San Antonio Water System

LIFT STATION DESIGN & CONSTRUCTION GUIDELINES

October 2007

TREATMENT OPERATIONS
2800 U.S. Hwy.281
San Antonio, TX 78212

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SAN ANTONIO WATER SYSTEM
LIFT STATION DESIGN GUIDELINES
TABLE OF REVISIONS

Section	Revision	Date
A. General Requirements	Added the design of the lift station shall incorporate a wet well sized for the ultimate capacity of the water shed. See subsection 2.	10/12/2006
	Relocated Table 1 from subsection 6 to subsection 3, and modified design operating conditions and piping configuration	10/12/2006
	Added the requirement of proposed grades on site layout. See subsection 4	06/26/2007
	Added contributing and transition to the EARZ See subsection 5.	10/12/2006
	Added temporary and permanent access road alignment design, weather surface material design, submittal details and easement requirements. See subsection 8.	10/12/2006
	Added turn around requirement if straight access road is not provided. See subsection 8.	06/26/2007
	Added the requirement of a letter certifying the site is protected from the 100-year flood event. See subsection 10.	06/26/2007
	Added hatch safety grate requirement. See subsection 12.	06/26/2007
	Modified lift station site surface requirements to either asphalt or concrete. Added design needs to consider 80,000 pound tanker truck loading. See subsection 14.	10/12/2006
	Added combination freeze proof hose bib and eyewash/shower station requirement. (Eyewash/Shower on a case-by-case) See subsections 15 &16.	06/26/2007
	Added galvanized steel canopy requirement. See subsection 17.	10/12/2006
	Added coating design and surface preparation specifications. See subsections 19 and 20.	10/12/2006
B. Wet Well Design	Added fiberglass reinforced polyester (FRP) wet well requirement up to 18 foot diameter. See subsection 1. Also need SAWS permission to install precast wet well. See subsection 6.	10/12/2006
	Added contributing, transition to the EARZ See subsection 2.	10/12/2006
	Added consideration of odor control requirement. See subsection 3.	10/12/2006
	Relocated Table 3 in subsection 6 to Section C, Pumping Equipment Design, subsection 3.	10/12/2006
	Added coating design and surface preparation specifications. See subsection 7.	10/12/2006
	Added compaction and backfill specification for excavated wet wells. See subsection 9.	10/12/2006
	Required coordination between Design Engineer and Wet Well Manufacturer. Replaced sand backfill with crushed stone or concrete (Over EARZ). See subsection 10.	10/12/2006

Section	Revision	Date
B. Wet Well Design	Relocated approved wet well manufacturer L.F Manufacturing to the first paragraph and added Containment Solutions. See subsection 20.	10/12/2006
C. Pumping Equipment Design	Added 2-Pole motors are not acceptable. See section 1	06/26/2007
	Relocated Table 3 in Wet Well Design, subsection 6 to subsection 3.	10/12/2006
	Added O&M Manual submittal requirements. See subsection 5.	10/12/2006
	Added impeller and mechanical seal specifications for self priming pumps. See subsection 6.b.	10/12/2006
	Added impeller, mechanical seal and motor specifications for submersible pumps. See subsections 6.b and 6.c.	10/12/2006
	Added minimum submersible pump efficiency requirement and no pump substitutions after SAWS approval See subsection 6.d.	10/12/2006
	Added submersible pump sealing requirement. See subsection 6.e.	10/12/2006
	Deleted subsection 6.i.	10/12/2006
	Deleted Mapeco and ITT Goulds in subsection 7a	10/12/2006
	Added minimum self priming pump efficiency requirement. See subsection 7.c.	10/12/2006
	Modified minimum wet well access to 3 feet x 4 feet in subsection 7.e.	10/12/2006
	Added electric motors shall be in compliance with NEMA Premium Efficiency specification in subsection 7.m.	10/12/2006
	Added electric motors shall be totally enclosed and fan cooled in subsection 7.n.	10/12/2006
D. Station Piping **F. Force Main**	Added the surge relief valve mounting position. See subsection 2.	10/12/2006
	Added tracer wire specification for location purposes in subsection 2.	06/26/2007
	Added plan and profile requirement on construction drawings. See subsection 3.	10/12/2006
	Added air release valve and/or vacuum valves installation and design requirements. See subsection 5.	10/12/2006
	Change the optional HDPE / PVC pipe for HDPE pipe only. See subsection 8	10/12/2006
G. Electrical Equipment	Added double barrel force main consideration requirement. See subsection 9.	10/12/2006
	Added enclosure specifications for the electrical, instrumentation and communication components. See subsections 1, 3, and 5.	10/12/2006
	Added seal off requirement. See subsection 2.	10/12/2006
	Added main electrical disconnect switch specifications. See subsection 3.	10/12/2006
	Deleted subsection 4 requirement for NEMA 4X enclosure for the verbatim and the phone in subsection 4.	10/12/2006

Section	Revision	Date
G. Electrical Equipment	Added high water-float shall be normally open and non mercury type. See subsection 4.	10/12/2006
	Added canopy mounting components and details. See subsection 7.	10/12/2006
	Added the automatic transfer switch requirement. See subsection 9.	10/12/2006
	Added natural gas fuel and noise control requirement for the generators. See subsection 9.	06/26/2007
	Replaced the rigid metal conduit by PVC coated rigid galvanized conduit. See subsection13.	10/12/2006
	Added reference to standard drawings for mounting task light to the canopy. See subsection 14.	06/26/2007
	Added soft start and soft stop features for soft starters. See subsection 18.	10/12/2006
	Added consultant shall prepare flood plain permit and obtain approval. See subsection 21.	10/12/2006
H. Station Controls, Instrumentation and Monitoring	Added telemetry/SCADA requirements to monitor certain alarm signals. See subsection 2.	10/12/2006
	Added a SCADA material list reference. See subsection 2.	10/12/2006
	Added the pressure transducer requirement. See subsection 3.	06/26/2007
	Added location requirement of the control system transducer and high level float control in the wet well. Also Added junction box material and housing requirements. See subsection 4.	06/26/2007
	Added pressure gauge requirement and specifications. See subsection 6.	10/12/2006
	Added elapsed time meter and overload reset requirements and specifications. See subsection 7.	10/12/2006
	Added reference to mounting rack standard detail drawing. See subsection 8.	10/12/2006
	Deleted verbatim and phone requirement.	10/12/2006
I. Emergency Provisions	Added contributing and transition to EARZ. See subsections 1.a and 1.c.	10/12/2006
	Added standby generator specifications and design requirements. See subsection 1.c.	10/12/2006
J. Submittal Requirements	Added submittal requirements based on SAWS Utility Services Regulations Section 11.4. See subsection J1	06/26/2007
	Modified 300 GPD/EDU to 240 GPD/EDU. See subsection J.2.C.1.a	10/12/2006
	Identified storage requirements for sites not over the Edwards Aquifer contributing, transition, and Recharge Zone and added storage requirements for sites over the Edwards Aquifer contributing, transition and recharge zone. See subsection J.2.C.8.b	10/12/2006

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LIFT STATIONS

A. General Requirements

1. As required by Section 11.4.2 of the San Antonio Water System Utility Services Regulations (USR), a consultant or developer who proposes to construct a lift station and force main system shall prepare a present value analysis of the cost of constructing gravity mains compared to the cost of the lift station/force main system. This analysis shall show that the lift station installation cost plus 30 years of operational and maintenance expenses would be less than the cost of the gravity mains. Lift stations will only be considered a viable option if the cost analysis clearly shows that the gravity sewers are not economically feasible. Lift stations will not be allowed where an acceptable alternative gravity route exists.

2. Design the lift station to consider the potential for expansion to build-out densities. The design of the lift station shall incorporate a wet well sized for the ultimate capacity of the water shed. The lift station design shall consider both the total number of acres and number of Equivalent Dwelling Units (EDU) to be developed, as stated in the Water and Sewer Commitment submitted to SAWS. The flow capacities are determined in accordance with applicable chapters and sections of Texas Commission on Environmental Quality (TCEQ) Design Criteria for Sewerage Systems, Chapter 317, Section 317.3, dated March 1997 or the latest edition thereof, and in accordance with the assumptions and requirements of Section 11.3.1, San Antonio Water System Utility Service Regulations, February 18, 2003 or the latest edition thereof.

3. Lift stations may be submersible, suction lift self-priming, or packaged wet suction lift depending on station size/capacity, head requirements and motor horsepower. Table 1 outlines the allowable design criteria for each type of pump station:

TABLE 1
PUMPING STATION DESIGN CRITERIA

Station Type	Maximum Motor Horsepower
Suction-lift/Self-priming**	No restrictions
Submersible	No restrictions
Packaged Suction Lift	100 HP

** Combined total static and dynamic suction lift at “pumps off” elevation, and required NPSHR at design operating conditions shall not exceed 20 feet. Preferred maximum vertical lift is 15 feet and 7 feet horizontal suction length.

4. All lift stations shall be designed to meet the requirements of TCEQ 317.2(d), 317.3, 213 Subpart A (or the latest version thereof), and contemporary industry practices. An application or

submittal for a lift station shall satisfy all State requirements, which include final construction plans and a design report prepared by or under the direct supervision of and signed, sealed and dated by a Texas Licensed Professional Engineer. The lift station site layout shall show the proposed grades indicated in the standard drawings.

5. Lift stations located over the Edwards Aquifer recharge, contributing and transition Zone shall be designed and constructed to ensure that bypassing of any sewage does not occur (TCEQ 213a.5 (c)(3)(C)). All lift stations shall be designed to meet the requirements of §317.2(d) and §317.3. A lift station application shall include final construction plans and a design report prepared by or under the direct supervision of a Texas Licensed Professional Engineer. All design information shall be signed, sealed, and dated by a Texas Licensed Professional Engineer.

6. The firm pumping capacity of all lift stations shall be such that the expected peak flow can be pumped to its desired destination. Firm pumping capacity is defined as total station, maximum pumping capacity with the largest pumping unit out of service.

7. Lift Station site layouts shall consider clearances for unimpeded maintenance operations. The paved area surrounding the lift station components including, but not limited to, the wet well, pump and motor slabs, valve slabs, and generator shall be large enough to permit heavy equipment and vehicles ample room to maneuver. The lift station site shall be designed to allow maintenance vehicles to have direct access to the wet well, electric controls and generator.

8. **Access Road Design in Residential or Commercial Developments:** The lift station shall have an access road, either temporary or permanent, located in a dedicated right-of-way or permanent easement. The access road surface, either temporary or permanent, shall have a minimum width of 16feet and shall be constructed for access in all weather conditions. The access road surface, either temporary or permanent, shall be designed to be above the water level caused by a 25-year storm event. The design of the access road, either temporary or permanent, shall include plan, section and profile sheets of the access road and drain pipes, details and engineering calculations. The design shall limit the slope to no more than 8 percent (8%) and grade break to 3 percent (3%) and provide soil erosion protection to prevent collection of sedimentation along the all weather access road. Inside the boundary of a proposed residential development, design of the access road, either temporary or permanent, shall minimize turns and achieve the straightest possible alignment. If a straight access road is not provided, SAWS will determine whether or not an adequate turn around is required to allow a 55 foot 18 wheeler tanker truck to safely turn around depending on wet well size, influent flow and site location. In a phased development, a temporary access road alignment and all weather surface material shall be reviewed and approved by SAWS prior to the initial phase of development, with final paving and alignment to be accomplished in a later, agreed upon, phase. SAWS written approval is required prior to any modifications to the temporary access road. Inside the boundary of a proposed commercial development, the lift station will be accepted by SAWS for operation and maintenance only if there is an exclusive driveway and all weather access road that will be for SAWS use only. Design of the all weather access road inside the boundary of the proposed commercial development shall be a straight horizontal alignment, paved and inaccessible to the public. The paved all weather access road shall be a minimum of 16 feet wide without any interference with, but not limited to vehicles, landscape, curbs, posts, bollards, fences, parking stalls, striping, and above grade appurtenances, etc. If these design conditions can not be

satisfied, then the lift station shall be private and maintenance of all sewer facilities within the commercial boundary shall be maintained by the property owner or a legally designated association.

9. Provide 2-8 foot gates for a 16-foot clearance to allow access by large maintenance equipment. Turnarounds may be required for stations constructed along heavily traveled streets. Allow sufficient space for large maintenance vehicles to have unhindered access to the wet well and generator. Entries located parallel to the roadway should also be considered. Lift stations are not allowed within the street right-of-way.

10. The lift station, including all electrical and mechanical equipment, shall be protected from a 100-year flood event including wave action, and remain fully operational during such event. Provide a letter dated, signed and sealed by a Texas Professional Engineer certifying the site is protected from such an event. Attach drainage calculations if required by SAWS.

11. Provide protection of the lift station, including mechanical and electrical equipment, from access by any unauthorized person. The lift station shall be enclosed within an intruder resistant fence or located entirely within a lockable structure. An intruder resistant fence shall consist of a chain link fence 6 feet minimum in height, with a 1-foot section above consisting of 3 strands of barbed wire "up-riggers." Privacy fences shall be analyzed in a case by case basis.

12. One or more lockable aluminum hatch covers shall be installed in the wet well cover for access to the wet well and pump(s). Minimum hatch dimensions shall be 3 feet by 4 feet, or large enough to allow plentiful room for removal of submersible pumps and access to wet well. Hatch safety grate shall be installed to provide fall protection and shall consist of aluminum or non corrosive fiberglass reinforced composite material. Coating requirements shall be in accordance with Manufacturer's recommendations.

13. Provide a reinforced concrete base slab, or other appropriate feature, sized adequately to counteract buoyancy, and provide supporting design calculations. The concrete slab of the top of the wet well, the electrical rack and the generator (when required) shall be 4" minimum and 6" maximum higher than the finished surface.

14. The lift station site shall be paved throughout the entire site. The pavement section shall be either concrete or asphalt pavement and the design shall be prepared by a Texas Professional Engineer. The design and construction shall be in accordance with all applicable City of San Antonio's Pavement Specifications for Construction, and if needed, includes additional reinforcement of the subgrade and base. The pavement design shall consider loading exerted by a 55 foot, 18 wheeler, 80,000 pound tanker truck. The pavement shall be shaped to the lines, grades, and typical sections that are on the approved construction plans. If trees exist, leave a circular pervious area with a minimum 12-inch clearance around tree.

15. Design shall provide for 3/4-inch minimum freeze proof water service with hose bib vacuum breaker attached to the hose connection. It shall be located near the wet well.

16. SAWS will require a freeze proof Eyewash/Shower station located near the wet well based on a case-by-case basis.

17. Design shall provide for a galvanized steel supported canopy that will provide a minimum 7.0 foot vertical clearance and spans 3.0 feet horizontal from the face and rear of the panel rack.

18. Provide calculations (in engineering report) to determine potential for hydrogen sulfide suppression in force main and wet well, and provide recommendations. If the development is phased, this analysis shall be made for both initial and final phases.

19. All exposed pipe, valves, and fittings outside the wet well shall receive after installation a 100% solids epoxy coating system with a top coat system of urethane, suitable for the environment. Prior to application, prepare surfaces in accordance with manufacturer's instructions and any reference to cleaning in the manufacturer's instructions shall be understood to refer to the applicable SSPC specifications. Thickness, mixing and application shall be in accordance with manufacturers instructions. Apply finish coat in accordance with the color-coding set forth in Table 2, below. Approved manufacturers are Tnemec, Carboline, Sherwin-Williams, PPG, and M.A.B. Paints.

20. All pump discharge pipe and fittings within wet well, except SS 316 and PVC, shall receive after installation, a 100% solids coal tar epoxy coating system. Thickness, mixing and application shall be in accordance with Manufacturers instructions. Prior to application, prepare surfaces in accordance with manufacturer's instructions, and any reference to cleaning in the manufacturer's instructions shall be understood to refer to the applicable SSPC specifications. Approved manufacturers are Tnemec, Carboline, Sherwin-Williams, PPG, and M.A.B. Paints.

21. For appropriate landscaping of the Lift Station Site (outside the fence), comply with the UDC Section 35-510 as it may apply.

TABLE 2
SAN ANTONIO WATER SYSTEM LIFT STATION COLOR CODES

TYPES OF EQUIPMENT	COLOR
1. Pump Suction Piping	Gray – Pantone Number 431 U
2. Header and Force Main Piping	Gray – Pantone Number 431 U
3. Pump/Motors and Mounts	Gray – Pantone Number 431 U
4. Potable Water Line	Avalon Blue – Pantone Number 558 C
5. Compressed Air Line (where used)	Green – Pantone Number 349
6. Power Conduit	Orange – Pantone Number 166
7. Control/Instrumentation Conduit	Yellow – Pantone Number 109
8. Recycle water pipe	Purple – Pantone Number 521 C

B. Wet Well Design

1. **Dimensions:** Minimum 72" in diameter or (larger) as necessary to accommodate pumping equipment for submersible stations. Depth of wet wells on submersible lift stations shall consider adequate submergence of the pumps and emergency storage requirements. Fiberglass reinforced

polyester (FRP) wet wells shall be installed for diameters up to 18 feet, unless prior arrangements have been made and approved by SAWS to install precast wet well. Prior arrangements shall be made for SAWS to consider and approve any proposed Dry Vaults.

2. **Emergency Storage:** Includes additional volume within the wet well as well as capacity of sanitary collection system upstream from the lift station. Emergency storage capacity shall be supported by calculations in the engineering report. Design emergency storage for the following capacities, using Average Daily Flows (ADF): 1) 60-minutes for lift stations in the Edwards Aquifer recharge Zone, or 2) For the stations over the Edwards Aquifer contributing and transition zone, SAWS staff shall evaluate the site location, water stream proximity, remoteness, and geographical features to determine if the lift station site shall be treated as if it were over the EARZ or 3) For the stations outside the Edwards Aquifer recharge, contributing and transition Zone with available power records, minimum of 60-minutes or equal to a longer electrical outage recorded during the past 24 months, but not to exceed 120 minutes. If no Power Company records are available, use 120 minutes to calculate required retention capacity. For calculation purposes, the start level of the emergency storage begins at the wet well elevation at which the last normally operating pump (Pump #1 in a 2-pump lift station), excluding the standby pump, has just begun to operate. Note that this requirement exceeds the minimum TCEQ requirements.

3. The lift station design shall minimize odor potential. Locate incoming well gravity pipes to reduce turbulence. Minimize detention times in wet well during all phases of development. If detention times are greater than 180 minutes, SAWS may require odor control measures based on evaluation of, but not limited to phasing, prevailing wind direction, and proximity to neighborhoods. If odor control measures are needed, odor control shall consist of the chemical drum scrubber with top mounted blower to absorb odorous compounds for oxidizing. The drum scrubber shall be designed to operate at 99.5% gas removal. The design specification shall be prepared by the drum scrubber and media supplier. Approved manufacturer is Purafil, or an approved equal.

4. No fixed ladders are permitted in the wet well; however when used elsewhere, ladders shall be aluminum with non-skid rungs and must comply with all other of OSHA 1910.27, Fixed Ladders.

5. The wet well floors shall have a minimum of 10 percent slope to the pump intakes and have a smooth finish. There shall be no wet well projections that will allow deposition of solids under normal operating conditions. Include anti-vortex baffling on all lift stations with greater than 5 MGD firm pumping capacity.

6. If permission is provided by SAWS, construction of precast wells shall include a monolithic base structure. The minimum wall thickness shall be 8 inches for all wet wells. The minimum base thickness shall be 12 inches. The precast top slab shall have a minimum thickness of 10 inches.

7. Line interior of precast wet well with either a 100% solids epoxy or urethane coating system. Surface preparation, thickness, mixing and application shall be in accordance with the manufacturer's instructions. Wet well joints shall be sealed per the manufacturer's recommendations. Approved manufacturers are Raven, Tnemec, Belzona, Carboline-Polybrid,

and Madison. Alternatively, a high-density polyethylene (HDPE) and Polypropylene Copolymer (PPR) thermal plastic liner installed at the foundry as an integral part of the concrete casting process, as manufactured by AGRU Sure Grip is also approved.

8. The exterior of precast wet well, shall be coated with a coal tar epoxy system. Coating shall be continuous, free of "pin holes" and/or voids, and it's to be applied in accordance with manufacturer instructions. After wet well top slab, base and all sections have been permanently set in place, seal outside with a chemically compatible non-shrink grout prior to exterior application of protective coal tar coating. Approved manufacturers are Koppers, Tnemec, and Sherwin-Williams.

9. The bottom of the excavation for the wet well structure shall be a level subgrade approximately 18 inches of crushed stone below the bottom of the wet well structure and native soils shall be compacted with excavation equipment for the installation of 6 inches of flexible base to support the base of the structure. Compaction of native soil and flexible base shall achieve minimum ninety-five (95%) of the maximum dry density as determined by the TXDOT testing method Tex 113-E.

10. Concrete subgrade filler shall also be installed between the wet well and the excavation to an elevation of 1/3 the total depth of the structure, as measured from the well bottom. The remaining 2/3 shall be backfilled with crushed stone. Wet well manufacturer shall design the wet well thickness if concrete or flowable fill are used to backfill the wet well excavation.

11. Use 316 Stainless Steel screens on passive ventilation, gooseneck type or turbine, to prevent the entry of birds or insects into the wet well. If passive ventilation is provided for the wet well, any mechanical and electrical equipment in the wet well shall be of explosion-proof construction. Size the passive ventilation to vent at a rate equal to the maximum pumping rate of the station and not exceed 600 fpm through the vent pipe. The minimum air vent size shall be 4-inch diameter, and it shall be made of stainless steel 316. Vent outlets shall be at least 1 foot above the 100-year flood elevation.

12. If explosion proof mechanical and electrical equipment is not provided throughout the wet well, use continuous mechanical ventilation to ventilate the wet well. Size the ventilation equipment for 12 air changes per hour and construct of corrosion resistant material. In residential areas, there may be a need for reducing potential odors from the ventilated wet well.

13. Provide permanent mechanical ventilation for dry wells located below the ground surface and for wet wells having screens or mechanical equipment requiring regular maintenance and inspection.

14. Connection between wet well and dry well ventilation systems is not allowed.

15. Provide multiple air inlets and outlets in dry wells over 15 feet deep. Do not use dampers on exhaust or fresh air ducts. Avoid screens that are finer than #10 sieve or other obstructions within air ducts to prevent clogging.

16. Provide manual lighting/ventilation switches to override automatic controls installed for any intermittently operated lighting/venting equipment. The location of these switches will be at the Wet/Dry Well entrance.

17. Incorporate hoisting equipment, or access for hoisting equipment, for removal of pumps, motors, valves, etc. into the design.

18. All ancillary hardware in wet well including but not limited to chains, cables, bolts, nuts, fasteners, brackets, anchor bolts, washers, cable holders and slide rails, shall be 316 stainless steel.

19. The distance between the bottom of the wet well and the bottom of the inflow pipe shall not be less than 5 feet.

20. Fiberglass reinforced polyester (FRP) wet wells shall be manufactured from commercial grade polyester resin or vinyl ester resin, with fiberglass reinforcements. The wet well shall be manufactured in one-piece including body, bottom and top, and it shall be sit over a concrete slab design to counteract buoyancy forces. Design engineer shall design the top concrete slab. Approved manufacturers are L.F. Manufacturing, and Containment Solutions or approved equal

a. The resins used shall be a commercial grade unsaturated polyester resin.

b. The reinforcing materials shall be commercial Grade "E" type glass in the form of mat, continuous roving, chopped roving, roving fabric or a combination of the above, having a coupling agent that will provide a suitable bond between the glass reinforcement and the resin.

c. If reinforcing materials are used on the surface exposed to the contained substance, it shall be a commercial grade chemical-resistant glass that will provide a suitable bond with the resin and leave a resin rich surface.

d. Fillers, when used, shall be inert to the environment and wetwell construction. Additives, such as thixotropic agents, catalysts, promoters, etc., may be added as required by the specific manufacturing process to be used. The resulting reinforced plastic material shall meet the requirement of this specification.

e. The exterior surface shall be relatively smooth with no sharp projections. Handwork finish is acceptable if enough resin is present to eliminate fiber show. The exterior surface shall be free of blisters larger than 1/2 inch in diameter, delamination and fiber show.

f. The interior surface shall be resin rich with no exposed fibers. The surface shall be free of grazing, delamination, and blisters larger than 1/2 inch in diameter, and wrinkles of 1/8 inch or greater in depth. Surface pits shall be permitted up to 6 square feet if they are less than 3/4 inch in diameter and less than 1/16 inch deep.

g. The bottom to be fabricated using fiberglass material. Bottom to be attached to wet well pipe with fiberglass layup to comply with A.S.T.M.-D3299 specifications.

Reinforcement, if needed, shall be fiberglass channel laminated to wet well bottom per A.S.T.M.-D3299.

h. The fiberglass wet well top shall be fabricated using fiberglass material. Top to be attached to wetwell pipe with fiberglass layup to comply with A.S.T.M.-D3299 specifications. Reinforcement, if needed, shall be fiberglass channel laminated to wetwell bottom per A.S.T.M.-D3299.

i. Influent pipe shall be Kor-N-Seal or Inserta-Tee (refer to standard drawings for details). Sleeve shall be either PVC or Fiberglass Pipe, and it shall be installed and tested by the manufacturer. Alternative methods are grouted PVC sewer pipe, or link seal FRP sleeve with a reinforced wall. Installation of stubouts to be fiberglass layup to comply with A.S.T.M.-D3299 specifications.

j. The complete wet well shall have a minimum dynamic-load rating of 16,000 ft-lbs. To establish this rating, the complete wetwell shall not leak, crack, or suffer other damage when load tested to 40,000 ft-lbs and shall not deflect vertically downward more than 1/4 inch at the point of load application when loaded to 24,000 lbs.

k. The (FRP) wet well shall be installed in strict accordance with the wetwell manufacturer recommendations.

l. Each wetwell shall be marked with the following information.

(1) Manufacturer's name or trademark
(2) Manufacturing special number
(3) Total length and nominal diameter

C. Pumping Equipment Design

1. Provide a minimum of two pumps, and controls to alternate lead and lag pumping. All pumps, regardless of station design, shall be electric, centrifugal non-clogging units capable of passing an incompressible 3-inch sphere, and shall have no less than 4-inch diameter suction and discharge openings. Inspection and cleanout plates, located both on suction and discharge sides of each pump, are required for all non-submersible pumps to facilitate locating and removing blockage-causing materials unless the pump design accommodates easy removal of the rotation elements. Specify pumps and motors suitable for continuous operation at full nameplate load while the motor is completely submerged, partially submerged, totally non-submerged or self priming pump. 2-Pole motors are not acceptable.

2. Pumps shall be capable of meeting all system hydraulic conditions without overloading the motors. In addition, a minimum of 5-hp motor is required, unless prior arrangements have been made and approved by SAWS. Submit pump head capacity and system curves to SAWS, along with the lift station plans. Base the curves on the total of static lift, friction losses through force mains, headers and pump risers.

3. Based on peak flow, pump cycle time shall not be less than those in Table 3 *.

TABLE 3
MINIMUM PUMP CYCLE TIMES

Pump Horsepower	Minimum Cycle Times (minutes)
Submersible pumps	6
Non-submersible pumps	10

* Chapter 317.3(4)(b)

4. All lift stations shall operate automatically based on the water level in the wet well. Locate wet well level mechanisms so that they are unaffected by currents, rags, grease, or other floating materials. All level mechanisms shall be fully accessible without entering the wet well.

5. Contractor shall submit minimum 3 hard copies and an electronic copy of the Operation and Maintenance Manuals to the Inspector. Operation and Maintenance Manuals shall detail the following, but not limited to technical data, performance levels, specifications, parts description, installation, operation and maintenance of electrical, mechanical, and instrumentation components.

6. Submersible Pumping Stations

   a. The lift station shall consist of a minimum of two submersible centrifugal sewage pumps, stainless steel 316 guide rail system, wet well access, discharge seal and elbow, motor control center, starters, liquid level control system and all hardware necessary to make a complete working system. Every integral component of the guide system shall be stainless steel 316, which includes the following but not limited to: guide rails, brackets, fittings, bolts, screws, fasteners, adapters, attachments, etc. Flanged discharges are not allowed.
   b. Impellers shall consist of cast stainless steel or ductile iron. Mechanical Seals shall consist of Tungsten Carbide.
   c. Motor insulation shall be rated at Class H, inverted duty.
   d. Minimum pump efficiency shall be 65% and no substitutions accepted after SAWS approval of the Lift Station construction plans and Engineering report. Designer shall consider different combinations of pumps, impellers and pipe sizes including discharge and force main piping in order to achieve the minimum 65% efficiency. The Utility Services Regulations, Section 11.4.4 requires Energy Calculations which mean the engineering report shall prove the proposed pump is the most efficient option. Exemptions may be considered on a case-by-case. Approved pump manufacturers are ITT Flygt, Hydromatic, and ABS.
   e. Sealing of the pump unit to the discharge connection shall be a machined metal to metal water tight contact.
   f. The proposed elevation of all critical components shall be shown in the drawings including, but not limited to pump intake line inverts, control and alarm levels, top of the wet well, top of the dry well, influent line invert(s).
   g. Pumps shall be readily removable and replaceable without dewatering the wet well or disconnecting any piping in the wet well.
   h. All electrical equipment/panels, and controls shall be above ground.

7. Non-packaged Suction Lift/Self-priming Stations.

    a. Suction lift stations shall meet all applicable requirements in this standard, as well as those required by TCEQ Chapter 317. The lift station shall consist of a minimum of two self-priming, horizontal, centrifugal, sewage pumps, wet well access, discharge seal and elbow, motor control center, starters, liquid level control system and all hardware necessary to make a complete working system. Supply and warranty will be through a single company. Approved pump manufacturers are Hydromatic, and Gorman Rupp.
    b. Impellers shall consist of ductile iron or cast stainless steel. Mechanical seals shall consist of Tungsten Carbide.
    c. Minimum pump efficiency shall be 65% and no substitutions accepted after SAWS approval of the Lift Station construction plans and Engineering report. Designer shall consider different combinations of pumps, impellers and pipe sizes including discharge and force main piping in order to achieve the minimum 65% efficiency. The Utility Services Regulations, Section 11.4.4 requires Energy Calculations which mean the engineering report shall prove the proposed pump is the most efficient option. Exemptions may be considered on a case-by-case.
    d. Suction-lift pump stations using dynamic suction lifts exceeding the limits outlined in the following paragraphs will not be approved. Detailed calculations shall include static suction lift as measured from the "lead pump off" elevation to the centerline of the pump suction, friction and other dynamic head losses altitude correction, required net positive suction head and a safety factor of 4 feet.
    e. The pump equipment pad or compartment shall be above grade or slightly offset and shall be physically located either on top of or as close as possible to the wet well to prevent the humid and corrosive atmosphere from entering the compartment. Wet well access shall be provided through another opening on the wet well cover, 3 feet x 4 feet minimum dimensions.
    f. Self-priming pumps shall be capable of priming and repriming at the "lead pump on" elevation. Self-priming and repriming shall be automatically accomplished within 60 seconds under design operating conditions.
    g. Discharge piping shall not exceed the size of the pump suction and shall not exceed 15 feet in total vertical lift with zero horizontal suction pipe length. Wet well slab design shall consider structural loading due static and dynamic loading exerted by the pump and any deadweight. Request to design a separate slab for the pump shall be reviewed by SAWS and considered for approval on a case by case basis. The total of the dynamic suction lift at the "pump off elevation" and required net positive suction head at design operating conditions shall not exceed 20 feet.
    h. Use "T" fittings on the individual suction lines, instead of 90-degree elbows, at the last turn before the pumps, to facilitate suction line cleaning.
    i. Install dresser couplings with rubber compression rings on the suction lines to reduce vibrations and facilitate removal.
    j. A ¾-inch bleeder valve and piping shall be installed on the discharge side of the pump housing and terminate back into the top of the wet well for priming and cleaning of the pumps. Piping shall be schedule 40 PVC
    k. Use flanged fittings for piping at the pumps to facilitate pump removal.
    l. Provide heavy duty and supported pulley guards.

m. Electric motors shall be in compliance with the NEMA Premium Efficiency specification.
n. Electric motor shall be totally enclosed, fan cooled.
o. Pump and motor configuration shall be belt drive with drive end of motor (rotating counter clock-wise) opposing driven end of pump (rotating clock-wise), and motor located above pump on adjustable hinged mounting base allowing access to pump. Minimum number of belts is 2 for motors up to 10 HP, 3 belts for motors larger than 10 HP and up to 30 HP, 4 belts for motors larger than 30 HP.
p. Motor base shall be hinged, bolt adjustable and manufactured as a primed single frame. Motor base size shall accommodate NEMA mounting dimensions. The motor and base fit shall provide tolerance for alignment, ease of belt adjustment and tensioning without removal of guards, as well as simple removal and replacement of belts, shieves, and pumps. Equipment shall be supported by concrete or steel frame support bases used as part of the noise and vibration isolation of the equipment. Motor manufacturer shall furnish the support bases and properly size them for the mounted motor and base and grout as necessary for stable footing.

8. Packaged Suction Lift/Self-priming Stations.
   a. Approved manufacturers are Gorman-Rupp and Hydromatic.
   b. Station design shall satisfy all the requirements for Non-packaged Suction Lift/Self-priming Stations, listed above.
   c. All pumps, motors, internal valves and piping, level indicators, control switches, ladder, alarms, blower and dehumidifier shall be manufactured and assembled as a package. Supply and warranty will be through one company.
   d. The pumps shall be self-priming, horizontal, centrifugal, sewage pumps.
   e. All motors shall be totally enclosed, fan cooled, premium efficiency.

D. Station Piping

1. Each non-submersible pump shall have a separate suction pipe. Eccentric reducers shall be used on suction pipes in lieu of a concentric reducer. Pipes in wet wells of suction lift pumps shall be equipped with a turndown type flared intake and consist of ductile iron or SS 316.

2. The design shall consider surge effects and provide protection where necessary. Surge relief shall be contained in the system. If a surge relief valve is needed, it shall be installed in the exact position shown in the standard drawings.

3. All main piping shall have manual vents and drains to allow draining of sewage prior to piping disassembly.

4. Floor drains from valve vaults to wet wells shall be designed to prevent gas from entering the valve vault. Such designs shall include flap valves, "P" traps, submerged outlets, or a combination of these devices. Sumps pumps are acceptable in lieu of floor drains.

5. Provide reinforced concrete or metal manufactured supports for pipes between wet well and drywell or pump pad, where appropriate.

6. Lift station piping shall be D.I. and shall have flanged connections to allow for removal of pumps and valves without interruption of the lift station operations. Wall penetrations shall be designed to allow for pipe flexure while excluding exfiltration or infiltration. Pipe suction velocities shall be between 3 and 7 feet per second. Provide restrained flexible couplings on all outlet pipes within 2 feet of the station wall.

7. Use forty-five (45) degree cast iron elbows for pump discharge piping turns where the force main bends toward the ground.

8. Install vacuum gauges with ball valves on the suction lines at pump housings. Install pressure gauges with ball valves on the discharge line of each pump.

E. Station Valves

1. Gate Valves: Install a gate valve on the upstream side of the check valve. Gate valves shall be resilient wedge, flanged joints. All resilient wedge gate valves shall conform to the applicable requirements of ANSI/AWWA C509, and shall be handled and installed in accordance with the recommendations set forth in the appendix to ANSI/AWWA C509 and the recommendations of the manufacturer. All interior and exterior ferrous metal surfaces of valves and accessories shall be shop coated for corrosion protection. Approved manufacturers are Clow F-6102, Mueller A-2360, Kennedy 4561/4701, and American Flow Control – Series 2500

2. Check Valves: A FL. X FL. check valve shall be installed on the discharge side of each pump, followed by a full-closing isolation valve on each pump. Check valves shall be swing type with an external lever and minimum pressure rating of 250 psi. If the full-closing valve is other than a rising stem gate valve, the valve shall include a position indicator to show its open or closed position. Approved check valve manufacturers are Clow Style 106LW, Mueller #2600-6-01, Kennedy IBBM Swing Check Valve, American “50” Line with Weight and Lever.

3. Butterfly valves, tilting disc check valves, or other valves utilizing a tilting disc in the flow line are not allowed.

F. Force Main

1. Install the Force Main at least 3 feet below finished ground surface, and higher than the gravity inlet line elevation.

2. Tracer Wire: The maximum bury depth shall be three feet, minimum depth shall be one foot. Tracer wire shall be utilized for location purposes. Tracer wire shall be of solid core (14 gauge insulated), and shall be taped to the main in minimum of 2ft increments. Wire shall also come up to the top of air release, vacuum valves, combination valves, top of ground at lift station, and at the main discharge point.

3. Provide plan and profile of the force main.

4. Install a gate valve on all force mains, immediately outside the pump station.

5. Minimize the number of peaks and valleys along the Force Main profile to limit the accumulation of gases. High points shall have air release and/or vacuum valves as determined in design.

6. Force Mains shall transition into a gravity line within a manhole in a manner that minimizes agitation of sewage. The crowns of the force main and outlet gravity line shall match where possible, with bench grouting installed to direct flow into the outlet with a minimal change in the gravity flow angle.

7. Size Force Mains so that flow velocity is between three (3.0) and five (5.0) feet per second at ultimate development (velocities slightly above 3 ft/s are preferred). During initial development phases, flow velocities may be as low as two and one-half (2.5) feet per second.

8. All Force Main pipe material, for both Private and SAWS lift stations, shall consist of HDPE. Pipe shall consist of HDPE solid wall referred as to Drisco 1000, Drisco 8600, Quali Pipe, Poly Pipe, and Plexco Pipe that is in compliance with ASTM F714. All pipe and fittings shall be high density polyethylene pipe and made of virgin material, and shall have a minimum working pressure rating of 150 psi. The liner material shall be manufactured from a High Density High Molecular weight polyethylene compound which conforms to ASTM D 1248 and meets the requirements for Type III, Class C, Grade P-34, Category 5, and has a PPI rating of PE 3048. Solid wall pipe shall be produced with a plain end construction for heat-joining (butt fusion) conforming to ASTM D 2657; no flanged or slip-on joints will be accepted. See SAWS Standard Specifications for Construction, Item No. 900: "Reconstruction of Sanitary Sewer by Pipe Bursting/Crushing Replacement Process", Section 900.2.1. No PVC force main piping will be allowed.

9. Double barrel force main shall be considered on a case by case basis. SAWS will fund the over sizing cost of the second force main.

G. Electrical Equipment

1. Electrical service shall be 277/480-volt, 3-phase, and 4-wire, unless otherwise Approved by SAWS. Minimum service size shall be 200 amps. General lighting and power transformer shall be 10KVA, minimum and shall be housed with load center in a separate stainless steel enclosure. Request for smaller electrical service shall be reviewed by SAWS and considered for approval on a case by case basis. All electrical enclosures shall be rated NEMA 4X, NEMA 3R stainless steel 316 with lever type door closures. Single-phase systems are not allowed. Use the following color scheme:

Phase A:	Purple
Phase B:	Brown
Phase C:	Yellow

2. Due to the potential presence of hydrogen sulfide and other corrosive gases, greases, oils, and other constituents frequently present in sewage, all mounting hardware shall be Type 316 Stainless Steel and install seal-offs in conduit leading into the pump control panel. All enclosures

shall be Type 316 Stainless Steel, and disconnects shall be FRP-NEMA 4X. All enclosures and disconnects shall be lockable with a padlock.

3. Main electrical disconnect shall be housed in either a separate NEMA 4X, NEMA 3R stainless steel enclosure and shall be equal to Square D, Class 3110, 600-volt class, heavy duty, service rated safety switch, NEMA 4X, with all copper current carrying parts, Model H36_DS. Provide with fusing class size based on the characteristics of the motor loads served and the available fault current. Main electrical disconnect shall be time delay fuse or time delay circuit breaker. Provide a surge arrestor in a separate enclosure attached to the back of the main electrical disconnect enclosure. Approved Manufacturers: Square D, Siemens, General Electric, Cutler-Hammer.

4. Electrical equipment shall comply with the National Electrical Code (NEC) requirements for Class 1, Group C and D, Division 1 locations. Additionally, equipment located in wet wells shall be suitable for use under corrosive environments. Each flexible cable shall be provided with a watertight seal and separate strain relief. High water float switch shall be normally open and non mercury type.

5. Free-standing electrical service and transfer switch shall be housed in heavy-duty electrical weatherproof, NEMA 4X, NEMA 3R stainless steel enclosures securely mounted onto the rack a minimum of 24” above the ground. Provide 120-volt duplex, GFI, receptacle in a weatherproof box.

6. All electrical equipment shall be protected during a 100-year flood event and be protected from potential flooding from the wet well. If the electrical equipment is raised significantly to be above the 100-year flood event, then a platform shall be constructed with rails and adequate working clearance in front of the electrical equipment, with permanent ladder or steps for access. As a minimum, Motor Control Centers shall be mounted on a 4-inch tall concrete housekeeping pad. All electrical equipment and connections in wet wells and dry wells shall be explosion proof unless continuous ventilation is provided.

7. All enclosures, panels, and boxes housing electrical, communication, control and instrumentation components shall be mounted on a single rack under the Canopy as detailed in the standard drawings. Mounting rack shall be constructed of PVC-coated steel, epoxy coated steel, or type 316 stainless steel strut, 1-1/2” minimum, mounted on 4” galvanized steel pipe. See mounting rack layout and structural details on the standard drawings. Approved manufacturers: UNISTRUT, Kindorf, and B-Line. Touch up any scratches where coatings are applied. Close all exposed pipe ends with proper size PVC plug caps. Do not use the electrical service pole as one of the supports.

8. Provide connector for emergency generator with manual transfer switch. Generator connectors shall be Crouse-Hinds, cam-lok, E1016 or 1017 Series, male type. 5 connectors – 3-phases, ground and neutral, shall be mounted in a panel adjoining the manual transfer switch. The manual transfer switch shall be equal to Square D, Class 3140, 600-volt class, double throw, non-fused safety switch, NEMA 4X, Model 8234_DS. Size the transfer switch to handle the entire load of the lift station. Approved Manufacturers: Square D, Siemens, General Electric, and Cutler-Hammer.

9. If a generator is required, the transfer switch shall be automatic, and it shall be provided by the generator manufacturer. SAWS recommends to have a combo package that includes the generator and the automatic transfer switch. The generator shall be fueled by natural gas, unless prior arrangements have been made and approved by SAWS to use another fuel type. The generator shall have a 4-foot clearance all around, and it shall be provided with noise control package. Noise Control Package Specification for Generator shall be residential rated. Sound attenuation includes enclosure and exhaust muffler. Sound attenuation system performance shall result in measured sound levels not to exceed 78 dB @ 7 meters (23 feet), 60 Hz. Approved manufacturers are Generac, Onan and Kohler or approved equal. Manufacturer to submit sound equivalencies for SAWS to review and approve noise control submittal package.

10. Provide terminal blocks and panel wiring for future remote start and stop contacts.

11. If a dry well is used, consider it a confined space, and provide explosion proof dry well lighting adequate to illuminate the ladder and the floor of the dry well.

12. All underground electrical conduits shall be grey, rigid nonmetallic conduit (RNC). Field manufactured bends are not permitted. Only factory fabricated conduit bends are allowed. Buried conduit shall have a cover depth of 18 to 24 inches beneath the finished surface. Conduit shall comply with minimum NEC bend radius and not burned or kinked.

13. All exposed pipe shall be PVC coated rigid galvanized conduit. Apply touch-up PVC coatings to field cut pipe threads.

14. Provide general illumination of 1.0 foot-candle (average) on the lift station equipment areas. Use Metal Halide fixtures for general illumination. Mount task lighting to the canopy as detailed in the standard drawings.

15. Provide ability to operate station with one pump removed for maintenance, by utilizing a local-remote switch and no parallel switching in order to allow for proper lockout procedures. Where applicable, provide local disconnect at motor per NEC.

16. Provide explosion proof local control in dry well, when one is used, to operate pumps for testing.

17. Install all conduit runs in initial construction sized to meet ultimate electrical and instrumentation needs.

18. The pump controller shall be provided with lead-lag controls within a NEMA 4X enclosure. The pump control enclosure shall also contain the motor disconnect circuit breaker, motor starters, Milltronics, and soft starters. Soft Starters shall be installed for motor size of 50 HP or greater with soft start and soft stop features.

19. Special considerations for submersible stations:

a. Design electrical supply, control and alarm circuits to allow for disconnection outside the wet well. Terminals and connectors shall be protected from corrosion by location outside the wet well in a NEMA 4X stainless steel enclosure.
b. Locate the motor control center outside the wet well, readily accessible and protected by conduit seals, to meet the requirements of the national Electrical Code to prevent the atmosphere of the wet well to enter the control center. The seal shall be so located that the motor may be electrically disconnected without disturbing the seal.
c. Pump motor cables shall meet the requirements of the National Electrical Code for flexible cords in wastewater pumping stations. Power cord terminal fittings shall be corrosion-resistant and constructed in a manner to prevent entry of moisture into the cable, and shall be provided with strain relief appurtenances.

21. Consultant shall prepare flood plain permit and obtain approval.

H. Station Controls, Instrumentation and Monitoring

1. Primary level monitoring and pump control must be of the ultrasonic or radar type. Accepted manufacturers are Siemens (Milltronics HydroRanger 200), Greyline Instruments, and Drexelbrook.

2. The pump station shall be equipped with telemetry/SCADA per SAWS Standards and as approved by SAWS. At a minimum, the following alarm signals shall be made available from the pump station control panel to the telemetry/SCADA system: pump #1 ON, pump #2 ON, pump # 1 FAIL, pump #2 FAIL, motor #1 HIGH TEMP, motor #2 HIGH TEMP, phase failure, power outage, generator/utility power, Force Main pressure, wet well level, low water alarm, and high water alarm. For stations with more than two pumps, alarm signals shall be expanded to include all pumps. See electrical standard drawings for the complete list of components.

3. The pressure transmitter shall have a 150 psi pressure range, it shall operate at 24 Vdc, 4-20 mA output, and it shall be located before the last valve as shown in the standard drawings. It shall be provided with an isolation ball valve. Approved manufacturer is Rosemount model 2088G2S22A1B4E5M5 or approved equal.

4. Place the control system transducer and high level float control in an area of the wet well which is removed from the effects of the influent flow(s) being received. The control system transducer junction box, and a separate junction box that houses both the pump/motor splice and the high level float, shall be located on top of the wet well and made of SS316.

5. Lift station shall be capable of delivering all anticipated peak flows with the largest unit out of service. The “lead” pump is turned on at the first “on control elevation” and the “lag” pump will start with a rising liquid level at the “second on control elevation.” The “lead” and “lag” pumps will continue to operate until the “pump off control elevation” is reached. The “lead” and “lag” shall automatically alternate between the two pumps at the completion of each pumping cycle. The “lag” pump shall; however, start if the “lead” pump fails to start at the beginning of a cycle.

6. Install pressure gauge that has minimum 4" Dial, 5% accuracy, and is liquid filled with a standard ¼ inch NPT. Approved manufacturer is Ashcroft or an approved equal. Provide an isolation ball valve.

7. Install elapsed time meters and overload reset with metal extension and plastic cap on the inner panel (Dead Front) of the pump control enclosure. Meters shall be five digit, indicates tenths of hours and be non-resetting. Operating power shall be 120 volt. Approved manufacturers are Cramer, Hobbs, Honeywell, and Redington

8. Provide structural support of the mounting rack that houses electrical, communication, control, and instrumentation components as detailed in the standard drawings.

9. If specifically required by SAWS, provide flow-measuring devices with instantaneous rate indicators, totalizers and recorders designed specifically for sewage force mains on the discharge side of the pump station. Meters, Flowtronics or approved equal, shall be in an approved vault. Flow display to be installed at lift station electrical/controls rack.

I. Emergency Provisions

1. Design Lift Stations to prevent overflow from the lift station due to loss of power or mechanical failure within the operating time frames defined in this section. An audio-visual alarm system (red flashing light and horn) shall be provided for all lift stations. All alarm conditions shall be transmitted, through use of an auto-dialer system or telemetering system, to a location(s) where 24-hour assistance is available. The alarm system shall be activated in case of power outage, pump failure, or a specified high wet well water level. In addition to the alarms and telemetering requirements, all lift stations shall be provided with service reliability based on the options detailed in paragraphs a-d, below:

a. The retention capacity of <u>lift stations not over the Edwards Aquifer recharge, transition, and contributing Zone</u> shall have the wet well and incoming gravity sewer lines designed to insure that no discharges of untreated wastewater will occur at the station or any point upstream for a period of time equal to the longest electrical outage recorded during the past 24 months. If no records are available, the designer shall use 120 minutes of Average Daily Flow (ADF) to calculate required retention capacity. A minimum of a 60-minute retention period using Average Daily Flow (ADF) shall be used even when power company records indicate a shorter period of outage. Power outage records shall be on the utility company letterhead, bear the signature of a utility representative, identify the location of the lift station, list the total number of outages that have occurred in the past 24 months, and indicate the duration of each power outage. For calculation purposes, the start of the outage period or mechanical failure shall begin at the wet well elevation at which the last normally operating pump, excluding the standby pump, has just begun to operate.

   The retention capacity of <u>lift stations over the Edwards Aquifer recharge Zone</u> shall have the wet well and incoming gravity sewer lines designed to insure that no discharges of untreated wastewater will occur at the station or any point upstream for a period of time equal to 60 minutes. In addition to the 60-minute retention capacity requirement,

emergency power shall be provided by on-site, automatic electrical generators sized to operate the station at its firm pumping capacity.

The retention capacity of lift stations over the Edwards Aquifer transition and contributing Zone shall be determined by SAWS staff at the outcome of an evaluation of the site location, water stream proximity, remoteness, and geographical features to decide if the site shall be treated as if it were over the EARZ. SAWS will make a written determination prior to design after receiving a written request from an engineer.

b. The lift station may meet the emergency power requirement by arranging for the facility to receive electrical service through either two separate electrical distribution circuits or from separate power companies which have a fully automatic switch over capability designed to assure continuous service. The two distributions lines shall be physically separated, not carried on the same pole, and obtain their power from different substations. If separate distribution circuits originate from the same substation, overall substation reliability shall be demonstrated.

c. All Lift Stations over the Edwards Aquifer recharge Zone shall be furnished with a standby power generator with noise control package. The standby generator shall be sized to power motors to pump at firm pumping capacity, which is to pump wet weather peak flows with the largest pumping unit out of service.

d. The use of a spill containment structure as a means of providing service reliability is prohibited. Spill containment structures may be used in addition to one of the service reliability options detailed in this section, provided a detailed management plan for cleaning and maintaining the spill containment structure is discussed in the final engineering design report. Additionally, any spill containment structures shall be fenced with a six-foot fence which has a minimum of 3 strands of barbed wire and which has a locked gate. Spill containment structures shall not be used to reduce other power reliability requirements in any way.

2. Emergency (quick-connection) pump by-pass system shall be provided at all lift stations. Connection shall be sized according to station and header pipe size, and shall consist of a gate valve, adapter flange with “quick-disconnect” male fitting with dust cap. Provide a check valve to allow flow only in the direction of Force Main.

J. Submittal Requirements

1. An engineering design report that include Construction feasibility and site analysis, a present value analysis with detailed cost estimate, flow development for initial and final phases of the development, wet well design, wet well detention time and force main flush time for both initial and final phases, system curves, pump curves and head calculations (Total Head including Static Head, Friction Losses and Minor Losses). Calculations and system curves at both minimum (all pumps off) and maximum (last normal operating pump on) static heads and for a C value of both 100 and 140 shall be provided for each pump and for the combination of pumps (modified pump curves). Buoyancy calculations for the wet well in order to design a concrete slab heavy enough to keep the wet well in place. Energy consumption calculations shall be

presented comparing different pumps, impellers and pipe sizes in order to select the most efficient pump. Where a suction lift is required, the report shall include a calculation of the available net positive suction head (NPSH) and a comparison of that value to the required NPSH for the pump(s) specified (TCEQ 317.3(c)(4)). The overall layout of the development and the development master plan shall be submitted for SAWS review.

2. The engineering design report shall be presented in the following format, although the designer is not required to use the same formulas:

A. **TITLE PAGE** - Title page should include the project name, date, developer/owner's name and engineering firm preparing plans.

B. **SEWER SYSTEM INFORMATION**

1. Introduction
   a) Type, location and size of development
   b) Number of and range in size of lots or buildings to be serviced
2. Existing Sewer System
   a) Location and type of gravity system the force main will discharge into.
   b) State whether the entire development will be serviced by the proposed phase or if several phases will be involved.
   c) State the number of lots this phase will encompass initially and finally if future phases are to be constructed.

C. **PUMP STATION AND FORCE MAIN DESIGN CALCULATIONS**

(The following formulas are provided as guidelines. The design engineer can use other formulas, of preference, to achieve the same results.)

1. Site Characteristics, and allowances, to Calculate Flows (SAWS Utility Service Regulations 11.3.1):
   a) Residential EDUs @ 240 gals/day per EDU
   b) Commercial SF @ 0.07 gals/day per SF
   c) Multi-family Units @ 0.70 EDUs per Unit
   d) Peaking Factor - Sect 11.3.1 SAWS USR
   e) Inflow and Infiltration (I/I) Allowance of 300 GPD/acre.

2. Average Dry Weather Flow (ADF): This is the flow developed without the maximum flow peaking factor. This flow is used to determine the average detention time in the wet well.

   a) ADF (GPD) = Residential (single and multi-family) + Commercial GPDs
   b) ADF (GPM) = ADF (GPD) / 1440 (Min/Day)

3. Peak Dry Weather Flow (PDWF) (SAWS Utility Service Regulation 11.3.1): This flow is used to determine pipe size in the collection system.

   a) Peaking Factor = 2.5 for Proposed Residential Development, SAWS USR
   b) PDWF (GPD) = PF * ADF

c) PDWF (GPM) = PF * ADF (GPM)

4. Peak Wet Weather Flow (PWF): This flow is used to determine the lift station design capacity. All lift stations shall be designed to handle the maximum wet weather flow for its service area.

   a) Inflow and Infiltration (I/I): Total Development Acreage * 300 GPD/acre
   b) PWF (GPD) = PDWF (GPD) + I/I (GPD)
   c) PWF (GPM) = PWF (GPD) / 1440 (Min/Day)

5. Minimum Dry Weather Flow (MDWF): This is used to determine the maximum detention time in the wet well.

   $MDWF = (0.2* (0.0144 * ADF)^{0.198}) * ADF$

6. Minimum Pump Requirements (Peak Wet Weather Flow, PWF):
   a) For two-pump stations, size each pump to handle PWF.
   b) Calculate Total Dynamic Head (TDH):
      1) Static Head (Hs)
         Eh = Maximum force main elevation
         E1 = Wet well low water elevation
         Hs = Eh – E1
      2) Loss (Lf) due to friction in force main
         Length = Total equivalent length of force main and piping on station
         Lf = Length x Friction Factor
         (Use Hazen-Williams C of 100 and 140 for friction losses)
      3) TDH = Hs + Lf
   c) Plot System Curve on Pump Curve and determine operating point to select proper pump sizes.

7. Net Positive Suction Head: For suction lift stations, compare the net positive suction head ($NPSH_R$) required by the pump with the net positive suction head available ($NPSH_A$) in the system, at the operating point. The NPSH available shall be greater than the NPSH required.

   $NPSH_A$ (suction lift) = $P_B + H_S – P_V - H_{fs}$

   Where;
   P_B = barometric pressure in feet absolute, use 33.4 feet
   H_S = minimum static suction head, in feet
   P_V = vapor pressure of liquid in feet absolute, use 1.4 feet
   H_{fs} = friction loss in suction, in feet

   a) Velocity Produced in Force Main. 3 to 6 fps at ultimate development; may be as low as 2.5 fps during initial development phases:

$V_{fm} = 0.4087099 * (Q / d^2)$

Where;

Q = Actual flow for selected pump(s)
d = Force Main interior diameter, inches

8. Storage Requirements:
   a) Required Wet Well Volume (volume between "pump on" and "pump off" elevation):

$$Vr\ (Gals) = \frac{\text{Pump GPM} * \text{T (Minimum Cycle Time, Table 3)}}{4}$$

   b) Volume of Storage (Vs)

Not over the Edwards Aquifer recharge, transition and contributing Zone:

Vs (Gals) = ADF (GPD) * [(1hr. minimum/2 hr. maximum storage) / 24 hours per day]

Vs (CF) = Vs (Gals) / 7.481 CF per Gal

Over the Edwards Aquifer recharge, transition and contributing Zone:

Vs (Gals) = ADF (GPD) * [(1hr.storage) / 24 hours per day]

___ Vs (CF) = Vs (Gals) / 7.481 CF per Gal

   c) Dimensions of Storage Facility

1) Use Table 2 for Wet Well diameter, minimum 72-inch diameter
2) Wet Well Depth = $\frac{4 * Vs\ (CF)}{PI() * (\text{Wet Well diameter})^2}$

9. Buoyancy Checks: A buoyancy check shall be performed for the pump station wet well and the retention chamber.

10. Water Hammer Calculations: Calculate surge pressures and compare to the pressure rating of the force main pipe to determine the need for a surge relief valve.

$P = (a)*(V)/(2.31)*(g) + \text{operating pressure}$

Where:
P = water hammer pressure
a = pressure wave velocity
V = flow velocity in the pipe
g = acceleration of gravity (32.2 ft/sec^2)

D. **CYCLE TIMES.** Calculate detention times (Td) for Average Dry Weather Flow, Maximum Wet Weather Flow, and Maximum Dry Weather Flow.

$$Td = Tf + Te$$

Where;

Tf = time to fill wet well in minutes = Vr / i
Te = time to empty wet well in minutes = Vr / (Q – i)
Vr = Required Wet Well Volume, 8.a
i = Flow into the station for given condition
Q = Pump capacity in gpm

1. Average Detention Time (based on Average Dry Weather Daily Flow):

   a) Tf = Vr /ADF (GPM)
   b) Te = Vr / (Q – ADF)
   c) Td (ADF) = Tf + Te

2. Maximum Detention Time (based on Minimum Dry Weather Flow):

   a) Tf = Vr /MDWF (GPM)
   b) Te = Vr / (Q – MDWF)
   c) Td (MDWF) = Tf + Te

   If detention times exceeds 180 minutes, SAWS may require the design and installation of a chemical drum scrubber with top mounted blower for odor control. See Section B(3) for details.

3. Total Cycle Times:
   Pump ON for Te
   Pump OFF for (2) Tf + Te

   The pump is on for one pumping cycle of Te and off for 2 storage cycles of Tf plus one pumping cycle of Te because pumps alternate

E. LISTING OF RESULTS FROM THE DESIGN CALCULATIONS TO BE PRESENTED IN THE FOLLOWING ORDER:

1. Number of Lots or Buildings
2. Population Equivalent
3. Average Daily Flows in GPM
4. Peak Daily Flows in GPM
5. The Volume of the Retention Chamber
6. Static Head
7. Total Dynamic Head
8. The Pump Selected (including type manufacturer, model number, size, Hp, RPM, phase and GPM)
9. Net Positive Suction Head Available ($NPSH_A$) for suction pumps
10. Total Detention Times for, Maximum Dry Weather Flow, and Average Dry Weather Flow.

11. Total Cycle Times for, Maximum Dry Weather Flow, and Average Dry Weather Flow.
    a) Number of Minutes ON (Pumping Time)
    b) Number of Minutes OFF (Fill Time)
12. Size and Length of Force Main
13. Velocity Maintained in Force Main
14. Force Main Retention Time (at initial flows and at design flows)
15. Wet well buoyancy calculations.

F. COST EFFECTIVENESS ANALYSIS

As required by the San Antonio Water System Utility Services Regulations.

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