A.C.0 Mechanical Design

A.C.1 Pump Station General Information

The two pumping stations are significantly different in size and complexity. For the purposes of this report, the stations shall be differentiated as small-sized and medium-sized. The small-sized pumping station (S-525B) has a total pumping capacity of less than 250 cubic feet per second (cfs) and includes no pumps that have a capacity of more than 75-cfs each. The medium-sized pumping station (S-525A) is defined as having at least one pump with a capacity greater than 75 cfs, and no pumps with a capacity greater than 450 cfs. The two pump station shall be designed in accordance with Hydraulic Institute Standards, EM 1110-2-3102 (General Principles of Pumping Station Design and Layout), and EM 1110-2-3105 (Mechanical and Electrical Design of Pumping Stations). The pumping stations will also follow the guidance of ETL 1110-2-313 (Hydraulic Design Guidance for Rectangular Sumps of Small Pumping Stations with Vertical Pumps and Ponded Approaches). The use of siphon discharges for the pumps at S-525A and S-525B shall be evaluated during preparation of the plans and specifications for the pumping station, and shall be based upon the required pumping heads and life cycle cost analysis.

It is assumed that axial flow or mixed flow pumps will be used for both of the pumping stations. All of the pumps will be water-lubricated. The small and medium sized pumping stations will be designed with vertical, axial flow pumps configured with either horizontal or siphon-type discharges. Pumping station criteria and information are located on **Table A.C-1,** Site 1 Impoundment Pump Station Information and Criteria. Plates M-1 through M-4 show section and plan views of typical medium-sized and small-sized pumping stations. Plate M-5 shows a representative section of a pumping station with a siphon-type discharge. Plate M-5 also shows a pump with an FSI (Formed Suction Intake) but because of the size of the pumps, FSIs will not be considered for these stations.

Table A.C-1: Site 1 Impoundment Pump Station Information and Criteria

Pump Station	Total Capacity (Cfs)	No. Of Pumps	Type Of Pump Drives	Flow Rate (Cfs)	Intake, Ngvd Min. Drawdown Pumping Level	Discharge, Ngvd Max. Discharge Pumping Level
S-525A	650	4	Diesel	150	5.25	18.0
S-525A	650	1	Electric	50	5.25	18.0
S-525B	150	2	Electric	75	6.5	18.0

Pump Station	Static Head	Total Head Pump Selection (In.)		Efficiency %	Engine Or Motor H.P.	*Discharge Type
S-525A	22.25	25.5	72	82.0	1350	Horizontal or Siphon Type
S-525B	15.0	18.2	36	80.0	250	Horizontal or Siphon Type

* Will be evaluated during design for selection.

A.C.2 Pump Station 525A

The S-525A pump station will be configured similar to that shown on Plates M-1 and M-2. This medium-sized pump station will have the following features:

A.C.2.1 Pumps: Pumping Capacity, Pump Sizes, and General Information

The medium-sized pump station will have five pumping systems. The pumps will be axial-flow-type vertical-shaft pumps. Power to four pumps will be provided by diesel engines through right angle reduction gear drives. One pump will be powered by a directly-coupled electric motor. The diesel engine pump drives will be standard model, 2 or 4 cycle, with mechanical fuel injection, and keel cooler or heat exchanger cooling. The reduction gears will be designed for an application factor of 2.0 times the maximum input power. ***Table*** *A.C.1* lists the number of pumps, the capacities of the pumps, the drives, etc., for the pump station.

Plates M-1 and M-2 represent a five-bay pumping station, that may be similar to a designed S-525A. The pumps at this pump station are expected to run at less than 500 rpm with efficiency greater than 80%. The diesel engine pump drives will be approximately 600 horsepower each.

This medium-sized pumping station will include various support items including the following:

1. Diesel fuel system, including vaulted double-wall aboveground fuel storage tanks capable of holding enough fuel to operate all of the engine driven pumps and the emergency generator continuously for 7 days. Day tanks shall be provided and sized to adequately supply the diesel engine pump drives and generator within the limitations of NFPA 37. The Florida Administrative Code (FAC) shall be followed in designing the fuel system for the pump station.
2. An overhead bridge-type electric crane/hoist will typically be used. The crane/hoist shall be capable of lifting and moving loads up to the heaviest loads in the pump station. The crane/hoist will handle pumping station equipment such as the diesel engine pump drives, reduction gears, and the pumps during initial installation, as well as for general service thereafter.
3. Toilet facility with a water closet and a lavatory.
4. Kitchen-type sink.
5. Potable water system and a septic system for the plumbing fixtures.
6. Ventilation system to provide fresh air in the pump bays, generator area, and toilet room.
7. Air-conditioning system for the office.
8. Stilling wells containing float switches to be used for pump operations and water level monitoring.
9. Control systems for the engine pump drives. These systems shall be as described in the Electrical Design section below.

10. An emergency generator to supply power to the engine auxiliaries and station electrical equipment during commercial power outages. This will include providing power for the lights, ventilation fans, trash rake, etc. (Note: Emergency/back-up power will not be provided to the electric motor-driven pump.)
11. During the detailed design, the designer shall coordinate with local and state authorities to ensure that the various permits (air, fuel, etc.) are all adequately addressed.

The pumps for this medium-sized pump station will be designed with bell intakes and may include siphon discharges. A representative section of a pump station with a siphon discharge is shown on Plate M-5.

In order to reduce the engine size and horsepower (and fuel) required to overcome the head on the large pumps, siphoning discharge systems may be used. If a siphon discharge system is used, priming may be accomplished by means of a station vacuum system; however, with the impeller submerged as shown and depending on the characteristics of the equipment offered, the pumping systems should be capable of being self-priming in an emergency. During self-priming, the engine pump drives may be subjected to momentary overload. Again, the design decision on whether to use siphon discharges for the larger pumps in this medium-sized pumping station will be based on comparing the increased construction costs with potential savings on the cost of the diesel engine pump drives and the lower fuel requirements over the life-cycle of the pumping station. Backflow prevention means shall be evaluated during the design phase.

For discharge pipes that will be below high water levels, a second means of preventing backflow will also be incorporated. The discharge pipes will have their upper invert elevation (summit) above the high water level on the discharge side. The siphon would then self-break.

During design development the discharge arrangement will be selected based on a life cycle cost analysis of the operational and construction costs.

A.C.2.2 Trash Rake

Trash rake/rack system will be an automatic, continuously rolling, flex rake and trash rack system such as that manufactured by Duperon.

A.C.3 Pump Station 525B

The S-525B pump station will be configured similar to that shown on Plates M-3 and M-4. This small-sized pump station will have the following features:

The small-sized pump station will have about two pumping systems. The pumps will be axial-flow-type vertical-shaft pumps. Power to the pumps will be provided by direct-drive electric motors. ***Table*** *A.C.1* lists the number of pumps, the capacities of the pumps, the drives, etc., for the pump station.

Plates M-3 and M-4 depict a two-bay pump station, that may be similar to a designed S-525B. The pumps are expected to run at no less than 600 rpm with an efficiency of about 80%. The pump drives should be about 250 horsepower each for a 75 cfs flow rate.

This small-sized pump station will include various support items including the following:

1. Hoisting system for maintenance or repair of the pumping equipment.
2. Ventilation system to provide fresh air in the pump bays.
3. Stilling wells containing float switches to be used for pump operations and water level monitoring.
4. Trash rake/rack system will be an automatic, continuously rolling, flex rake and trash rack system such as that manufactured by Duperon.
5. Control systems for the electric motor pump drives. These systems shall be as described in the Electrical Design section below.

A.C.4 Gated Culverts

A.C.4.1 Operating Mechanism

The culvert gate will be a commercially available self-contained aluminum gate unit similar to those manufactured by Waterman Industries, Inc. An electric operator will operate the rising stem of design suitable for attaching to a concrete bulkhead. The electric operator will include, but not be limited to, the motor, actuator unit gearing, limit switch gearing, position limit switches, torque switches, stem nut, declutch lever, high precision gate position potentiometer, and handwheel as a self-contained unit. The actuator will have sufficient capacity to raise or lower the gate at a speed of 6-inch/min against the operating heads. The handwheel will operate in the clockwise direction to close. External declutch lever will be padlockable in either the manual (handwheel) or motor mode.