

## VII. Pump Stations

A. Introduction - HRSD owns and operates wet well stations and pressure reducing stations. Wet well stations are sized to receive projected flows from gravity sewers and discharge to force mains. Pressure reducing stations and/or other facilities are sized to maintain the pressure head in force mains within HRSD operating limits. Wet well stations, force mains and pressure reducing stations are all sized and operated per HRSD policy for a maximum pressure head under normal operating conditions equal to the required static head plus a maximum head loss of 65 feet due to friction head loss and velocity head loss.

1. Wet Well Pump Station - Flows are discharged by gravity sewers or force mains into a wet well from which they are pumped into a force main. The pumps are designed for a flooded suction condition and are located in a separate dry well adjacent to the wet well with intake piping leading from the wet well to the pumps.
2. Pressure Reducing Station (PRS) - A pressure reducing station is connected directly to a force main and is used to maintain the pressure on the suction side of the pumps between ten feet and 65 feet plus the plant influent elevation provided by the HRSD Hydraulic Model.

### B. Description of Operation

1. Wet Well Pump Station
  - a. Wet well stations typically use variable speed pumps to match flow fluctuations and minimize turbulence in the wet well to reduce odor, corrosion and air entrainment
  - b. Wet well stations operate by starting the lead pump when the wet well water level increases to a preset limit. The lead pump speeds up and slows down to maintain the wet well water preset level or range. If the lead pump cannot maintain the wet well water preset level or range, an additional pump or pumps are started and are operated together with the lead pump to maintain the wet well water level within the preset level or range. As the wet well water level decreases to preset lower limits, the pumps are stopped in reverse order as needed until all pumps are stopped.

## 2. Pressure Reducing Station

- a. Pressure reducing stations typically use variable speed pumps to match flow fluctuations to lower the pressure on the suction side of the booster pump station from approximately 65 feet to ten feet. Pressure reducing stations do not necessarily run continuously and are not normally required to operate until the force main flow reaches approximately two-thirds of the design flow.
- b. Pressure reducing stations operate by starting the lead pump when the force main discharge pressure increases to a preset high limit. The lead pump speeds up and slows down to maintain the force main suction pressure within a preset range. If the lead pump cannot maintain the force main suction pressure within the preset range, an additional pump or pumps are started and operated together to maintain the suction pressure within the preset range. As the force main discharge pressure decreases to preset lower limits, the pumps are stopped in the reverse order as needed until all pumps are stopped.
- c. Provide for piping and valves at the pump station site so that the force main flows can be pumped in either direction as appropriate with the operation of a minimum number of valves.

## C. General

1. Provide a separate generator room or building with adequate space for maintenance and heat rejection from the engine block and exhaust system or isolate remaining areas from generator noise and heat.
2. Pump station shall meet the design capacity with one pump out of service. In a station with two pumps, one pump is required to meet the design capacity and in a station with three pumps only two of the three pumps are required to meet the design capacity. The normal control sequence shall include only the pumps required to meet the design capacity.
3. Provide a slope on the pump room floor that will convey seepage from pump packing and drainage from wash down to a sump.
4. Provide a commode in a separate room or enclosure. Provide a wash basin in the pump station.

5. Include a site plan showing property lines, building, piping, existing & proposed utilities, valves, emergency pump connection (wet well stations only), physical features, topography, etc and any other requirements by the local approving authority.
6. Design shall incorporate measures to facilitate the maintenance and removal of equipment and pumps.
7. Provide access to dry well and wet well by stairs. Spiral stairs are not acceptable. Stairs shall be a minimum width of 36 inches and shall include handrails on both sides.
8. Design wet well and influent piping to minimize turbulence and air entrainment in the wet well.
9. Provide minimum submergence required to eliminate vortex at pump suction intake.
10. Provide for odor control for the wet well.
11. Locate discharges for sump pump, pump air release and restroom discharge away from pump intakes in the wet well and design to minimize turbulence and air entrainment.
12. Provide a shut off valve or slide gate on the gravity influent pipe.
13. Provide removable bar screen.
14. Provide smooth interior wet well surfaces. Provide a PVC sheet liner such as T-Lock on all interior concrete surfaces of the wet well except the floor. Use white, not black.

D. Site Work

1. See the Miscellaneous Section for additional information.
2. Provide concrete entrance and a paved driveway for off street parking, access to building and provision to turn around a crew truck.

E. Masonry

1. See the Miscellaneous Section for additional information.
2. Building walls shall be concrete block with exterior brick veneer.
3. All lintels shall be stainless steel.

F. Equipment

1. Provide for the peak design flow conditions to be met by all pumps operating together except the standby pump.
2. Provide a minimum of three equal sized pumps including standby pump.
3. Pumps shall be dry-pit submersible pumps installed in the dry well. Pump, motor and impeller shall be balanced as a unit at the factory prior to shipment. Motor shall be inverter duty rated.
4. Pumps shall generally operate at speeds below 1,000 RPM.

G. Conveying Systems

1. Provide a load rated monorail and hoist with appropriate hatches and doors to facilitate the removal of the pumps and motors for maintenance. Use removable load rated grating to cover interior openings that are to be used for removal of equipment. Indicate the load ratings on the plans and stencil load ratings on the hoist and monorail.
2. Provide rated lifting eyes to assist with equipment removal.

H. Mechanical

1. Interior Piping
  - a. Provide ductile iron flanged joint.
  - b. Provide a gate valve on the suction and discharge sides of each pump.
  - c. Provide ductile iron resilient seat gate valves that meet the requirements of AWWA C509. Valves shall be OS&Y, open left and be coated with fusion bonded epoxy.

- d. Provide a check valve on the discharge side of each pump between the gate valve and the pump.
  - e. Provide iron body, bronze seat check valves with packing glands and external lever and spring in accordance with AWWA C508.
  - f. Provide adequate pipe support and thrust restraint with base elbows, base pads or hangers as required. Pipe supports on the floor shall be mounted on housekeeping pads.
  - g. Use eccentric reducers (match elevations at top of pipe) on the suction and discharge piping in order to prevent the entrapment of air.
  - h. Provide a manual air release on the discharge of each pump. Reduce from tap on pump volute to ½ inch pipe and ½ inch ball valve. Provide a union to transition to ¾ inch HDPE air release piping to wet well. All pipe valves and fittings except HDPE shall be stainless steel.
  - i. Exterior wall penetrations shall be accomplished with a wall sleeve. Seal between sleeve and carrier pipe with a “Link Seal” type seal. Penetrations between the pump room and wet well for pump suction piping shall utilize wall pipe with integral collar.
  - j. Provide an eye wash station near the generator batteries in accordance with the current safety requirements.
2. Exterior Piping (Force Main)
- a. See the Pipelines Section for additional requirements for force mains.
  - b. Wet Well Pump Station - Provide an emergency pump connection with a flanged wye and blind flanges.
3. Provide for space heating to prevent freezing of pump station facilities.
4. Provide for ventilation of approximately 30 air changes per hour when the pump station is occupied.
5. Provide potable water for the restroom and hose bibs from the municipal water system or from a well if municipal water system is not available.
6. Provide a Virginia Department of Health approved backflow preventer to be installed on the main potable water line where it enters the pump station and prior to any outlets in the pump station.

7. Provide for the discharge of restroom drainage and the sump pump.
  - a. Pressure Reducing Station – Discharge restroom drainage to the municipal sanitary sewer system, if available or pump discharge into the pump station suction leg utilizing a small package grinder pump. Grinder pump shall meet the maximum inlet head conditions.
  - b. Wet Well Pump Station – Discharge restroom drainage to the pump station wet well.

I. Electrical

1. See the Electrical and Instrumentation Section for additional information regarding electrical and instrumentation systems.
2. Provide diesel generator or other source of alternate power in order to meet Class I reliability. The generator shall be designed to meet the design capacity of the pump station with the primary power off.
3. Install electrical equipment and motors (unless submersible motors are used) above the 100 year flood elevation.
4. Require Contractor to install wiring for alarm system to the transmitter. Alarm points to be determined by HRSD. Alarm transmitter shall be provided by HRSD.
5. Provide variable frequency drive controllers to control pump speed.
  - a. Pressure Reducing Station
    - (1) Pump speed shall be controlled in response to suction pressure.
    - (2) Provide pressure sensors on the suction and discharge piping. See Standard Details Section.
  - b. Wet Well Pump Station
    - (1) Pump speed shall be controlled in response to wet well level.
    - (2) Provide pressure sensor on the discharge piping.
6. Include contacts to operate the pumps across the line in the event that the variable frequency drives fail. The alarm system will notify the operators of a variable frequency drive failure and the drives must be switched to the across the line contacts manually. The pumps can be started sequentially in the

across the line mode of operation. Evaluate other means of providing variable frequency drive backup when motor horsepower exceeds 200 HP. In all cases, investigate the capacity of the local power grid to accommodate the across the line motor starting.