CITY OF SCOTTSDALE
BOOSTER AND WELL PUMP STATION DESIGN CRITERIA
August 31, 2018

The purpose of this document is to provide general design criteria for booster and well pump stations that will ultimately be owned by the City of Scottsdale (City). While this document provides general design guidelines, there are many site specific conditions that may require additional or varying design criteria. In addition, updates to regulations and City requirements may require modifications to this criteria. This document shall serve as a general design template, and site specific designs shall be modified as required by the City. The reader shall also refer to the City of Scottsdale Design and Policies Manual (DSPM) for additional system requirements.

1. SITE DESIGN

1.1 Ownership: The property on which a booster pump station is located shall be owned in fee by the City. It is preferred that the property on which a well site is located is owned in fee by the City. However, if ownership of the well parcel is not an option and due to aquifer characteristics, water quality characteristics, or proximity to existing water infrastructure, or the location is highly suited for a production well, then a long-term utility easement for the parcel is acceptable.

1.2 Access: Two vehicular access points shall be provided or turn around space for required maintenance vehicles and fire trucks shall be provided. Crane access shall be provided to the pumps, fueling access shall be provided to the generator, and chemical loading access shall be provided to the disinfection storage equipment.

1.3 Size & Layout **(Wells Only)**: The preferred size for a new well site is 150 feet by 150 feet (0.52 acres). This size is preferred so that multiple replacement wells can be drilled on the site if needed. The minimum size for a new well site is 1/3 of an acre (120 feet by 120 feet). The site shape does not necessarily need to be square, but the length of the long side should not be more than 2 times the length of the short side (e.g. for 0.5 acres, 105 feet by 210 feet). Well site layouts shall incorporate the following:

- Sanitary sewer separation per ADEQ requirements.
- Locate equipment, waste basin, utilities, and electrical service to allow space for future replacement wells.
- Provide adequate space for well rig and laydown staging.
- Provide a minimum clearance of 20’ between wellhead and site walls.

1.4 Location **(Wells Only)**:

- The preferred well site location is as far away as possible from any existing or planned residential development to minimize possible noise issues.
- The preferred location for a production well site is in an area with suitable aquifer characteristics (e.g. thick saturated interval and high hydraulic conductivities), suitable water quality (e.g. low arsenic and nitrate), relatively shallow depth to static water level, and in close proximity to existing water infrastructure that will simplify entry into the distribution system.

1.5 Ground Cover: Non-roadway surfaces shall be covered with 2” of ¼” minus decomposed granite.

1.6 Roadway Surface: Access driveways located outside of the site shall be concrete or asphalt pavement designed for H20 loading. Interior roadway surfaces shall be crushed stone over compacted ABC or soil cement designed for H20 loading**. (Wells Only)** Rig set up, laydown staging, and future replacement well areas shall be constructed to the "roadway surface" requirement.

1.7 Grading & Drainage: Site grading, drainage, and detention/retention shall be in accordance with Chapter 4 of the City DSPM.

- The City may require a Drainage Report based on the site specific conditions and proposed improvements.
- Positive drainage shall be provided away from all structures and equipment.
- Erosion control measures shall be included for reservoir overflows, reservoir drains, roadway surfaces, and site outfalls.
- Culvert diameters shall not be less than 18-inch.
- **(Wells Only)** Well sites shall include a below ground concrete pump to waste basin with an open top at grade. The pump to waste basin shall be sized for a usable volume equal to two time the waste volume. The basin shall have a sanitary sewer connection per Section 1.11. Separate drainage facilities shall be provided, and the site shall be graded so that storm water does not enter the pump to waste basin.

1.8 Walls, Gates, & Man Doors: The site shall be surrounded by an 8-ft high CMU wall, solid grout. Include 16-ft wide rolling gates for vehicle access and a separate 3-ft man door. Equipment height shall not exceed wall height. Gate and door security access shall be per the City Security and Safety team requirements. Include conduits and space for a future motorized gate operator.

1.9 Equipment Pads: All equipment shall be placed on concrete equipment pads. Pad elevations shall be a minimum of 6" above the drainage outfall elevation for the site. **(Wells Only)** Well head pads shall be constructed per ADEQ requirements, shall include a survey monument, and shall be sized to accommodate the sound enclosure per Section 6.6.

1.10 Water Service: Potable water service shall be provided onsite for maintenance hose bib, emergency shower (if required), landscape irrigation (if required), and fire protection (if required). All services shall be metered and include a backflow prevention assembly. **(Wells Only)** Aquifer Storage Recovery (ASR) wells shall also include a water service and backflow prevention assembly for the water-flush line shaft.

1.11 Sanitary Sewer Service: A sanitary sewer service connection is required for all onsite waste streams including, but not limited to, pump room floor drains, air conditioning condensate, chlorine analyzer discharge, emergency shower/eyewash discharge, and disinfection storage containment sumps. On-site rock drainage pits will not be permitted for these discharges where existing sewer collection systems are in proximity to the site as determined by the City. **(Wells Only)** The pump to waste basin shall include a metered sanitary sewer connection with motor actuated plug valve and level transducer to control the discharge rate and timing from the basin to the sewer system. Provide sump pump and controls as required for sewer connection.

1.12 Signage: Site address, facility number, phone number, warning, and no trespassing signs shall be posted outside the front of the site after construction completion. Warning and no trespassing signs shall also be posted on the outside of the side and back walls.

1.13 Paint: All walls, enclosures, above ground piping, reservoirs, and equipment shall be painted to match natural surroundings.

- The City must approve paint colors prior to construction.
- Approved paint manufacturers: TNEMEC or approved equal

1.14 Operation & Maintenance Manuals: Provide Operation and Maintenance Data in the form of instructional manuals for the following:

- All equipment and systems
- All valves and related accessories
- All instruments and control devices
- All electrical gear.

1.15 Project Record Documents: Prepare site "As-Built" drawings that are certified and sealed by an Arizona Registered Land Surveyor prior to start up.

1.16 Noise: Pump sites shall not cause noise that exceeds a fifteen-minute average sound level of 45 decibels in residential areas and 60 decibels in commercial areas. An average sound level will be determined from 15 measurements performed with an ANSI-S1.4-1971 Type 1 or Type 2 Sounds Level Meter using the A-weighting network. The instrument response shall be "slow" and measurements shall be made when wind velocity is less than five miles per hour. The location for measuring exterior sound levels shall be at the property line of the pump station facility, four to five feet (4' to 5') above ground level and at least four feet (4') from walls and other reflective surfaces. **(Wells Only)** Provide well pump sound enclosures per Section 6.6.

2. MECHANICAL

2.1 Pumps & Motors **(Booster Stations Only)**: Pumps shall be vertical turbine, solid shaft type, suitable for pumping potable water. Each pump shall comply with the latest edition of the Hydraulic Institute Standards.

- Booster Sizing: Pump station flow rate and pressure shall be designed to meet domestic and fire protection water supply. Sizing shall be based on the Basis of Design Report and Hydraulic Modeling in accordance with Chapter 6 of the City DSPM for average day demand, peak hour demand, and maximum day demand plus fire flow. When available, the hydraulic evaluation and modeling shall incorporate City Supervisory Control and Data Acquisition (SCADA) records for existing system operations. The hydraulic modeling shall also incorporate existing City water models as directed by the City. The total number of pumps and individual pump sizing shall be selected to meet the range of low to high flowrates from the SCADA data and hydraulic modeling diurnal curve for system demand. The total pumping capacity

shall meet the largest of either peak hour or maximum day plus fire flow with the largest pump out of service.

- Booster Drives: Pump motors shall be driven by Variable Frequency Drives (VFD) unless otherwise approved by the City. All VFD's shall include air conditioning cooling. Soft starters may be allowed by the City for certain fire flow applications or when a pump station feeds directly into a reservoir. Full voltage non-reversing starters may only be considered for certain low horsepower applications. See Section 7.2 for drive design requirements.

- Booster Discharge Accessories: Pumps with VFD drives shall include a globe style silent check valve. The City may require an alternate check valve style for certain high pressure applications. Pumps with soft starters and full voltage non-reversing starters shall include a hydraulic pump control valve manufactured by either Bermad or Cla-Val. All pump discharges shall also include a combination air release valve, drain port, flexible coupling, pressure gauge and switch, and isolation valve. See Section 7.2 for motor controls, monitoring, and protection.

- Booster Motors: Motors shall be Totally Enclosed Fan Cooled (TEFC), squirrel cage induction type, 460 volt, 60 Hz, 3 phase electric power. Motors shall be cast iron, Nema Energy Spec ISO9000 certified. Provide air cooled anti-friction guides, oil lubricated thrust bearings, and reverse rotation ratchets. Motor shall have a stainless steel plate indicating all essential lubricating information. The motor shall not be loaded more than 90% of rated horsepower. Approved motor manufacturer Emerson US Motors.

- Booster Discharge Head: The discharge head shall be manufactured by the pump manufacturer and shall be a fabricated steel fitting that mounts to the pump can flange. Cast iron discharge heads are not allowed. The Discharge flange shall match the pressure rating of the booster station piping. Prior to machining, the discharge head shall be stress relieved by a thermal process. A flanged four piece adjustable spacer type coupling shall be provided with a coupling guard for seal removal. An air release valve shall be provided on the discharge head base to relieve air in the suction barrel. Provide taps and penetrations on the discharge head required for the mechanical seal drain and air release valve. The discharge head and flanges shall be rated for the maximum pressure on the pump curve.

- Booster Pump Column: The pump column shall be fabricated steel with welded steel flanges capable of supporting the bowl assembly. Limit the column sections to a maximum length of 10-ft and connected with isolated 316 stainless steel hardware. Column sections shall be rated for the maximum pressure on the pump curve.

- Booster Suction Barrel: The suction barrel shall be welded steel with a mounting flange and side suction nozzle/flange. Suction barrels shall be manufactured by the pump manufacturer. Wall thickness as determined by Section VIII of the ASME code based on 0.125 corrosion allowance and the pump rated head, but in no case less than 0.375 inch thick. Do not install baffles inside suction barrels. Vortex suppression fittings shall be installed on the pump bowls. All barrels shall be placed on a concrete leveling pad.

- Booster Shaft Assembly: Support the bowl shaft by no less than two bearings. Support line shaft bearings by rigid spiders spacers at a maximum spacing of 5-ft apart. Provide fully machined shafts of sufficient diameter to transmit torsional and axial loads under all specified operating conditions, diameter per pump manufacturer recommendations. Provide shafts made of 410 or 416 stainless steel at a maximum length of 10-ft. The shafting shall be coupled with Type 316 stainless steel couplings, designed with a safety factor of one and half times the shaft safety factor and shall be left-hand thread to tighten during pump operation. Provide shaft sleeves of Type 416 stainless steel hardened to 250 - 400 BHN at each intermediate line shaft bearing and at the seal box. Secure the sleeves to the shaft by a positive mechanical method which prevents the sleeve from rotating on the shaft.

- Booster Bearings: Bowl bearings shall be Bismuth Tin Bronze UNS C89835 or other NSF 61 approved bronze material. Provide suitable lubrication grooves to adequately pass water through the bearings and distribute lubrication evenly. Pack the suction bell bearing with a water resistant grease approved for use in potable water. The bearings shall be located at intervals of no more than five (5) feet and as recommended by the pump system manufacturer. Bearing spacing shall be provided in distances as recommended by the manufacturer to avoid natural frequency effects. Provide a protecting collar made of bronze to exclude solids or foreign matter from entering the bearing.

- Booster Mechanical Seal: The mechanical seal must be removable without removing or raising motor and must include a seal drain. Champion mechanical seals 401 316-SS, Hastelloy “C” springs alpha silicon carbide face material rated at 450 psi. Provide one spare seal for each pump.

- Booster Bowls: Pump bowls shall be of close-grained, cast-iron conforming to ASTM A48 Class 30 or ductile iron, having a minimum tensile strength of 30,000 pounds per square inch, free from blow holes, and sand holes. Bowls shall be fitted with a replaceable bronze bowl wearing rings. Bowl fasteners shall be Type 316 stainless steel. Bowl suction case shall have four webs to support lower bowl bearing. Bowl inlet shall have a stainless steel strainer with anti-vortex blades.

- Booster Impeller: Provide enclosed impellers of one piece, constructed of NSF 61 approved Type 316 Stainless Steel or nickel aluminum bronze. Provide impellers with vanes of uniform spacing, rounded inlet edges, and smooth water passages. Provide removable bronze wear rings at the inlet end of the impeller and at the casing, secured by a positive mechanical method to prevent loosening in any operating mode. Secure impeller to the shaft by a stainless steel key and locknut or locking collar so that it cannot unscrew or become loose due to torque or rotation in either direction.

- Booster Coatings and Linings: Coat all interior and exterior ferrous metal surfaces of pump, motor, bowls, column pipe, and suction barrels with a high solids epoxy coating system. All coatings in contact with potable water shall be NSF 61 certified. Approved coating manufacturer: TNEMEC.

- Booster Tests: Provided shop hydrostatic tests, shop performance tests, shop job motor tests, field vibration analysis and tests, field performance tests, and Reed

Critical Frequency calculations for VFD's. The complete pumping unit shall conform to the vibration requirements set forth in Section 9.6.4 of the 2018 edition of the Hydraulic Institute Standards. All tests and test reports shall conform to the requirements and recommendations of the Hydraulic Institute Standards. Acceptance criteria shall be Grade 1U as defined by table 14.6.3.4 in Hydraulic Institute Standards 14.6 - 2011.

- Booster pump approved manufactures: National Pump Company, Fairbanks Morse Pump Corporation, Goulds, Peerless, or Flowserve.

2.2 Pumps & Motors **(Wells Only):** Criteria listed for **Production Wells** is specific to wells intended to deliver raw water to the potable water treatment and distribution network. Criteria listed for **Aquifer Storage and Recovery (ASR) Wells** is specific to wells that have the ability inject water back into the aquifer through the well for recharge. All other criteria in this section applies to both types of wells. Well pumps shall be vertical turbine, enclosed, hollow shaft type, suitable for pumping deep well pumping of raw ground water. Provide steady bushing as required by design. The pump shall be designed to meet the minimum down-thrust requirement of the motor and not exceed the maximum motor thrust requirement. All surfaces, including coatings which will come in contact with raw ground water, potable water, or water that will become potable following additional treatment shall be NSF 61 certified. Each pump shall comply with the latest edition of the Hydraulic Institute Standards.

- Well Pump Sizing: Well pump sizing shall be based on the hydrogeologist report, well drilling, well construction, and well testing results. The City Hydrogeologist must be involved in the development of the well and must approve the results and recommendations of the hydrogeologist report prior to drilling the well. The City Hydrogeologist must also be involved in the construction of the well and must approve the results and recommendation from the well testing prior to sizing the well pump. The approved hydrogeological results shall then be used to prepare a Basis of Design Report and Hydraulic Modeling in accordance with Chapter 6 of the City DSPM for the final well pump sizing.

- Well Discharge Accessories **(Production Wells Only):** Production well pumps shall be equipped with globe style check valves, motor actuated pump to waste valves, bypass, and a flow meter. All pump discharges shall also include a combination air release valve, drain port, discharge/sand test port, flexible coupling, pressure gauge and switch, and isolation valves. See Section 7.2 for motor controls, monitoring, and protection.

- Well Discharge Accessories **(ASR Wells Only):** ASR well pumps shall be equipped with a sleeve control valve and a two-way flow meter. If required by the City, ASR well pumps will include motor actuated pump to waste valve assemblies. All pump discharges shall also include a combination air release valve, drain port, discharge/sand test port, flexible coupling, pressure gauge and switch, and isolation valves. See Section 7.2 for motor controls, monitoring, and protection.

- Well Drives: Pump motors shall be driven by soft starters unless otherwise required by the City. See Section 7.2 for drive design requirements.

- Well Motors: Motors shall be weather protected Type 1 squirrel cage induction type, 460 volt, 60 Hz, 3 phase electric power. Motors shall be cast iron, Nema Energy Spec

ISO9000 certified with Class H insulation and Class B temperature rise conforming to IEEE 841. Provide synthetic oil lubricated motor, and reverse rotation ratchets. Provide water cooling system as required by the design. Motors shall have a stainless steel plate indicating all essential lubricating information. Motors shall have stator moisture protection by means of vacuum impregnation of epoxy with copper windings. The motor shall not be loaded more than 90% of rated horsepower. Approved motor manufacturer Emerson US Motors, GE, or approved equal.

- Well Mechanical Seal: The mechanical seal must be removable without removing or raising motor and must include a seal drain. Champion mechanical seals 401 316-SS, Hastelloy "C" springs alpha silicon carbide face material rated at 450 psi. Provide one spare seal for each pump. Provide needle valve and pressure gauge on stuffing box inlet and pipe flushing water to approved drain location.

- Well Discharge Head: The discharge head shall be manufactured by the pump manufacturer and shall be a fabricated steel fitting that mounts to the pump can flange. Cast iron discharge heads are not allowed. Prior to machining, the discharge head shall be stress relieved by a thermal process. Provide bypass ports for seal drain. The discharge head and flanges shall be rated for the maximum pressure on the pump curve.

- Well Pump Bowls: Pump bowls shall be of close-grained, cast-iron conforming to ASTM A48 Class 30, ductile iron, or stainless steel having a minimum tensile strength of 30,000 pounds per square inch, free from blow holes, and sand holes. Bowls shall be fitted with a replaceable bronze bowl wearing rings. Bowl fasteners shall be Type 316 stainless steel.

- Well Pump Impeller: Provide enclosed impellers of one piece, constructed of NSF 61 approved stainless steel or nickel aluminum bronze. Provide impellers with vanes of uniform spacing, rounded inlet edges, and smooth water passages. Provide removable bronze wear rings at the inlet end of the impeller and at the casing, secured by a positive mechanical method to prevent loosening in any operating mode. Secure impeller to the shaft by a stainless steel key and locknut or locking collar so that it cannot unscrew or become loose due to torque or rotation in either direction.

- Well Pump Inlet Strainer: The strainer shall be a cone type 18-8 316 SS. Net inlet area shall be equal to four times the net impeller inlet area. Maximum inlet area shall not exceed 75 percent of the minimum opening of the water passage through the bowl or impeller.

- Well Pump Bowl Shaft: The pump shaft shall be ASTM A 582, 416 SS or 174 SS. The shaft shall be sized for the total axial thrust plus the weight of all rotating parts supported by it and the horsepower transmitted.

- Well Accessories: Well shall include a vent pipe, a 1-1/2" 316 SS sounder tube, and a 1-1/2" 316 SS transducer tube. Sounder and transducer tubes shall be sch. 40 in 20-ft lengths connected with treaded couplings and shall be strapped to the column pipe every 20-ft with 316 SS straps, extending from the discharge head to the top of the bowl assembly.

- Well Production Casing: Well production casing shall be per the Hydrogeological Report and shall include at a minimum Rosco Moss stainless steel screens/blanks and Colorado Silica packing. The top 40-ft of casing shall be slurry encased per ADEQ requirements. Provide concrete well pedestal per ADEQ requirement as designed by a registered structural engineer.

- Well Pump Column: The column pipe shall be A53 Grade B steel with a minimum thickness of 0.375". Column sections shall be 20-ft lengths and interchangeable. Size such that friction loss will not exceed 5 ft/100ft. The ends shall have 3/16" taper threads, faced parallel to butt against subsequent column pipes and ensure proper alignment when assembled. Column sections shall be rated for the maximum pressure on the pump curve.

- Well Line Shaft **(Production Well Only):** Line shafts shall be C1045 steel at a maximum length of 20-ft. Diameter sized per manufacturer. The shafting shall be coupled with C-1215 steel self-tightening couplings, designed with a safety factor of one and half times the shaft safety factor and shall be left-hand thread to tighten during pump operation. Provide shaft sleeves of at each intermediate line shaft bearing and at the seal box. Secure the sleeves to the shaft by a positive mechanical method which prevents the sleeve from rotating on the shaft.

- Well Line Shaft **(ASR Well Only):** Line shafts shall be ASTM A 276, 416 SS at a maximum length of 20-ft. Diameter sized per manufacturer. The shafting shall be coupled with Type 316 SS self-tightening couplings, designed with a safety factor of one and half times the shaft safety factor and shall be left-hand thread to tighten during pump operation. Provide shaft sleeves of Type 416 stainless steel hardened to 250 - 400 BHN at each intermediate line shaft bearing and at the seal box. Secure the sleeves to the shaft by a positive mechanical method which prevents the sleeve from rotating on the shaft.

- Well Line Shaft Bearings **(Production Well Only)**: The shaft bearings shall be bronze. Bearings shall be suitable for potable water service and enclosed in a shaft tube. Bearings shall have a minimum wall thickness of ½". Production well bearings shall be vegetable oil lubricated. Bearings shall be spaced no more than 5-ft apart or as recommended by the pump manufacturer.

- Well Line Shaft Bearings **(ASR Well Only)**: The shaft bearings shall be Graphalloy GM 205.3 by Graphite Metallizing Corporation or bronze as directed by the City. Bearings shall be suitable for potable water service and enclosed in a shaft tube. Bearings shall have a minimum wall thickness of ½". ASR well bearings shall be water flush. Bearing shall have vertical grooves sized specifically for water flush to allow more water to pass through for lubrication. Bearings shall be spaced no more than 5-ft apart or as recommended by the pump manufacturer.

- Well Line Shaft Tube (**Production Wells Only)**: The line shaft tube shall be Schedule 80, A53 Grade A carbon steel pipe, sized per the pump manufacturer to accommodate the line shaft bearings specified. Shaft tube shall use bronze or steel coupling, which will act as a housing for the line shaft bearings.

- Well Line Shaft Tube (**ASR Wells Only)**: The line shaft tube shall be lined and coated Schedule 80, A53 Grade A carbon steel pipe or stainless steel, sized per the pump manufacturer to accommodate the line shaft bearings specified. If carbon steel is used, then the interior and exterior shall be coated with an NSF approved epoxy coating. Shaft tube shall use bronze or steel coupling, which will act as a housing for the line shaft bearings.

- Well Prelubrication System **(Production Wells Only)**: Production well line shafts shall be lubricated with drinking water grade vegetable oil. Storage, valves, fittings, and controls shall be provided for automated, adjustable prelubrication of the line shaft bearings. Controls shall provide a 30 minute timer and flow control operated through SCADA.

- Well Prelubrication System **(ASR Wells Only)**: ASR wells shall be lubricated through a water flush system. Water service, valves, fittings, and controls shall be provided for automated, adjustable prelubrication of the line shaft bearings. Controls shall provide a 30 minute timer and flow control operated through SCADA.

- Well Coatings and Linings **(Production Wells Only)**: Coat all interior and exterior ferrous metal surfaces of pump, motor, discharge head, and bowls, with a high solids epoxy coating system. All coatings in contact with potable water shall be NSF 61 certified. Approved coating manufacturer: TNEMEC.

- Well Coatings and Linings **(ASR Wells Only)**: Coat all interior and exterior ferrous metal surfaces of pump, motor, discharge head, bowls, and shaft tube with a high solids epoxy coating system. All coatings in contact with potable water shall be NSF 61 certified. Approved coating manufacturer: TNEMEC.

- Well Tests: Provide shop bowl flow tests, shop job motor tests, field vibration analysis and tests, field performance tests, and Reed Critical Frequency calculations for VFD's. The complete pumping unit shall conform to the vibration requirements set forth in Section 9.6.4 of the 2018 edition of the Hydraulic Institute Standards. ASR well pumps shall also include reverse flow tests. All tests and test reports shall conform to the requirements and recommendations of the Hydraulic Institute Standards. Acceptance criteria shall be Grade 1U as defined by table 14.6.3.4 in Hydraulic Institute Standards 14.6 - 2011.

- Well Sand Separation Equipment: Provide well discharge test data to City for sand content review. If required by the City, provide sand separation equipment at well discharge as approved by the City.

- Well pump approved manufactures: BW/IP International (Byron Jackson), Goulds, Fairbanks Morse Pump Corporation, American Turbine or approved equal.

2.3 Above Ground Piping: Above ground piping refers to the pump station's discharge manifold and discharge piping. The discharge manifold shall include a non-threaded sample connection and a drain connection. Both connections will include a ball valve.

- Sizing: The discharge manifold and discharge piping should be sized such that the inside diameter of the piping maintains a velocity equal to or less than 5 ft/s. The discharge manifold shall be a constant size.

- Material: Ductile iron pipe or fabricated steel in conformance with ASTM A53 and AWWA C200.
- Coatings and Linings: Coat exterior surfaces with a UV resistant, high solids epoxy coating system. Line interior surfaces of steel pipe with NSF 61 certified, high solids epoxy system. The interior of the above ground ductile iron pipe shall be shop applied cement mortar lined per AWWA C104. Approved coating manufacture: TNEMEC
- Bolts: Above ground bolts shall be zinc coated per MAG specifications.

2.4 Below Ground Piping: Below ground piping refers to the pump station's suction manifold, suction piping and yard piping. The suction manifold shall be furnished with flush/air release connection at the end of the manifold. The connection will terminate in a hose bib or sample station.

- Sizing: The suction manifold and suction piping should be sized such that the inside diameter of the piping maintains a velocity equal to or less than 3 ft/s. Higher velocities that are less than 5 ft/s in the header and less than 4 ft/s in the individual pump supplies may be considered by the City when supported by NPSH requirements. The yard piping should be sized such that the inside diameter of the piping maintains a velocity equal to or less than 5 ft/s.
- Material: Booster pump suction manifold and individual booster pump supply shall be fabricated steel in conformance with ASTM A53 and AWWA C200. Yard piping shall be ductile iron in conformance with AWWA M41, C110, C115, C150, C151, C153 and MAG 750.
- Coating: The exterior of below ground steel pipe and suction manifolds shall be tape wrapped per AWWA C209, C214, C216 and cement mortar coated per AWWA C205. The exterior of the ductile iron yard piping shall be coated with a bituminous coating and wrapped in polyethylene encasement per AWWA C105.
- Lining: The interior of buried steel pipe and steel suction manifolds shall be shop applied cement mortar lined per AWWA C205. The interior of the ductile iron yard piping shall be shop applied cement mortar lined per AWWA C104.
- Bolts: Below ground nuts and bolts shall be 304 stainless steel with isolation kits.

2.5 Valves:

- Gate: Resilient wedge type gate valves shall be provided in accordance with Chapter 6-1.409 of the City DSPM, except as modified here in. Above and below ground valves smaller than 16" shall be resilient wedge type. Below ground 16" valves shall be low torque resilient wedge or butterfly type. Approved manufactures Mueller Company, Clow, M&H McWane, or approved equal.
- Butterfly: Butterfly type shutoff valves shall be provided in accordance with Chapter 6-1.409 of the City DSPM, except as modified here in. Above ground valves 16" and larger shall be butterfly type. Below ground 16" valves shall be low torque resilient wedge gate valves or butterfly type. Below ground valves larger than 16" shall be butterfly type. Approved manufacturer: DeZurik or approved equal.
- ARV: Combination air/vacuum release type valves shall be provided in accordance with Chapter 6-1.410 of the City DSPM. The ARV shall have a pressure rating

greater than or greater than the pipeline it is connected to. Approved manufacturers: ARI, Val-Matic, or approved equal.

- Pressure relief **(Booster Stations Only):** A ductile iron pressure relief valve shall be provided on the pump station discharge header that allows water to recirculate to the suction header in a high pressure situations such as a pump stuck in the on position. The pressure relief valve shall be installed upstream of the station's flow meter to avoid recording flows that are recirculated to the pump header. Surge anticipation valves are not allowed. The pressure relief valve shall be a hydraulic diaphragm type valve with V-port plug, position indicator, limit switch, and stainless steel control lines and accessories. The pressure relief valve shall have a pressure rating greater than or equal to the pipeline it is connected to. Approved manufacturers: Bermad, Cla-Val or approved equal.

- Pressure reducing/sustaining: Ductile iron Pressure reducing/sustaining valves (PRV) shall be provided where high pressure zones are feeding low pressure zones. PRV's shall be provided per the City Design Standards Development for Pressure Reducing Valves. PRV's shall be hydraulic diaphragm type valves with V-port plug, position indicator, limit switch, and stainless steel control lines and accessories. The PRV shall have a pressure rating greater than or equal to the pipeline it is connected to. Approved manufacturers: Bermad, Cla-Val, or approved equal.

- Reservoir Fill Valve: Ductile iron fill control valves shall be provided on the inlet booster pump station storage reservoirs. The fill valve shall be hydraulic diaphragm type solenoid control valve. The reservoir fill valve shall have an upstream pressure transmitter and downstream magnetic flow meter. The fill valve shall be controlled by a Badger SEVA-100 electric actuator and RCV Type 564 3-way control valve. The fill valve shall be able to be controlled by reservoir level and either upstream pressure or flow rate. The fill valve shall have a position transmitter, and stainless steel control lines and accessories. Anti-cavitation trim may be required for large pressure differentials as recommended by the valve manufacturer. The fill valve shall have a pressure rating greater than or equal to the pipeline it is connected to. Approved manufacturers: Bermad, Cla-Val, or approved equal.

- Pump Control Valve: Hydraulically operated, diaphragm solenoid actuated, ductile iron check valves shall be provided on the discharge of all non-VFD driven pumps. The control valve shall be closed when the pump starts and open slowly. The control valve shall close slowly as the pump stops to prevent pipeline surges. Hydraulically operated control valves shall also be provided on well pump waste assemblies to pump the initial discharge to the waste basin and purge impurities in the initial flow stream when starting the well pump. The control valve shall have opening and closing speed control, stainless steel control tubing and accessories, and limit switch. The control valve shall have a pressure rating greater than or equal to the pipeline it is connected to. Approved manufacturer: Bermad, Cla-Val or approved equal.

- Check Valve: Globe style silent check valves shall be provided on the discharge of all VFD driven pumps. Alternative style check valves shall be submitted to the City for review for conditions where globe style check valves are not feasible, such as high-pressure applications. Valves shall be of the type that begins to close as the forward flow diminishes and is fully closed at zero velocity. Valve shall permit flow in one

direction only and close tightly, without slamming, when its discharge pressure exceeds its inlet pressure. Valve shall have a ductile iron body and stainless steel seat, disc, and guide. The valve shall have a pressure rating greater than or equal to the pipeline it is connected to. Approved manufacturers: APCO, Val-Matic, or approved equal.

- Actuators: Where required by the City, electric actuators shall be provided for butterfly valve operation. The actuator shall be compatible for use with the selected valve and factory mounted by the valve manufacturer. Provide modulating actuators as required by the City. Approved manufacturer: Rotork

2.6 Flow Meters: Magnetic flow meters with digital totalizers and solid state transmitters shall be provided at reservoir inlets and pump station discharges. The flow meter shall have 4-20 mA outputs, prevention from memory loss during battery change out, one year battery life, and empty pipe detection that uses no external devices. The flow meter shall be sized to meet both low and high flow ranges per manufacturer recommendations. A minimum of 5 times the diameter upstream and 2 times the diameter downstream of straight pipe shall be provided on each side of the flow meter with any bends or obstructions. The flow meter shall have a pressure rating greater or equal to the pipeline it is connected to. Approved manufacturers: Endress+Hauser

2.7 Hydropneumatic Tanks **(Booster Station Only)**: A welded steel hydropneumatic tank shall be provided on the booster pump station discharge piping. The hydraulic evaluation and modeling shall include a surge analysis for sizing the tank. The tank shall be rated at pressure that exceeds the high operational and transient pressures anticipated at the facility's discharge. The hydro tank system shall include the following:

- Air compressor: The air compressor shall be a two-stage simplex compressor suitable for use with potable water, mounted on top of an 80 gallon receiver tank. Electric power supply shall be 460 volt, 60 Hz, 3 phase. The air compressor shall be rated for a pressure greater than or equal to the pressure relief setting for the hydro tank. The air compressor shall be located within the pump room enclosure on a 4" elevated concrete pad. The air compressor shall include a filter, dryer, auto drain, pressure switch, and flexible connection. Approved manufacturer: Ingersoll Rand Series 2340.

- Air Compressor Controls: Provide a compressor control system that will start and stop the compressor as required based on hydro tank level. Provide all control switches, pressure switches, auxiliary relays, magnetic motor starters, and other accessories required for control of the compressor. Starters shall be provided with factory set thermal overloads with a manual "Reset" push button. All control equipment for the compressor module shall be housed in a NEMA 4 control panel except for the low receiver pressure switch.

- Pressure Assembly: A pressure assembly shall be provided to aid in hydro tank level control and compressor operation. The pressure assembly shall be located on a stainless steel rack mounted next to the hydro tank. The assembly shall include a pressure relief valve, pressure switch, pressure gauge, two solenoid valves, a quick connect for bypass external air source, a check valve, and isolation valves with true unions. The compressor shall be started and stopped based on individual set points configured in the pressure switch to pressurize the receiver tank. The pressure

assembly solenoid valve shall be controlled to allow pressurized air into the hydro tank from the receiver tank based on water level in the hydro tank. The pressure assembly air release solenoid shall open when the hydro tank experiences a low water level alarm. The air release solenoid valve shall be de-energized when level in the hydro tank rises above the low level alarm probe.

- Accessories: The hydro tank shall include a tank isolation valve, 2" minimum pressure relief valve, air release valve, fire hose connection on drain, dielectric fittings for dissimilar metals, and stainless steel probe bottle with 5 probes and site glass. The tank outlet shall include an anti-vortex fitting. The hatch shall be 24" diameter. Steel legs shall be provided that are mounted to reinforced concrete foundations.
- Name Plate: A permanent name plate shall be provided that includes manufacturer name, working pressure at rated temperature, maximum allowable pressure, serial number, date of fabrication, thickness and tensile strength of shell and head steel.
- Coatings and Linings: Coat exterior surfaces with a UV resistant, high solids epoxy coating system. Line interior surfaces with NSF 61 certified, high solids epoxy system. Approved coating manufacture: TNEMEC or approved.

3. DISINFECTION

3.1 Type: Disinfection of water shall be achieved using 5.25% liquid sodium hypochlorite. Chlorine gas disinfection is not allowed. The liquid disinfection system shall be designed to accommodate bulk-delivered sodium hypochlorite.

3.2 Sizing: Size chemical storage tank(s) to supply station's demands for one (1) month using the station's average flow rate and average chlorine demand. Provide redundant metering pumps. Size each metering pump to meet the follow flow range:

- Minimum Range: Station's average flow rate at the lowest estimated dosing rate.
- Maximum Range: Station's peak flow rate at the highest estimated dosing rate.

3.3 Metering Pumps: Metering pumps shall be peristaltic pumps. The pumps shall be self-priming, provide suction lift and meet the pressure requirement at the injection point.

- Approved manufacturer: Blue-White Industries, Watson-Marlow or approved equal.

3.4 Piping: All chemical piping shall be 1" minimum diameter, Schedule 80 PVC for interior installations and CPVC for exterior applications. Paint all chemical piping yellow with a UV resistant coating. Provide insulation with aluminum jacket on all outdoor exposed piping. Include chemical and direction labels on the piping.

3.5 Accessories: The disinfection system shall consist of the following accessories:

- Valves: Provide vented ball valves, pressure relief valves, pressure sustaining valves (if needed), check valves, and a quick disconnects at pump connections. Size valves to meet both minimum and maximum flow ranges. Valves shall be resistant to sodium hypochlorite.
- Pulsation dampers

- Flow verification sensor
- Calibration column: Size calibration column to allow draw down in 30 seconds at maximum flow rate.
- Pressure gauges: Include a 4.5” dial and a diaphragm seal resistant to sodium hypochlorite.
- Storage: Storage tanks shall be double walled, white, high-density cross-linked polyethylene tanks, used for indoor and outdoor environments. Tanks shall include a seismic restraint system, an emergency air surge relief manway cover, a fill connection, an overflow connection, a vent connection, a sight tube, a suction/drain connection, a level transducer connection, and flexible connections to account for tank expansion and contraction. Approved manufacturers: Poly Processing or approved equal.
- Location: Locate storage tanks inside separate building rooms or within three sided shade structures. See Section 6.5 for shade structure and building requirements.
- Mounting: Mount tank to elevated concrete pad to match top of calibration column. Surround pad with 6” containment curb for nuisance leaks. Provide mortar base coat and fiberglass mat lining to concrete pad and 6” curb for outdoor installation.
- Concrete pad shall include a sump with alarm float inside of the 6” curb. The sump shall be plumbed to sewer with a cap that is normally closed at the sewer inlet. The sump shall have grating and an opening that allows for the cap to be removed from outside of the sump.

3.6 Analyzer: Provide a digital multi-parameter transmitter and sensors to monitor chlorine concentration and pH.

- Approved analyzer manufacturer: Endress+Hauser or approved equal.

3.7 Injection: Locate injection quill along the pump suction line, away from the suction header. The injection assembly shall include an isolation valve, braided flexible hose, check valve, corporation cock, and injection quill located in a manhole.

3.8 Emergency Eyewash and Shower: Provide an emergency eyewash and shower at chemical storage and chemical pumping areas. Provide a stainless steel showerhead and a stainless steel eyewash bowl. Provide insulation and aluminum jacket on all outdoor exposed piping. The emergency eyewash and shower shall be provided with an anti-scald valve, and flow switch connected to SCADA.

- Approved eyewash and shower manufacturer: Guardian, Haws, or approved equal.

4. STEEL STORAGE RESERVOIR

4.1 General: Provide above ground steel storage reservoir as directed by the City. All steel reservoirs shall be designed in accordance with AWWA D100.

4.2 Sizing: Size storage reservoir per Chapter 6 of the City DSPM. Sizing shall be based on useable volume shall be based on the reservoir's maximum water level. The maximum water level shall be set 6-inches below the top of the overflow weir. The freeboard between the bottom of the reservoir's rafters and the maximum water level shall provide enough space such that the sloshing wave height during a seismic event or the head above the overflow during an overflow event do not come in contact with the rafters.

4.3 General Construction: Minimum floor thickness shall be 5/16". Roof shall be column supported with no projection at eaves. Center columns/pole shall not be welded to the floor or include splices. All rafters will be joined to clips at the dollar plate and rim angle with bolts. Install anti-sway bars between rafters. Alternative tank designs per AWWA D100, Section 14 are prohibited.

4.4 Foundation: Provide concrete ring wall 6-inch above grade with fiber board. Provide #57 rock foundation under tank floor. Subgrade and rock foundation per geotechnical evaluation.

4.5 Inlet: Inlet shall be welded steel and located above grade with flexible coupling and isolation valve. Provide mixing nozzle on inside of tank. Coat and line per Section 2.3.

4.6 Outlet: Outlet shall be welded steel located below ground from the tank floor. Outlet shall include a removable anti-vortex fitting extending above the tank floor. The portion of outlet located below the ring wall shall be encased in reinforced concrete. The remaining portion of outlet located below the tank floor shall be backfilled with 1-1/2 CSLM. Coat and line per Section 2.3.

4.7 Overflow: The overflow shall be an upturned 90-degree bend that will act as an overflow weir. The overflow piping will penetrate the reservoir's wall and continue downward along the exterior wall of the reservoir. The overflow will terminate with a flap valve. The total open cross sectional area of the overflow pipe exiting the tank shall be greater than or equal the total cross sectional area of all tank inlets.

4.8 Vents: Vents shall be provided at the center of the tank and along the perimeter at the 4 quadrants. The total open area of the vents, minus the mesh, shall be greater than the total cross sectional area of all tank inlets.

4.9 Roof Hatches: Provide two 4-ft x 4-ft roof hatches at opposite sides of the tank. Provide interior ladder on one of the roof hatches with a Bilco Ladder Up hand support extension. Provide hoist sleeve at interior ladder. Sleeve shall be a Miller Durahoist floor mounted sleeve Model DH-7ZP.

4.10 Antenna: All tank mounted antennas will be installed in a hinged base.

4.11 Manways: Provide two or more 30-inch, hinged manways on opposite sides of the tank.

4.12 Exterior Ladders: Provide ladder extending all the full height of the reservoir. Provide ladder shield, solid tube cage, and DBI Sala Lad-Saf Climbing fall protection system. Place safety railing system at top of tank.

4.13 Flush Cleanout: Provide 36-inch x 48-inch hinged flush cleanout with 8" drain.

4.14 Cathodic Protection: Provide a roof mounted, automatic, impressed current cathodic protection system on tank.

4.15 Level Sensors: Include exterior mounted pressure transmitter, submersible pressure transducer, and emergency alarm floats.

4.16 Mixing System: Include reservoir mixing system as required by the City. Provide type of mixing system as directed by the City. System shall include mixing system, power supply, controls, and structural supports.

4.17 Coatings: Coat exterior surfaces with a UV resistant, high solids epoxy coating system. Coatings shall be roll applied. Exterior spray is not allowed. Approved manufacturer: TNEMEC

4.18 Lining: Line tank interior with shop applied NSF 61 approved zinc primer system. Finish coat system shall be NSF 61 high solids epoxy coating system. Provide 100% solids epoxy if required by the City. Approved manufacturer: TNEMEC

5. CONCRETE STORAGE RESERVOIR

5.1 General: Provide below ground concrete storage reservoir as directed by the City. All concrete reservoirs shall be designed in accordance with AWWA D110. Concrete reservoir shall either be a conventional cast in place, reinforced concrete structure or pre-stressed shell with cast in place foundation and roof.

5.2 Sizing: Size storage reservoir per Chapter 6 of the City DSPM. Sizing shall be based on useable volume shall be based on the reservoir's maximum water level. The maximum water level shall be set 6-inches below the top of the overflow weir. The freeboard between the bottom of the reservoir's rafters and the maximum water level shall provide enough space such that the sloshing wave height during a seismic event or the head above the overflow during an overflow event do not come in contact with the rafters.

5.3 General Construction: With City approval, the reservoir can be partially buried so that the top of the reservoir does not extend above the top of the perimeter wall. Above grade portions of reservoir shall be accessible with steps and enclosed with a railing or parapet. Exposed concrete tank roofs shall a finish treatment as directed by the City.

5.4 Inlet: The inlet assembly will be installed in a pre-cast vault with hinged double door access hatch. Inlet piping within the vault shall be welded steel with a flexible coupling, disinfection injection tap, fill valve and isolation valves. Provide mixing nozzle on inside of tank. Coat and line per Section 2.3 for vault piping.

5.5 Outlet: The outlet assembly will be installed in a pre-cast vault with hinged double door access hatch. Outlet piping within the vault shall be welded steel with a flexible coupling, disinfection injection tap, and isolation valve. Provide a removable anti-vortex fitting extending above the tank floor. Coat and line per Section 2.3 for vault piping.

5.6 Overflow: The overflow shall be a concrete weir box that discharges to an exterior catch basin or concrete apron. The overflow will terminate with a flap valve. The total open cross sectional area of the overflow pipe exiting the tank shall be greater than or equal the total cross sectional area of all tank inlets.

5.7 Vents: Vents shall be provided at the center of the tank and along the perimeter at the 4 quadrants. The total open area of the vents, minus the mesh, shall be greater than the total cross sectional area of all tank inlets.

5.8 Roof Hatches: Provide two 4-ft x 8-ft roof hatches at opposite sides of the tank. Provide interior ladder on one of the roof hatches with a Bilco Ladder Up hand support extension. Provide hoist sleeve at interior ladder. Sleeve shall be a Miller Durahoist floor mounted sleeve Model DH-7ZP.

5.9 Level Sensors: Include submersible pressure transducer and emergency alarm floats.

5.10 Mixing System: Include reservoir mixing system as required by the City. Provide type of mixing system as directed by the City. System shall include mixing system, power supply, controls, and structural supports.

5.11 Lining and Coating: Do not apply linings or coating to concrete reservoirs.

6. ENCLOSURES

6.1 General: Booster pumps, disinfection, and electrical equipment shall be housed in pre-fabricated steel or block construction enclosures. Well pumps shall be housed in prefabricated acoustical panel enclosures. Pre-fabricated enclosures shall not have an integral floor and shall be installed over cast in place concrete foundations. Electrical, pump, and disinfection equipment shall be located in separate rooms or separate enclosures. All enclosures shall be provided with temperature transmitters. Prefabricated enclosure drawings shall be sealed by an Arizona Registered Structural Engineer. Block construction buildings shall be sealed by an Arizona Registered Architect. All enclosures and buildings shall be approved through the City's One-Stop-Shop Planning and Building review process.

6.2 Sizing & Layout: The enclosures shall be sized to accommodate all of the equipment and provide enough space for required clearances. The height of the ceiling in the enclosures shall provide sufficient vertical clearances from the top of all equipment. The layout of the equipment inside the enclosures shall be designed to provide enough space to walk around the equipment and open equipment doors, if applicable.

6.3 Booster Pump Enclosure: Booster pump enclosures shall be provided with roof hatches to allow for the removal of the pumps during maintenance or replacement. Hatches shall be centered over each pump and shall be sized to provide enough space to pass the pump, motor and discharge head. Provide a trench drain to collect all nuisance leaks from the pumps. The pump enclosures shall be cooled and ventilated for comfort with evaporative cooling per Section 6.8.

- Approved pre-fabricated steel enclosure manufacturer: AZZ Atkinson or approved equal.

6.4 Electrical Enclosure: Electrical equipment shall be housed in a separate enclosure or room and shall be air conditioned per Section 6.8. Electrical enclosures shall be equipped with doors large enough to remove the largest piece of equipment in its installed position. All equipment shall be mounted on 4" raised concrete pads.

6.5 Disinfection Enclosure: All disinfection equipment shall be housed either within a separate enclosure room or within a three-sided pre-fabricated shade structure. Enclosure rooms shall be air conditioned per Section 6.8. Shade structures shall be ventilated for comfort.

- Approved shade structure manufacturer: Aluma-line, Inc. or approved equal.

6.6 Well Pump Enclosure: A pre-fabricated acoustical panel enclosure shall be provided over the well pump and motor assembly. Sound enclosure shall meet the noise requirements outlined in section 1.16 (45 decibels in residential areas and 60 decibels in commercial areas). Wall and roof panels shall be of an all welded box construction consisting of an outer solid sheet and an inner perforated sheet with an absorptive material between. The fill material shall be inert, mildew resistant, vermin proof and meet fire rating per ASTM E-84. The acoustical enclosure shall include two man doors and one discharge pipe double door. All openings shall be of the same acoustical panel type and have the same acoustical characteristics as the panel components. The enclosure shall be anchored to the concrete well pad and allow for easy removal and replacement of the structure. The enclosure roof shall also be designed for easy removal when well service is required for the well pump and motor. Enclosure rooms shall be fan cooled or air conditioned as required by the City per Section 6.8

- Approved acoustical enclosure manufacturer: Commercial Acoustics, eNoise Control, or approved equal.

6.7 Automatic Fire Suppression: Automatic fire suppression systems within the enclosures shall include the following:

- FM-200 and control panel for all electrical enclosures. Approved manufacturer: Kidde-Fenwal, 84-732001-902.
- Automatic sprinkler system for all enclosures that do not contain electrical equipment, only as required by the City of Scottsdale's Code of Ordinances and One-Stop-Shop. Separate pump enclosures may not require sprinkler systems.
- A fire alarm system and control panel for all enclosures. Approved manufacturer: Honeywell Fire Lite MS-9050UD.
- Separate fire alarm radio and antenna. Approved radio dialer manufacturer: AES 7788F. Approved antenna manufacturer: AES 6db fiberglass antenna 7210-6-UC.
- Include field radio path study report for the fire radio.

6.8 HVAC: Provide cooling and ventilation within the enclosure based on the following criteria:

- Air conditioning: Provide air conditioning for electrical enclosures and disinfection rooms. Provide sufficient cooling to offset heat loads from the equipment and the enclosure's heat gains. The units shall be selected based on sensible cooling and shall be sized to maintain an indoor temperature of 85°F at an ambient temperature of 115°F. Provide two (2) units sized for 100 percent redundancy. The air conditioning units shall be split-system type. All outdoor units shall be installed on grade only. Roof mounted units are not acceptable. Provide one controller that alternates between units each day. Both units shall be locked out during a fire event based on a signal from the fire alarm system. Place controller and temperature transmitter away from the cool air path. Monitor air temperature through SCADA and provide 4-6 AC outputs

to SCADA through conversion module. Approved air conditioning manufacturers: Carrier, Trane, or approved equal.

- Evaporative cooling: **(Booster Station Only)** Evaporative cooling shall be provided for booster pump enclosures. Supply enough cooling to provide comfort within the enclosure. Blower housing, reservoir, and stand shall be stainless steel. Provide louvers adequately sized for the evaporative cooler unit selected. All units shall be installed on grade only. Roof mounted units are not acceptable. Approved manufacturers: United Metals Products.
- Well Pump HVAC: Provide a wall mounted air conditioning unit to offset heat loads from the equipment and the enclosure's heat gain. The unit shall be sized to maintain an indoor temperature of XX degrees.

7. ELECTRICAL, CONTROLS AND INSTRUMENTATION

7.1 Power Distribution: Power distribution at the site shall achieved through the following components:

- Service Entrance Section (SES): The SES shall be equipped with a Surge Protective Device (SPD) with a minimum surge rating of 240kA per phase. The total calculated load for new sites shall not exceed 90% of utility service or service panel rating. The SES shall also be furnished with a Power Quality Meter (PQM). The PQM shall be equipped with an Ethernet communications adapter so as to allow respective parameters to be communicated to RTU/SCADA via the Modbus TCP/IP protocol. Provide a minimum of (4) programmable 4-20mA outputs with the PQM. Approved SES manufacturer: Square D or approved equal. Approved PQM manufacturer: SEL.
- Lighting and distribution panels: All lighting and distribution panels shall be equipped with a SPD with a minimum surge rating of 80kA per phase. The panels shall have a minimum of 25% spare space and/or spare breakers for future use. Approved manufacturer: Square D or approved equal.
- Transformers: Transformers less than or equal to 15KVA shall be 480:120/240V, 1PH. Transformers greater than 15KVA shall be 480:120/208V, 3PH. Provide a minimum 25% spare capacity for future use. Approved manufacturer: Square D or approved equal.
- Motor Control Center (MCC): The MCC shall be equipped with a minimum of two (2) 12" spare spaces above and beyond that anticipated for any future loads. See Section 7.2 for associated motor starter requirements. Approved manufacturer: Square D or approved equal.

7.2 Motors and Motor Control:

- Solid State Starter (SSS), i.e. Soft Starter: SSSs shall be utilized to control all pump motors greater than or equal to 25 HP that do not require speed control. Provide isolation contactors or shunt trip breakers as recommended by the manufacturer. SSSs shall be equipped with bypass contactors and shall be protected against electrical fault conditions in both ramp up/down and bypass modes. Power (KW) monitoring shall be provided for each pump motor (Booster Pump Stations only). Real-time power value is to be communicated to the RTU/SCADA via 4-20mA output.

If an SSS does not have a programmable 4-20mA output capable of communicating real-time power value, a separate power monitor is to be installed inside the respective SSS starter cabinet so as to provide this functionality. Typical I/O from each starter to be communicated to/from the RTU/SCADA include run status, individual fault alarms (i.e. high discharge pressure, high temperature SSS fault, etc.), in auto status, start/stop command, remote reset command, and motor power (4-20mA). Approved SSS manufacturer: Benshaw. Approved power monitor manufacturer: SEL or approved equal.

- Variable Frequency Drives (VFD): VFD's shall be equipped with harmonic filters (18-pulse drives not allowed) so as to ensure compliance with IEEE 519-1992 based on a point of common coupling (PCC) being defined as bus where respective feed breaker is connected. Power (KW) monitoring shall be provided for each pump motor (Booster Pump Stations only). Real-time power value is to be communicated to the RTU/SCADA via 4-20mA output. If a VFD does not have a programmable 4-20mA output capable of communicating power, a separate power monitor is to be installed inside the respective VFD starter cabinet so as to provide this functionality. Typical I/O from each starter to be communicated to/from the RTU/SCADA include run status, individual fault alarms (i.e. high discharge pressure, high temperature VFD fault, etc.), in auto status, start/stop command, remote reset command, speed control (4-20mA), speed feedback (4-20mA), and motor power (4-20mA) **(Booster Pump Stations Only).** Approved VFD manufacturer (motors greater than or equal to 25HP): Toshiba. Approved VFD manufacturer (motors less than 25HP): Toshiba or approved equal. Approved power monitor manufacturer: SEL or approved equal.

- Across the Line Starters, i.e. Full Voltage Non-Reversing (FVNR) Starters: Across the Line Starters shall be used to control motors less than 25 HP that do not require speed control. The starters shall utilize electronic overloads. Typical I/O from each starter to be communicated to/from RTU/SCADA include run status, individual fault alarms (i.e. high discharge pressure, high temperature fault, etc.), in auto status, start/stop command, and remote reset command.

- Starter logic: Starters shall incorporate a user adjustable backspin timer **(Wells only),** a user adjustable High Discharge Pressure timer, a user adjustable Low Suction Pressure timer **(Booster Stations only, where applicable),** a reservoir Low Level Interlock **(Booster Stations only, where applicable),** an E-stop, a high motor winding temperature, a user adjustable 'Pump To Waste' timer **(Wells only, where applicable)**, and an incomplete valve sequence **(Wells only)**. Indicator lights are to be provided on the front door of starters indicating the run status and fault alarm/status (each fault to be individually indicated).

- Motors: Motors less than 100 HP do not require thermal protection. Motors greater than or equal to 100 HP shall be equipped with thermostats.

7.3 Standby Power Systems:

- Standby generator: Provide standby generator sized to support operation of all site loads with exception of any redundant/backup booster pumps. The generator shall be sized for an ambient temperature of 122°F (50°C), a maximum allowable voltage dip of 20%, and a maximum genset load of 90%. A diesel based generator shall be

utilized unless otherwise directed by the City. The generator shall utilize a day tank for fuel storage as opposed to a sub-base style tank. The day tank shall be sized to support operation of the generator for 12 hours at full load. The day tank shall be equipped with a level transducer/transmitter capable of relaying tank level to the RTU/SCADA via 4-20mA output. Generators shall be equipped with sound attenuating, weatherproof enclosures that limit sound levels to a maximum of 75 dBA at 23 feet as measured from the center of the generator or as required by any applicable noise ordinances, whichever is more stringent. Typical I/O to be communicated to/from the RTU/SCADA include generator run status, generator fault, generator in auto, generator remote start/stop command, day tank low fuel level, day tank leak alarm, and day tank fuel level (4-20mA). Approved manufacturer: CAT, Kohler or Cummins.

- Automatic Transfer Switch (ATS): Typical I/O to be communicated to/from the RTU/SCADA include ATS in primary (utility) position and ATS in backup (generator) position. Approved manufacturer: ASCO or approved equal.

7.4 RTU/SCADA:

- PLC: The PLC shall be equipped with 16pt. (isolated) 24VDC digital input cards, 16pt. (isolated) 24VDC digital output cards, 8pt. (isolated) analog input cards, and 4pt. (isolated) analog output cards. Provide an additional 10% of I/O's from the design. Approved manufacturer: Bristol Babcock ControlWave Micro.
- OIT: Approved manufacturer: Maple Systems model HMI5100L.
- Radio: Approved manufacturer (licensed): MDS SD9. Approved manufacturer (unlicensed): TBD.
- Ethernet switch: Approved manufacturer: CISCO 1000, 2000 or 3000 series (Industrial Ethernet Switches).
- UPS: The UPS shall be equipped with a relay output card that can annunciate UPS low battery and UPS fault conditions via dry contact. Approved UPS manufacturer: Liebert model GXT3-1000MT120 or approved equal. Approved relay card manufacturer: Liebert model 'IS-RELAY' or approved equal. If an approved equal is allowed it shall have a backup capacity capable of supporting operation of all connected loads for a minimum of 60 minutes.
- Miscellaneous: The RTU shall be equipped with redundant 24VDC power supplies. Power supplies are each to be equipped with a dry contact-based fault relay. Each power supplies fault relay shall be individually monitored by RTU/SCADA. The RTU cabinet shall be equipped with a high temperature switch that is to be monitored by the RTU/SCADA. Surge suppressors shall be provided in association with all analog inputs and outputs that are connected to devices located outside building in which the RTU is installed. Approved high temperature switch manufacturer: Hoffman ATEMNO or approved equal.
- Enclosure: The RTU/SCADA equipment shall be housed in a separate enclosure meeting the requirements of Section 6.4.

7.5 Telemetry: Provide a field-based radio path surveys. Results of the survey(s) shall be summarized in report form and shall be provided to the City for review and approval.

7.6 Instrumentation:

- Reservoirs and chemical tanks level: Provide a radar-based level transmitter with backup level detection. Approved radar-based level transmitter manufacturer: Endress+Hauser Micropilot FM56 or approved equal. Approved backup level detection manufacturer: Siemens 9G-EF Mercury free floats or approved equal.
- Wells level: Provide a submersible level transducer/transmitter connected to the RTU. Approved manufacturer: Endress+Hauser Waterpilot FMX21 or approved equal.
- Hydropneumatic tank level: Provide stainless steel conductivity probes with relay/control modules. Approved manufacturer: GEMS/Warrick Series 3R probes with GEMS/Warrick Series 16M relay/control modules or approved equal.
- Magnetic flow meters: Flow rate shall be communicated to RTU/SCADA via 4-20mA signal. Totalized flow pulse not required. Approved manufacturer: Endress+Hauser Proline Promag L 400 or approved equal.

7.7 Fire Alarm Systems:

- I/O to be communicated from the fire suppression system control panel to the RTU/SCADA will be a system release alarm.
- I/O to be communicated from the fire suppression system control panel to the fire alarm system control panel will be a system release alarm.
- I/O to be communicated from the fire alarm system control panel to the Fire Department via a wireless transponder include a system fault/alarm, system trouble, and a system release alarm (fire suppression system).
- See Section 6.7 for control panel/system requirements.

7.8 Hydropneumatic Systems:

- Air Compressor Monitor/Control: Custom control panel shall be designed/provided to control air compressor. Control panel shall start and stop air compressor based on pressure in respective receiver tank. I/O to be communicated to the RTU/SCADA include run status, auto status, and fault/alarm.
- Hydro tank monitor/control: Custom control panel shall be designed/provided to control level in hydrotank and to monitor tank ‘High High’ and ‘Low Low’ levels. Control panel shall control (2) solenoid valves (‘fill’ and ‘air release’) mounted on hydrotank in efforts to regulate tank level. Tank level shall be monitored via conductance based level probes. I/O to be communicated to RTU/SCADA include Hydrotank ‘High High’ Level Alarm and Hydrotank ‘Low Low’ Level Alarm. Provide a Digital Output from the RTU to reset the Hydrotank High-High and Low-Low Alarms remotely via SCADA.

7.9 Site Security:

- General: The Developer shall coordinate site security requirements with the City's Site Security Team at the time of design. At a minimum, all building doors and roof hatches shall be equipped with provisions to facilitate installation of future intrusion switches as indicated below. Provisions shall be included to facilitate installation of future security cameras as indicated below.
- Future Security Panel Provision(s): A minimum of a 24" deep x 36" wide housekeeping pad shall be installed for a future security panel. Ensure a minimum of 84" of clear space is allotted on the wall above pad. Location of future security panel shall be confirmed with the City Security Coordinator.
- Conduits: All security system related conduits shall be 1". All underground conduits shall be schedule 40 PVC and shall be transitioned to GRS conduits when routed above ground. GRS underground to above ground transitions shall be wrapped in 20 mil tape that extends a minimum of 12" above ground.
- Security System Related Boxes: All external security system related boxes shall be NEMA 3R rated. All indoor security system related boxes shall be appropriately rated for the environment in which they are installed.
- Intrusion Switch Provisions: All exterior man doors into the site shall have a 4x4 NEMA 3R enclosure installed at hinge side of door. Two (2) 1" conduits shall be routed from each enclosure back to location of future security panel. All rolling gate site access doors shall have a 12" x 12" x 6" NEMA 3R enclosure installed. Three (3) 1" conduits shall be routed from each enclosure back to location of future security panel. All building access doors shall have one (1) 1" GRS conduit routed from hinge side of door to location of future security panel. Double doors shall have a conduit routed to side of each door. All overhead doors shall have one (1) 1" GRS conduit routed from location of future security panel to least intrusive side of door. Where a roof hatch is installed, install one (1) 1" GRS conduit from location of future security panel to roof hatch access point If more than one roof hatch is installed, provide a single 1" GRS conduit from location of future security panel to a 4x4 NEMA 3R box mounted adjacent to access point of nearest hatch. From this box route to other hatches in a series manner utilizing 1" GRS conduit. Where motorized rolling gates are utilized, install (2) 1" conduits from location of future security panel to a location outside of site near entry gate as identified by City Security Coordinator.
- Security Camera Provisions: Provisional conduits shall be routed from location of future security panel to locations identified in field by the City Security Coordinator for future security cameras. A provisional 1" conduit shall be routed from site 120/240V (or 120/208V) distribution panel to location of future security panel. A provisional 1" conduit shall be routed from the site's Network Communications cabinet to the location of the future security panel.

7.10 Lighting:

- Indoor: All indoor fixtures shall be LED based. Fixtures shall be rated for environment (temperature, atmosphere) in which they are installed.
- Outdoor: All outdoor fixtures shall be LED based. Fixtures shall be rated for operation at a 50°C ambient. Building and wall mounted fixtures shall be full-cutoff, wall-pack style and shall be equipped with integral photocells. Lighting designs shall be in compliance with any applicable City or County lighting codes, ordinances and/or standards.

7.11 Grounding: A low impedance site grounding electrode system shall be provided and consist of the following:

- UFER style ground in each major concrete pad/foundation (i.e. building foundations, generator foundations etc.).
- A minimum of (2) grounding rods mounted inside access/test wells.
- Grounding rings around each building and generator pad.
- Ground conductor in each duct bank.
- The items bonded to the grounding electrode system shall include the generator, all major pieces of electrical equipment (i.e. service panel, MCCs, step-down transformers, pump starters etc.), motor casings, well casings, RTU cabinet, antenna masts and lighting poles, building structural steel, magnetic style flowmeters, equipment skids, and the reservoir.

7.12 Communications:

- Provide a Network Communications enclosure, which should be house in a separate enclosure per the requirements of Section 6.4.
- Provide minimum 2” PVC conduit connections from the Network Communications enclosure to the RTU/SCADA enclosure, the Fire system control panel, and the Security panel.
- Provide minimum of two 4” PVC conduit connections from the Network Communications enclosure to a new communications pull box located in the ROW outside the exterior perimeter of the site. conduit bends shall have a minimum radius of 36"” Installation of additional pull boxes will be required to ensure that no conduit segment has a deflection greater than 180 degrees. Conduit warning tape indicating “Caution – Buried Communication Cable” shall be installed over the buried conduit. Detectable pump tape shall be inserted into all buried conduit.
- Provide for minimum 48 strand fiber optic patch panel to be located in the Network Communications enclosure. Approved manufactures Corning CCH, WCH, or approved equal.
- Provide for a minimum 48 strand fiber optic fan out kit.

- Single Mode Fiber Optic communication cable shall be installed from the communications pull box located in the ROW outside the exterior perimeter of the site to the Network Communications enclosure.

7.13 Control Description: Include a detailed, written control description in the project's technical specifications. At a minimum, the control description shall include details on the following:

- General overview of major component processes.
- Alarms
- Inputs, Outputs & tag numbers
- Sequencing for initialization
- Sequencing for shut down
- Pressure set points
- Descriptions of all operating modes (SCADA, PLC, Panel, etc.)