3. Sewer

Sewer design shall be in accordance with the DEQ SCAT Regulations and these Design and Construction Standards.

a. Gravity Sewers

1. General

Minor private extensions shall be constructed in accordance with the applicable building codes and these Design and Construction Standards and applicable details using cleanouts in lieu of manholes when line sizes and other factors permit. This assists the Authority in removing potential sources of Inflow and Infiltration and should provide a more cost effective and less maintenance intensive system for the owner. Any proposed line that will provide service to two or more customers, not part of a single owner commercial or multifamily development, shall be an Authority owned sewer line and installed in accordance with these Design and Construction Standards.

Sewers shall not be located in areas subject to flooding or in drainage ditches or basins that encourage inflow and infiltration unless otherwise approved by the Authority. Sewers shall be located outside of jurisdictional wetland areas whenever possible.

2. Capacity

a. Population Served

Generally, the capacities of lateral, trunk, and interceptor sewer systems should be designed for the estimated ultimate build out population of the service area being considered for development. Any known future development shall be considered as well.

The designer shall also estimate the ultimate build out population for the total sewer shed area. Future population densities should consider the Augusta County Comprehensive Plan, the Authority's Master Plan, Zoning Ordinance, and Subdivision Ordinance as applicable. Based on the results of this estimate, the Authority may participate in the project in accordance with Authority OPPM *Policy 10.2 System Improvements*.

b. Average Daily Flow

New sewer systems shall be designed on the basis of an average daily per capita flow of sewage in accordance with the DEQ SCAT Regulations.

For residential developments, this flow is 100 gallons per person per day. These figures are assumed to cover infiltration. The Authority currently uses an average of 2.4 persons per residence. (Reference 2015 – 2019 US Census Data).

Equivalent flows from motels, schools, hospitals, etc. shall be based upon that of the DEQ SCAT Regulations.

When a commercial or industrial development is proposed, but the specific industries are unknown, the designer shall use an average daily flow of 2000 gpd per acre.

When deviations from the foregoing per capita or per acre rates are proposed, the designer shall supply sufficient information, substantiated by sound engineering judgment to verify the design, with the submission. This information shall be subject to approval by the Authority.

c. Peak Flow

i. Laterals & Sub-Mains

Minimum Peak Design Flow shall be 400 percent of the average daily flow.

ii. Main Trunk and Interceptor Sewers

Minimum Peak Design Flow shall be 250 percent of the average daily flow.

3. Alignment & Slope

a. General

Sewers shall have a uniform slope and straight alignment between manholes. Gravity sewer size shall normally remain constant between manholes.

b. Minimum Slope & Velocity

Minimum grades shall not be less than those required to produce a velocity of no less than two feet per second when the size pipe selected is flowing full using a material roughness coefficient, "n" value, of 0.014, in the Manning Formula.

Pipe sizes shall be based on design flow and not increased in size in order to take advantage of a decreased grade, except with Authority approval.

The following table represents the minimum slopes to be provided for gravity sewer mains and sidewalk collectors; however, slopes greater than those listed are desirable:

Table 1. Minimum grades for non-settled sewage

Sewer Size	Number of Equivalent Residential Connections (ERC'S)	Minimum Slope
8" [1], [3]	10 or less	1.00%
8" [2], [3]	11 - 20	.60%
8" [2]	Above 20	.40%
10"		.30%
12"		.22%
15"		.15%
18" and larger		2 fps @ 1/2 full
Deviations from this table shall be applied for as a variance and special provisions may be required by the Authority. No slope shall be proposed less than the DEQ Sewage Collection and Treatment (SCAT) Regulations allow.		

Notes:
1. When 6 or less ERC's are served, such as a cul-de-sac or other location where no extension of the sewer is possible, the Authority may allow a sidewalk collector constructed of 6 inch pipe with a minimum slope of 1.00%.

2. When 8 inch pipe cannot be laid at the required minimum slope, an engineered system may be allowed where calculations demonstrate the ability of the system to meet a flow velocity of at least 1.5 fps. Engineered systems will be allowed only with prior written approval from the Authority taking into consideration the availability to increase the slope of the pipe, the length of the sewer line, the location of the sewer line, the feasibility and accessibility for maintenance and cleaning of the sewer line and other criteria which would be of impact on the Authority once the sewer line has been constructed and accepted. Calculations must be submitted and signed by a Professional Engineer licensed in the Commonwealth of Virginia.

3. Minimum pipe slope for dead end sewers, whether temporary or permanent, shall be 0.5% unless it can be shown by calculations that the velocity in the pipe is 2 feet per second or greater.

c. Maximum Slope & Velocity

The maximum slope of a sewer line shall normally be 10%. When steeper slopes are necessary, a drop manhole connection shall be used.

When an excessive number of drop manholes is required due to steep slopes, a steeper than maximum slope and/or additional depth may be used upon approval by the Authority.

The maximum recommended velocity at average daily flow is 10 feet per second. Velocity shall be calculated using a Manning's "n" value of 0.014.

Where velocities greater than 15 feet per second are expected, special provisions shall be made to protect against internal erosion by high velocity. The pipe shall conform to appropriate ASTM or AWWA specifications, which provide protection against internal erosion.

d. Anchors

When slopes 20% or greater are approved for use by the Authority, concrete anchors shall be specified. Anchors shall be in accordance with the Standard Details.

e. Deflection

The maximum deflection between the inflow and outflow lines at a manhole shall be 90 degrees.

4. Depth

In general, sewers should be designed and constructed sufficiently deep as to receive sewage from basements. Elevations shall be shown on the plans for service lateral inverts as well as the finished floor of the lowest floor proposed to be served.

All sewers shall be constructed in such a manner that a minimum of 3.5 feet of cover is maintained between the top of the pipe and the finished grade or ground elevation. Greater depths may be required if deemed necessary to provide service to adjacent properties or to serve lower lying properties. Where approved by the Authority and conditions dictate that the cover be less than 3.5 feet, ductile iron pipe, thickness class 50 shall be required. Sewers installed with 15 feet of cover or greater shall be constructed of C900 PVC pipe, thickness Class DR-18. Maximum depth shall be 18 feet unless otherwise approved by the Authority.

5. Size

No public sewer shall be less than 8 inches in diameter unless approved by the Authority. The Authority reserves the right to specify the size of sewer mains on any project. If the Authority specifies a sewer main larger than shown necessary by approved design calculations, the Authority may participate financially in the project according to Authority OPPM *Policy No. 10.2 System Improvements*. In any case, the designer shall be responsible to properly design the sewer system for the estimated population to be served.

6. Sewer Connections

Each house, building or other structure receiving service must have a separate paid sewer connection, except in the case of a “Temporary family health care structure” as defined in Augusta County Code. Service may be available to concentrated users through a single connection, on a single parcel, based on an evaluation by the Authority Engineering Department.

Connections to sewer lines 18 inches in diameter or larger shall only be made at manholes.

When connections are made to existing manholes, invert shaping shall be modified by the Contractor to accommodate the new connection. Invert shaping shall be coordinated and approved by the Authority.

For standard residential connections, a minimum 6 inch sewer lateral may be provided for a maximum of two residential connections and a minimum 4 inch for individual connections in accordance with the Standard Details.

For commercial subdivisions, sewer service laterals shall be provided by the Authority at the time of payment of connection fees (typically at the time of site plan approval for each additional lot.

Site plans submitted for lots located in commercial subdivisions shall indicate proper closure of existing unused sewer laterals as part of the site plan. This includes removal of all cleanouts and permanently capping the line on the same side of the road as the main.

Sewer laterals shall be constructed to the property line and a cleanout provided immediately at its terminus, installed to a point flush with the finish grade, or when the finish grade is unknown, to a point sufficiently above the existing grade. All openings shall be plugged and sealed with a watertight plug until line is put in to use. Construction shall be in accordance with the Standard Details.

Direct connections to the public sewer of roof drains, sump pumps, holes in floor drains, foundation drains, leaking laterals and other direct sources on inflow or infiltration into the public sewer system are prohibited.

At all junctions where a smaller diameter sewer discharges into a larger one and at all locations where the sewer increases in size, the invert of the larger sewer shall be lowered so that the energy gradient at design flow of the sewer at the junction is at the same level. Two approximate methods for securing this result which may be used are as follows:

a. Align the 80% capacity flow level of both sewers at the same elevation, or

b. Position the crown of both sewers at the same elevation.

Sewer joints shall be in accordance with ASTM design standards and/or according to manufacturer's recommendations. Sewer joints shall be designed to prevent infiltration and to prevent the entrance of roots.

7. River or Stream Crossings (Including Elevated Crossings) and Pipe Installation in Marshy Areas

Each river or stream crossing shall be submitted for review to the Virginia Marine Resource Commission (VMRC) using the Joint Permit Application (JPA) process and proof of approval by VMRC shall be provided to the Authority.

River and stream crossings shall be constructed of C900 pipe, thickness class DR18, manhole to manhole, and encased in concrete in accordance with the Standard Details and as required by the JPA process. The Authority reserves the right to require ductile iron river-crossing pipe and concrete encasement for pipe installation crossing rivers, streams, ditches, shallow areas or marshy areas. The pipe and joints shall be tested in place and shall exhibit zero infiltration. The pipe joints shall be designed and constructed for impacts due to hydraulic longitudinal and vertical loads and protected from erosion. A geotechnical engineering evaluation may be required to ensure adequate soil conditions for pipe support. If required, the evaluation will be performed at no cost to the Authority.

Minimum cover over the concrete encasement shall be 3 feet, in accordance with the Standard Detail.

Sewers shall remain fully operational during 25-year flood/wave action.

Sewers may be elevated on piers across/above ravines, streams, or rivers when it can be demonstrated that no other practical alternative exists. Such sewers on piers shall be Class 50 ductile iron pipe constructed in accordance with the manufacturer recommendations/Ductile Iron Pipe Association Standards. In addition, a stream flow analysis using HEC methods to determine the effect of the piers shall be performed by the designer as required by the Authority or other agencies having jurisdiction.

Construction methods and materials or construction shall be such that sewers will remain watertight and free from change in alignment or grade. Above grade sewers shall be installed with an approved insulation in accordance with the Approved Products List. Installation shall include an aluminum jacketing installed in accordance with the Standard Detail. The insulation and aluminum jacketing shall be shown on the plans in the plan and profile views.

b. Manholes

1. General

Standard and drop manholes, service connections and other appurtenances shall be designed and constructed in accordance with the Standards.

2. Layout

Manholes shall be installed at the end of each line, at all grade, size, or alignment changes, and at all sewer line intersections. Terminal cleanouts may be permissible in sidewalk collectors or as approved by the Authority.

In addition, manholes shall be provided at intervals not exceeding 400 feet on all sewers 15 inches in diameter or less and not more than 500 feet apart on sewers 16 inches in diameter or larger.

3. Size

Size of sewer manholes shall be in accordance with Standard Details. Manholes larger than minimum size may be required where pipe deflection or intersection of two or more upstream lines occur.

Monolithic bottoms with extended base may be required in unstable soil conditions or where floatation may be a problem. In areas subject to flooding or unstable soil conditions, calculations shall be performed which demonstrate that the standard manhole will not float, or that an extended base has been provided to prevent the manholes from floating. If extended bases are shown to be necessary, they shall be detailed on the plans.

4. Height

Manholes shall be constructed with as few sections needed to achieve proposed plan height and/or to meet finish grade. Manhole sections shall be provided to limit the number of joints in a structure to what is necessary.

5. Frame and Cover

In areas subject to flooding, and as required by the Authority, manhole tops shall be raised above the flood elevation, or watertight manholes shall be provided in accordance with Standard Details. Where the length of sewer line containing watertight manholes exceeds 1,000 feet, a non-watertight or vented watertight manhole shall be provided every 1,000 feet. Vented manholes shall be in accordance with Standard Detail.

Manhole frame and cover castings shall be installed so that the cover shall be exposed and flush with the finish grade. Frames and covers located in pavement or concrete shall be sloped to match the pavement or concrete to avoid damage. The frame shall be sloped using approved materials in accordance with the Approved Products List and the Standard Details.

6. Inverts and Slope

Invert shaping shall be provided for all manholes in accordance with Standard Details. Invert channels and benching shall be a continuous smooth surface that properly align so that flow will not be trapped and/or restricted. The slope through the manhole shall be the same as the slope of the main line incoming pipe or shall be a minimum of 2.5%. This incoming or minimum slope shall determine the drop across the manhole. Inverts in and out of the manhole shall be shown on the plans. The minimum slope of 2.5% across a 4 foot manhole is a drop of 0.10 feet. The maximum slope across a manhole shall be 10% which, across a 4 foot manhole, is a drop of 0.40 feet. The maximum slope of a gravity sewer line is 10%.

7. Force Main Receiving Manholes

Interior of force main receiving manhole and two downstream manholes shall receive an epoxy coating. Coating shall be 100 percent solids based epoxy binder combined with fibrous and flake fillers to minimize water vapor transmission and increase flexural strength. Material shall be specifically

designed for manhole rehabilitation. Coating shall be corrosion resistant. Material shall be applied at 40-60 mils thick on all interior surfaces of the manhole.

The invert shall be modified as necessary in the receiving manhole to ensure a smooth flow transition to the gravity flow section. Special consideration should be paid to design of the termination in order to prevent turbulence at this point. Any modifications made to existing inverts shall be coordinated with and be approved by the Authority.

The receiving manhole and two downstream manholes shall have a composite frame and cover assembly installed in accordance with the Approved Products List and Standard Details.

8. Drop Manholes

When approved by the Authority, drop manholes in accordance with the Standard Detail shall be provided to break steep slopes, to limit the velocities in the connecting sewer pipes, and reduce splashing effects of large falls which may release gasses. Where drop manholes are impractical for a reduction in velocity, and as approved by the Authority, the sewer main shall be of ductile iron.

Drop manhole connections 8 inches through 12 inches sewer pipelines shall have a minimum drop of 3 feet-9 inches and the maximum drop allowed is based on the following pipe slopes of the influent pipe of the drop connection:

a. Pipe slopes of 5% percent or less, the maximum drop allowed is 12 feet.

b. Pipe slopes of greater than 5% to 10%, the maximum drop allowed is 7 feet.

c. When approved, pipe slopes of greater than 10% to 20%, the maximum drop is five feet.

A drop connection shall be provided for a sewer entering a manhole at an elevation of 8 inches or more above the manhole base or as may otherwise be required to conform to the use of standard fittings in the drop pipe construction.

Inside drops may be allowed for pipe sizes less than or equal to 6 inches. Unless approved by the Authority, only one interior drop can be constructed in the manhole. Interior drops shall be constructed in accordance with the following:

a. Maximum pipe slope of the influent pipe is 5%.

b. If applicable, existing manholes shall be precast concrete.

c. The inside drop connection piping shall not be within the area that is defined by the projection of the manhole entrance vertically down to the manhole bottom. If necessary, relocate the existing frame and

cover, existing precast cone section and existing manhole steps to allow unobstructed entry and exit.

Every effort should be made by the designer to minimize the use or number of drop manholes.

9. Doghouse Manhole

Doghouse manholes shall not normally be allowed. If approved by the Authority, doghouse manholes may be used in cases where a new manhole cannot be cut in and pumping of sewage is not possible. Installation of additional materials may be required to ensure water tightness.

c. Force Mains & Pump Stations

1. General Requirements

The Authority strongly discourages the installation of pump stations and force mains where reasonable alternatives exist. The Authority will consider all such requests received from the perspective of the best interests of total sewer system development and operation. Convenience of any individual development and/or developer is a secondary consideration.

Prior to submitting a pump station and force main design, a Preliminary Engineering Report (PER) shall be submitted and approved by agencies having jurisdiction. These agencies shall include, but not be limited to the DEQ and the Authority. The PER shall address such items as the proposed service area, the overall effect on downstream facilities, peaking factor, and a cost benefit analysis of an alternative gravity sewer design. Force main and pump station detention times, wet well aeration, and odor control shall also be addressed. This shall consider start up flows as well as design build-out flows.

The sizing and configuration of the pumping station and the sizing of the attendant force main shall be within the parameters set forth in the PER. The facilities to be provided shall be based on ultimate flows unless an interim flow design was incorporated in the approved PER.

System design shall include but not be limited to the technical provisions of these Standards and those of the DEQ SCAT Regulations.

Stations must comply with all provision of the BOCA Code and be inspected by the Augusta County Building Inspections Department in addition to Authority inspectors.

2. System Design

a. Capacity

Pump Selection Capacity design for the pumping station and force main shall take into consideration such parameters as minimum, average and peak station inflows as well as minimum, average and maximum pumping rates. Initial capacity as well as capacity required to serve the entire drainage basin shall be taken into account.

Sewage pump station design shall consider the needs of the ultimate build out population of the service area being considered. Any known future development shall be considered as well. Provisions shall be made to accommodate future needs if the initial flow is significantly less than the ultimate demand.

The designer shall also estimate the ultimate build out population for the total sewer shed area. Future population densities should consider the Augusta County Comprehensive Plan, the Authority's Master Plan, Zoning Ordinance, and Subdivision Ordinance as applicable. Based on the results of this estimate, the Authority may participate in the project in accordance with Authority OPPM *Policy No. 10.2 System Improvements*.

b. Flood/Wave Action

All mechanical and electrical equipment, which could be damaged or inactivated by contact with or submergence in water, shall be physically located above the 100-year flood/wave action or otherwise protected against the 100-year flood/wave action.

All stations shall be designed to remain fully operational during the 25 year flood/wave action.

c. Hydraulic Analysis

Pump selection and force main sizing shall be based on a hydraulic analysis of the required flows, pipeline velocities, and receiving gravity sewer capacities. Each pump in the duplex system shall be capable of handling flows in excess of the expected maximum flow or a minimum of 2.5 times the average design flow, whichever is greater.

Calculations shall be prepared and system head capacity curves developed that will show static head, and total dynamic head (TDH) for both single and multiple pump operation, and high and low wet well levels. TDH calculations shall also show consideration of any and all high points in the discharge force main. Where variable speed pumping is contemplated, pump performance curves shall show performance at maximum speed, minimum speed just above static head and several intermediate speeds that will clearly indicate pump operation. When a VFD is used, factory variable speed curves shall be utilized and provided with the design calculations. Particular attention shall be given to the available versus required net positive suction head (NPSH) of the proposed system.

3. Pump Stations

a. General

The design engineer shall consider the need for protection of the pumping station, force main, and downstream manholes against hydrogen sulfide attack and shall provide the proper equipment if such protection is found to be justified by the design calculations. The designer shall prepare an operations and maintenance manual for the pump station.

b. Pumping Equipment

All pumping equipment and controls shall be in accordance with the Approved Products List.

The type of equipment to be installed in the pumping station will be influenced by the interim and ultimate capacity of the station and an evaluation of the period of time that the service of the station will be required. Pump selection shall consider operating speeds and motor efficiency. Except in special cases, sewage pumps shall not exceed an operating speed of 1,800 RPM. Design of those pump stations which discharge to sewage treatment facilities without dissipation of flow shall consider the need for variable speed pumps and be sized to handle matched flows. Pumps shall be selected such that their discharge under operating conditions is no greater than 120% or less than 60% of the noted discharge at the best efficiency point.

Pump stations shall consist of a minimum of two submersible sewage pumps and be protected against clogging. Pneumatic ejectors shall not be used. The station shall be equipped with one automatic flushing valve per duplex system. Pumps in which solids are able to pass through the impeller(s) shall be capable of at least passing a sphere 3 inches in diameter. Suction lift pumps may be considered by the Authority on a case by case basis.

The pump station shall be designed so that at full capacity each pump will run no greater than 16 hours per day and each pump can handle the peak flow individually. In addition, the pumps shall be designed to run for a minimum of one minute each time they start, and shall not exceed 3 starts per hour, per pump.

c. Power Requirements

Consideration must be given to designs that require the least power to accomplish the functions required. An energy analysis shall be provided which demonstrates that the design is the most efficient and cost effective system for the Authority to operate.

Transient voltage surge protection must be provided on all incoming power sources. A phase monitor to protect against phase imbalances. Three-phase service shall be provided, shall be either closed delta or four-wire wye, in order to reduce the risk of phase imbalances.

d. Vibration

Maximum allowable acceleration and amplitude of vibration must be specified, variable speed pump designs and installations must consider avoiding sympathetic resonant vibration.

e. System Layout

Suitable shut-off valves shall be placed on each discharge line of each pump for normal isolation. No shut-off valve need be placed on the suction side of the submersible pumps. The shut-off valve and check valve on the discharge lines of submersible pumps operating at flows greater than 25 gpm shall be located in a separate vault outside of the wet well allowing accessibility for inspection. Pump suction and discharge piping shall not be less than 4 inches in diameter. Discharge check valves shall not be of diameter significantly larger than the pump discharge size, such that it would create excessive startup pressure on the pump (through mechanical advantage).

When suction lift is approved by the Authority, each pump shall have its own suction/intake line. Velocity in the suction lines shall be in the range of 2 to 6 feet per second. Air relief valves shall be located on the discharge piping. The pumps, shut off valves, and check valves shall be located outside the wet well.

Pressure gauges shall be provided on the pump side of the discharge check valve for each pump. Where possible a pressure gauge shall be installed on the force main side of the check valves to indicate static pressure. Ball valves shall be provided at all gauges to allow for removal and/or cleaning during operations.

Equipment shall be installed to facilitate removal of pumps, motors, etc. without interrupting system service and without requiring personnel to enter the wet well.

A quick connect shall be provided in the piping layout that will accommodate a portable pump in the situation that both pumps must be taken off-line. At this same location and at the discretion of the Authority, a pigging station connection will be required.

f. Controls & SCADA

i. Float controls are preferred for all sewage pump stations. Provisions shall be made to automatically alternate the pumps in use referred to as lead-lag operation. Depending on the site, transducers may be required instead of floats.

In stations where wet well aeration is provided, controls shall automatically halt aeration prior to starting pumps and for the duration of their run time. Aeration controls shall include 24 hour time clocks for automatic operation.

ii. The following items shall be monitored and transmitted via the SCADA system.

- wet well levels
- high/low alarms
- power and phase failure
- generator status
- run time – each pump
- flow meter

iii. Components of the SCADA system shall be as shown in the Approved Product List found at www.acsawater.com. Panels shall be assembled by an electrical contractor or system integrator experienced and qualified to perform such work.

iv. Transient voltage surge protection shall be provided on all communication lines.

g. Wet Well

Wet well design shall take into account the selection criteria for pumps. Wet well capacity shall be such that start and stop set points can be achieved without loss of required net positive suction head. Capacity shall also account for pump cycle time such that no pump is started more than three times per hour. When the station is expected to operate at a flow rate less than 1/2 the average design flow for an extended period of time, the design of the wet well shall also address measures to prevent septicity due to long holding times in the wet well.

In cases where wet well or force main detention times may exceed 12 hours, either at start up or build out flows, provisions shall be made for aeration of the wet well to maintain the highest possible dissolved oxygen level in the force main. If detention times may exceed 24 hours, consideration shall be given to chemical feed systems to control odors. All odor control alternatives to chemical feed shall be considered. Chemical feed systems shall be considered a last resort for odor control.

The base of the wet well shall be filleted at a minimum slope of 1:1 in order to prevent the build up of solids in the bottom of the wet well. The pump shall be located at a distance from the sloped area in accordance with the manufacturer's recommendations to prevent the accumulation of solids. Low water level for stations with submersible pumps shall maintain compete submergence of the pump motor for cooling.

Sewage pump stations which pump sewage prior to grit removal shall pay special attention to design of the wet well and discharge piping in order to prevent solids from settling in the pumps' discharge lines.

Floatation calculations shall be provided which demonstrate that the wet well will not be subject to floatation. An expanded base shall be required if necessary to eliminate floatation.

Testing shall be in accordance with the following: All pipes leading to and from the wet well shall be plugged. Plugs shall be inserted into the pipes a distance greater than the length of the plugs used to air test each respective section of sewer line, so as to insure the wet well and line tests overlap. Plugs shall be secured to the wet well structure. The wet well shall be filled with water to the top of the structure and allowed to soak for a minimum of 12 hours to permit the wet well to absorb water. The wet well shall be constructed to finish grade prior to the soaking period with the cover/frame/hatch installed. At the end of the soaking period, water shall be added until the wet well overflows. No loss of water will be permitted over a 4-hour period. Upon successful completion of the test, the water shall be removed from the wet wel

h. Electrical

The designer shall determine the availability of electric service and coordinate the available electrical service with that required for the facility. The designer shall also determine the need for primary service extension. All costs for extension of electric service shall be the responsibility of the Developer and made part of the overall construction cost. Costs for extension of electric service shall not be rolled into a minimum consumption billing for startup of the facility.

All motors, motor control, external disconnect switch and other electrical equipment shall be housed in a weatherproof, above-ground structure. Adequate provisions shall be incorporated for the proper heating, ventilation, drainage and flood protection in order to insure maximum security, reliability, electrical and personnel safety.

If wet well is contained within a building, pumping station wet wells shall be considered explosion hazardous. All electrical equipment installed therein shall be approved for NEMA 7, Class I, Group D, in accordance with Article 500 of the National Electric Code (NFPA No. 70). The use of intrinsically safe controls in accordance with NFPA No. 493 is satisfactory and its use is required. If electrical boxes are contained in a separate structure from wet well and piping, boxes shall be NEMA 12.

The design engineer shall consider ground conditions in the case of metallic conduits and provide suitable cathodic protection where necessary.

An electrical schematic shall be shown on the plans which details all construction requirements for a complete working system.

i. Lighting

Pump stations housed in buildings shall be adequately lighted in accordance with VOSH and other applicable codes and standards. Pump station lighting shall be in accordance with Section 16500 – Lighting - of the Construction Specifications.

j. Ventilation

Shall be required in accordance with VOSH requirements and the DEQ SCAT Regulations for enclosed spaces within pump stations during all periods when the station is manned.

A properly screened vent with a diameter of at least 4 inches, with the end turned downward or a "mushroom" cap shall be provided as ventilation for the wet well.

Dampers shall not be used on exhaust or fresh air ducts, and fine mesh screens or other obstructions in air ducts should be avoided to prevent clogging.

Switches for the operation of the ventilation system shall be located above grade and located near the entrance.

There shall be no interconnection between the wet well and dry well ventilation systems.

Where the pump is permanently mounted below the ground, mechanical ventilation is required and shall be arranged so as to independently ventilate the dry well.

Wet well:
Continuous ventilation: 12 air changes/hour minimum
Intermittent ventilation: 30 air changes/hour minimum

Dry well:
Continuous ventilation: 6 air changes/hour minimum
Intermittent ventilation: 30 air changes/hour minimum

k. Flow Measurement

A flowmeter shall be provided from the Approved Products List which can be found at www.acsawater.com.

1. Water Supply

A sanitary frost proof yard hydrant in accordance with the approved products list shall be provided within 15 feet of the wet well. There shall be no cross connection between any potable water supply and a sewage pump station. When a sanitary type hydrant is utilized, additional backflow prevention is not required.

Consideration shall be given to the need for a water supply well in locations where a public water supply is not available.

m. Building Design

A building or wooden shelter, at the discretion of the Authority, shall be provided for all above ground piping and all electrical panels. The architecture of the pumping station shall be compatible with the surrounding neighborhood in accordance with these Design and

Construction Standards. All pumping stations shall be of sufficient size and contain adequate clearances to provide ample room for maintenance. A minimum work space of three feet shall be provided around all piping and equipment. Additional space shall be provided around electrical enclosure, in accordance with local building and electrical codes.

n. Site Grading

Site grading, seeding or sodding, trees or shrubs shall be provided to present a finished appearance, as approved by the Authority, consistent with the zoning, general appearance of the surrounding area, and 02200 – Site Construction for Pump Stations.

o. Fencing

Fencing with gates shall be provided in accordance with 02821 – Chain Line Fences and Gates to properly protect the facility and provide public safety.

p. Reliability Class Designation

Unless otherwise approved by the Authority/DEQ, a generator shall be provided to ensure that the pump station can operate for a minimum of 24 hours at 100% load without refueling during a power outage.

Should it be determined that standby power is not required, a hookup for a portable generator shall be installed, compatible with existing Authority equipment, and coordinated with the Authority's operation personnel.

q. Access

An all-weather road, storm drainage and parking shall be provided for easy access to the pumping station in accordance with 02200 – Site Construction for Pump Stations.

r. Vandalism

Pump stations shall be designed so as to minimize the risk of vandalism.

4. Force Mains

a. General

Every effort shall be made to maintain a full force main under operating conditions.

b. Capacity

Sizing of the main shall be such that at pumping capacity, a minimum velocity of 2.25 feet per second be maintained to provide adequate flushing. A velocity of 8 feet per second should not be exceeded. A minimum velocity of 3.5 feet per second may be required to re-suspend solids in longer force mains. Detention times shall be examined and appropriate odor control measures shall be provided in accordance with these Standards.

The minimum size of force mains shall be 4 inches in diameter unless otherwise approved by the Authority.

c. Materials

All force mains shall be cement lined ductile iron pipe, thickness class 50.

d. Alignments and Grade

Force mains shall have a positive slope from the pumping station to the point of discharge unless unusual conditions make this impractical. Extra depth or bury shall be provided in lieu of air or air/vacuum relief valves wherever feasible. Every effort shall be expended to maintain the force main below the hydraulic gradient. Air relief valves, should they be required at the system high points, shall have an automatic valve installed inside a standard manhole with adequate means of drainage in accordance with Standard Details.

e. Point of Discharge

Force mains shall enter a gravity sewer system at the invert of the receiving manhole. The force main should enter the manhole with its center-line horizontal to prevent air from traveling up into the pipeline. Invert shaping and protective coatings in the receiving manhole shall be in accordance with Section B.3.b. - Manholes of these Standards. Drum scrubbers shall be considered at the discharge manhole, if necessary to control odor.

f. Test Pressure

All force mains shall be tested at a minimum pressure at least 50% above the design operating pressure and pump shutoff head. This test pressure shall be shown on the plans.

g. Installation

See Section 02080 – Utility Pipe and Materials for bedding and installation of sewer lines.

h. Anchoring

The effect of hydraulic thrust must be countered by the use of thrust blocking, pipe anchorage or other suitable means to prevent movement of pumping equipment and pipelines.

Structural requirements for force mains include the proper selection of materials and strengths of pipe and pipe accessories. This will involve a study of anticipated trench conditions and bedding methods. The minimum depth of cover shall be governed by depths of other utilities and hydraulic gradient; however, not less than 3.5 feet of cover shall be provided.

d. Rules and Regulations for Wastewater Discharge

1. Connection of any storm water or ground water pumping system to the sanitary sewer system is prohibited.

2. Industrial Pretreatment Application

The applicant for sanitary sewer services, which produce processed wastewater, to serve industrial establishments shall conform to the requirements of the Authority's Industrial Pretreatment Program.

The Authority's Lab & Compliance Manager will contact the Developer/Owner when an industrial connection is to be made to determine if a processed waste is to be sent to one of the Authority's wastewater treatment facilities. There is an application procedure for acceptance of processed waste and the Owner/Developer must comply with the Authority's Rules and Regulations for Wastewater Discharges. Information regarding plant location, type of industry, raw and finished products, approximate volume of utility requirements, types of industrial wastes to be discharged, proposed facilities for pretreatment of industrial wastes and other data pertinent to the industry, shall be accompanied by the application for review. The Authority's Lab & Compliance Manager that can be contacted at 540-245-5670.

3. Oil/Water Separator

Any sanitary sewer connection that will be discharging waste that contains fat, oil, or grease in concentrations greater than the limits defined in the Authority's Pre-treatment Policy shall provide an oil/water separator as described below.

The Oil Water Separator shall be designed in accordance with Stokes Law and the American Petroleum Institute Manual on Disposal of Refinery Wastes, Volume on Liquid Wastes as stated in Chapter 5, Oil Water Separator Process Design and API 1630 First Edition, Waste Water Handling and Treatment Manual for Petroleum Marketing Facilities.

The free petroleum hydrocarbon concentration in the effluent from the Oil Water Separator shall not exceed 15 mg/l (15 ppm). To achieve this goal, it will be necessary to remove all free oil droplets equal to and greater than 60 microns

The Oil Water Separator capacities, dimensions, construction, and thickness shall be in strict accordance with Underwriters Laboratories, ANSI/UL 58.

Oil Water Separator Corrosion Control System shall be in strict accordance with STI P 3 specifications as applied by a licensee of the Steel Tank Institute. Manufacturer must be a licensee of Steel Tank Institute. No assigning or subcontracting of tank fabrication shall be permitted.

The Oil Water Separator shall be cylindrical, horizontal, and atmospheric-type steel vessel intended for the separation and storage of flammable and combustible liquids. The separator shall have the structural strength to withstand static and dynamic hydraulic loading while empty and during operating conditions.

The Oil Water Separator shall have an oil storage capacity equal to about 45% of the total vessel volume and an emergency oil spill capacity equal to 80% of the total vessel volume.

Each Oil Water Separator shall consist of inlet and outlet connections, non-clogging flow distributor and energy dissipater device, stationary under flow baffle, presettling chamber for solids, sludge baffle, oil coalescing chamber with a parallel corrugated plate coalescer to optimize separation of free oil from liquid carrier, effluent downcomer positioned to prevent discharge of free oil that has been separated from the carrier liquid, access for each chamber, fittings for vent, oil pump out, sampling, gauging and lifting lugs.

The oil/water separator shall be shown and detailed on the plans.

4. The Authority's complete Rules and Regulations for Wastewater Discharge are included in Appendix 3 of the Design and Construction Standards.