak-tight seal when fully closed. Head losses through the valve at 500 gpm will be used as a rating criteria for approving the valve type. The contractor shall provide, in their bid, the head losses anticipated through the specialty valve at 500 gpm.

B. The valve will come equipped with all lines and control unit. The control unit may be stand-alone, or require up to 120 VAC for operation. All expendable or conservative driving media must be included in the valve lease. All components required for the driving media to be utilized and controlled will be included. This will include a control panel providing the ability to open, or close the valve through the full operating range, including the ability to hold and sustain a valve position during operations.

Additional components required to reach the sustainable operation goal will be required. Speed controls will also be provided to allow adjustment of the valve operation rate.

2.05 Bore Hole Injection Valve Operation

A. The contractor will be responsible for the operation, operation oversight, and due care of the equipment. This includes security, equipment placement in non-hazard zones, and proper handling of the valve and components. Special handling instructions by the vendors must be adhered to, else the valve will be considered damaged and un-usable until such time the vendor certifies the valve for operation. Due care will be taken with handling control lines to prevent the introduction of contaminates into the control system. The contractor will be liable for all repair costs and lost time associated with valve damage resulting from improper handling.

END OF SECTION