US Army Corps
of Engineers
Portland District

SYSTEM OPERATION AND MAINTENANCE MANUAL

FOSTER DAM AND RESERVOIR
ADULT FISH FACILITY UPGRADE
WILLAMETTE RIVER BASIN
MIDDLE & SOUTH SANTIAM RIVER

September 14, 2016 **DRAFT FINAL**

SYSTEM OPERATION AND MAINTENANCE MANUAL CONTENTS

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Abbreviations and Acronyms

- ATS Automatic Transfer Switch
- AWS Auxiliary Water Supply
- CFS Cubic Feet per Second
- FCV Flow Control Valve
- FIT Flow Indicating Transmitter
- FWS Facility Water Supply
- GAC Granular Activated Carbon
- HMI Human Machine Interface (Graphic Terminal)
- HOA Hand-Off-Auto Selector Switch
- ICS Industrial Control System
- IPS Intake and Pump Structure
- LT Level Transmitter
- LOA Local-Off-Remote Selector Switch
- LSR Local-Stop-Remote Selector Switch
- NOAA National Oceanic and Atmospheric Administration
- O&M Operation and Maintenance
- PLC Programmable Logic Controller
- PM Preventative Maintenance
- SCADA Supervisory Control and Data Acquisition
- SOMM System Operation and Maintenance Manual
- VFD Variable Frequency Drive
- WSEL Water Surface Elevation

1. Chapter 1: General Information

Purpose and Scope

ODFW and the Willamette Project will be responsible for the operation and maintenance of the Foster Dam and Reservoir Adult Fish Facility Upgrade. The new facility is a complex system with many interacting mechanical, electrical, and structural components. In addition, the hydraulic performance must be carefully controlled so that the system operation meets NOAA Fisheries criteria and provides effective fish passage. The System Operation and Maintenance manual provides the necessary guidance in the general system operation and describes the specific operation and maintenance of each component in the system.

1.1. Parts of the Manual

There are seven chapters in this manual including:

1. General Information
2. System Description
3. Theory of Operation
4. Operations
5. Preventative Maintenance
6. Trouble Analysis
7. Corrective Maintenance and Checkout Procedures

Appendices include:

A. Special Tools and Test Equipment List
B. Repair Parts List
C. Vendor Data/Acceptance Tests
D. Warranty Data Information
E. Master Equipment List
F. As-Built Drawings
G. Contractor's O&M Manuals

1.2. Project Description

Foster Dam is located 34 air miles northeast of Eugene, Oregon, on the South Santiam River, which is a tributary of the Willamette River. The dam is located at river mile 37.9 on the South Santiam River.

The Foster Adult Fish Facility includes the following major features:

a. Fish ladder system including:
    i. Pools separated by weirs and orifices

ii. Two fish ladder entrance locations, each with an entrance gate

iii. AWS pump system and floor diffusers

iv. Transport channel (with telescoping weir) separating lower and upper fish ladder

b. Pre-sort pool including:

i. Finger weir, crowder, brail, and false weir

c. Sort Facility including:

i. Mechanical/electrical room and storage

ii. Fish flume and switch gates

iii. Anesthetic tank

iv. Sort table

v. Recovery tank

vi. Fish transport pipes including return to river pipe

d. Post-sort pools including:

i. Nine post-sort pools

1. Four short term ponds

2. Five long term ponds

ii. Common crowding channel with crowder, and hopper pit, and fish lock

iii. Two drain channels

1. Short term pond drain channel

2. Long term pond drain channel

e. Water Supply System including:

i. Gravity forebay water supply (FWS) System

1. Forebay intake trash rack

2. Piping and valving to headbox

3. Headbox

4. Piping from headbox to pre-sort pool, post-sort pools, flumes, etc.

ii. Pumped auxiliary water supply (AWS) system

1. Pump intake trash rack

2. Four AWS pumps

3. Piping and valves to existing conduits

4. Floor diffusers

f. Fish transfer and loading equipment including:

i. Hopper crane

ii. Hopper loading structure

iii. Fish hopper

iv. Fish truck

v. Fish lock brail

g. Drainage System

i. Piping and manholes

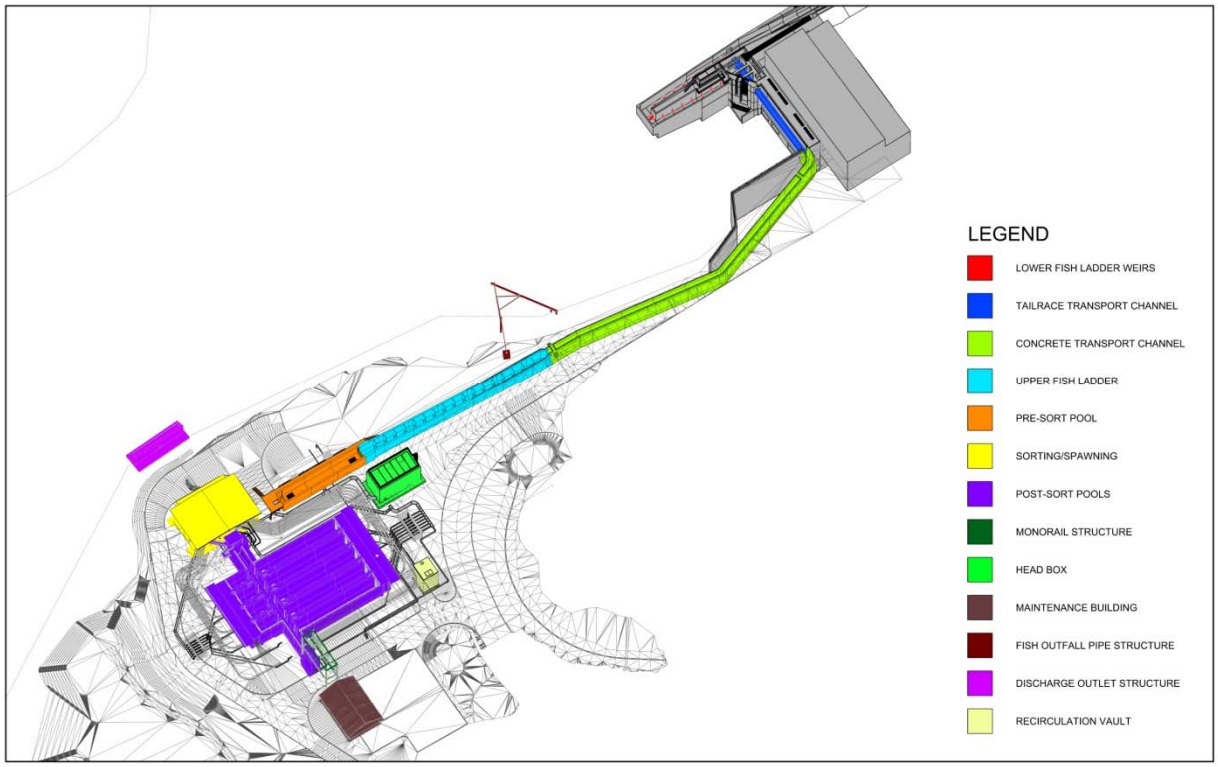
ii. Drainage outfall structure

h. Ancillary buildings including:

i. Office/Maintenance building, site host, two shade structures, chemical storage building

2. Chapter 2: System Description

2.1. Project Description



2.2. FISH LADDER

The fish ladder guides fish from the Project tailrace and stilling basin to the fish collection facility Presort Pool. This fish ladder is constructed of reinforced concrete. There are two fish ladder entrances: the main entrance (pool 1) discharges to the Powerhouse tailrace and the side entrance discharges to a spillway stilling basin. In raising the fish from pool 1 to the presort pool, the fish ladder consists of three main segments: the modified existing lower ladder, the transport channel, and the new upper ladder segment connecting to the Presort Pool. The ladder consists of 35 pools separated by 33 weirs total. The weir sections of ladder are approximately a 340-foot long in total and the invert is sloped at 1 on 10 feet, rising 33.9-feet from pool 1 to the presort pool. Connecting the two ladder segments, the transport channel is a horizontal section 494 feet long. Discharge down the ladder starts at the top from the pre-sort pool and steps down from pool 35 to pool 1 and releases out the entrances to the tailrace and stilling basin. The gravity Forebay Water Supply (FWS) System supplies the pre-sort pool and upper ladder flow (about 30 cfs). The auxiliary water system (AWS) pumps fish attraction water at 45-180 cfs to the lower ladder diffuser system to amend entrance flows. Figure 2-X and Figure 2-Y present flow schematic diagrams for the forebay water, auxiliary water, and fish ladder systems (see drawings M-608 and M-609).

2.2.1. Fish Ladder Entrance

The fish ladder has two entrance areas with one entrance gate at each location (see drawing MB510):

1. Main entrance (pool 1) is located at the north side of Powerhouse tailrace;
2. Side Entrance is located in the south wall of the spillway stilling basin.

The side entrance is not operated during large spill operations or when the water reservoir is low. The entrance opening invert elevation at both locations is 522.6 NAVD 88. The original 64-foot long transportation channel connects the side entrance with pool 1 and the main entrance. The base of the lower fish ladder weirs start from the west side of pool 1.

2.2.1.1. Fish Entrance Gates

The entrance gates consist of orifice openings that operate as weirs and are raised to close off the entrance. The invert of the opening will typically be operated to maintain a differential between the upstream and downstream water surfaces as established by operator entered setpoints. A fish barrier Picket Gate can be positioned in a slot upstream of each fish entrance gate to exclude fish when maintenance is being conducted. Access to the entrance gate machinery is located on the tailrace deck for the main entrance and on a platform above the spillway for the side entrance. The entrance gates are coated carbon steel slide plates that are moved by electrically-operated, wire-rope drum hoists. The

position of the gates will be modulated automatically by the facility control system to maintain the water differential setting.

2.2.1.1.1. Main Entrance Gates

The main entrance gate has an opening of 5 feet wide x 9 feet high (see drawings MB512 and MB513). The main entrance gate is designed for a water surface differential operating range of between 6 inches and 2 feet but normally 1 foot. The invert of the main entrance gate orifice can range between entrance invert 522.6 up to 532 feet, but will typically operate between 525 and 531. The entrance gate is designed to function as a submerged weir.

2.2.1.1.2. Side Entrance Gate

The side entrance gate has an opening of 4 feet wide x 9 feet high (see drawings MB515 and MB516). The side entrance gate is designed for a water surface differential operating range of between 6 inches and 2 feet but normally 9 inches. The invert of the side entrance gate orifice can range between entrance invert 522.6 up to 532 feet, but will typically operate between 525 and 531.

2.2.1.1.3. Telescoping Weir (Transportation Channel Gate)

The transportation channel gate consists of two adjacent, overlapping and interconnected weir plates, an "upper leaf" and "lower leaf", which telescope into position (see drawings MB510 and MB511). The gate and channel are 5 feet wide with a 39-inch high concrete weir wall on the upstream side of the gate. The transportation channel gate is designed for a water surface differential operating range of between 0 inches and 2 feet but normally 3 inches. The invert of the gate can range between channel weir invert 525.83 up to 535.83 feet, but will typically operate between 526 and 534. Similar to the entrance gates, the invert of the weir gate will typically be automatically modulated to maintain a differential between the upstream and downstream water surfaces as established by the operator entered setpoint.

2.2.1.1.4. Gate Hoisting Systems

New gate hoisting systems have been provided for the main entrance, side entrance, and transportation channel gates. The hoisting systems consist of new electric, wire-rope drum hoists and new wire rope and hardware. Existing wire-rope sheaves were refurbished for reuse. The entrance gates are positioned in their

guides using wire ropes attached at the two top outer corners, which routes the wire ropes within the gate guide space, thus, avoiding the water flow path and fish passageway. For the main entrance gate, sheaves at the deck level translate the wire ropes horizontally for coiling on either end of the two-section hoist drum. For the side entrance gate, the two wire ropes are coiled directly onto tandem drums positioned over either side of the gate opening but operated by one hoist. For the transportation channel gate, two sets of sheaves at the deck ceiling level translate the wire ropes up and over from the gate slot to the either end of the two-section hoist drum at floor level. All hoists are electric-motor driven through a multi-turn, worm-gear actuator with manual handwheel for backup. The actuator incorporates electronic controls with user interface through the control mode (Local/Off/Remote) selector switch, pushbuttons, and digital display for configuring, monitoring, and troubleshooting the actuator. Actuator controls include position control and indication, data logging, indication lights, fault status, and diagnostics. The gate hoists will automatically modulate the position of the gates in response to control system input. Gates will be regulated by the control system to maintain the water surface differentials based on the level outputs from respective level sensors (tailrace, main entrance pool, and transportation channel) and the setpoints entered by operators.

2.2.1.1.5. Instrumentation

Entrance gate controls are based on water levels in the tailrace, pool 1, transportation channel, and stilling basin. New level elements were installed at the existing stilling wells located in a sump off of pool 1 and accessible from the pump room and at the side entrance (see drawings EC403, EC404, and EC501). The gates are controlled automatically based on the water level signals connected to the control system.

2.2.1.2. Fish Barrier Screens (Picket Gates)

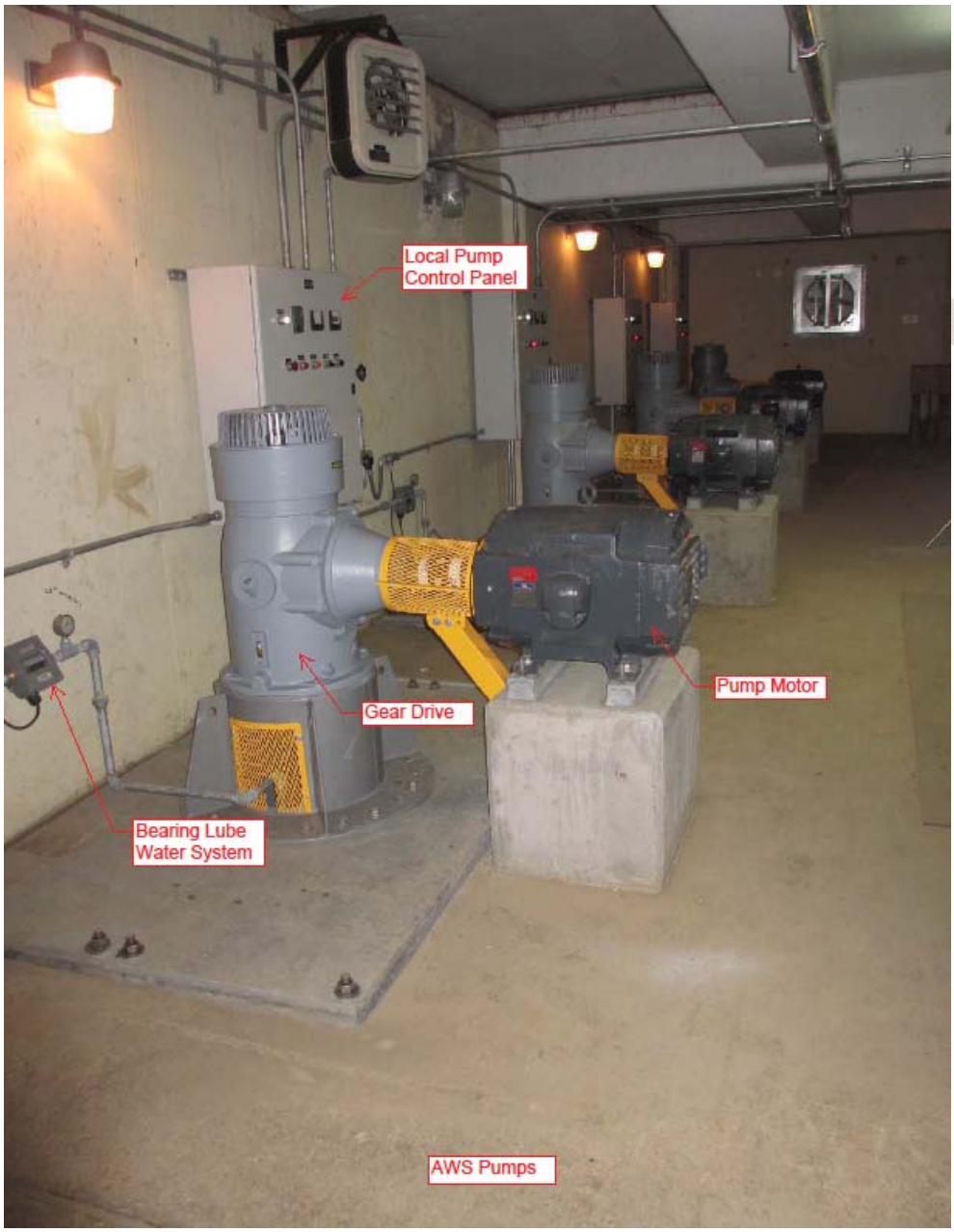
The picket gates are used to keep fish from entering the fish ladder during commissioning, start up, and shut down operations. The original 6-foot wide picket gate and lifting mechanism for the main entrance was refurbished during construction (see drawing MB514). A similar picket gate and lifting mechanism was installed for the side entrance. Each picket gate is raised and lowered by a manual winch-style hoist that is post-mounted at worker level.

2.2.2. Auxiliary Water Supply (AWS) System

The AWS system is supplied with tailrace water by the AWS pumps that discharge directly into the main entrance pool (pool 1) through diffusion grating in the floor. This fish attraction water amends the fish ladder flow with all flows exiting pool 1 through the main entrance gate and/or the side entrance gate.

2.2.2.1. AWS Pumps

There are four AWS pumps with approximately 45 cfs capacity per pump, or 180 cfs total. Each pump is installed in a separate pump bay fed by a common pump intake channel located below the pump bays (see drawings MB102 and MB301). Each pump has separate discharge piping including a cast iron flap gate check "valve" with the discharges commingled in the existing concrete AWS upper and lower supply channels.



There is a vacant fifth pump chamber with provisions for a potential additional 35 cfs pump as per the original facility design.

2.2.2.2. Pump Intake Screen

The pump intake trashrack is located under the main entrance and is designed to prevent debris and adult fish from entering the AWS pump system. The channel opening dimensions for the trashrack are 10 feet 6 inches wide by 10 feet 7 inches high. The screen openings are 5/8 inch with ¼ inch wide x 1.5 inch deep bars. There are two lifting eyes for removing the trashrack for maintenance purposes.

2.2.2.3. Pump Intake Channel and Sump

After passing through the trashrack, AWS flows are drawn through the pump intake channel located on the bottom level of the pumphouse. AWS flows pass up through openings in the bottom level ceiling to the pump intake level and turn horizontally into the pump bays. These passages were upgraded to improve the flow hydraulics and include horizontal and vertical vanes within each opening to better direct the flow to the pump intakes.

After removing the trashrack, a bulkhead can be inserted in the trashrack guides to seal off the channel. With the bulkhead in place, the pump intake and supply channels can be emptied through horizontal drains to a sump below the floatwells that can be drained to the Powerhouse.

2.2.2.4. Pump Intake Bays

The original pump bays were modified to address issues regarding non-conformance to Hydraulic Institute Standards for vertical pump intakes (see drawings MB501 through MB505). In addition to the turning vanes installed in the pump channel openings, each pump bay had fillets and a flow splitter with perforated vane installed to promote flow into the pump intake and reduce the potential for vortex formation.

2.2.2.5. Pump Discharge Piping and Flap Valves

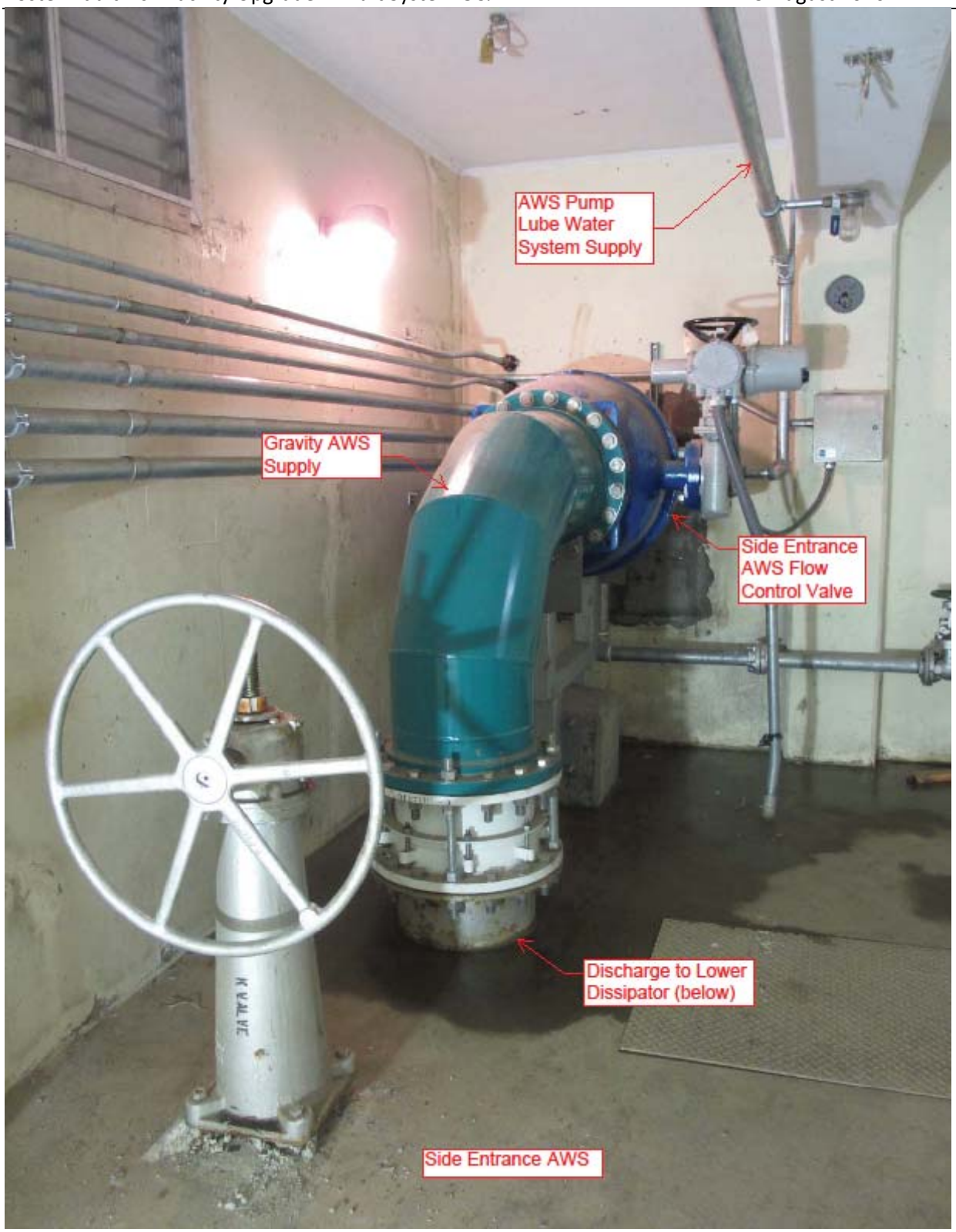
Each pump discharges through a 30-inch discharge pipe into one of the supply channels (Pump No. 1 into the upper supply channel; Pumps Nos. 2-4 into the lower supply channel). The discharge pipe connects to the pump discharge elbow with a restrained flexible pipe coupling at the upstream end. The other end is bolted to a steel closure plate that seals off the supply channel wall opening while providing a solid surface for mounting the discharge flap gate, which prevents backflow into non-operating pumps.

2.2.2.6. AWS Conduits and Diffusion Chamber

The pumped AWS flow passes through the supply channels and discharges into the diffusion chamber below the floor diffuser screen in pool 1. The upper supply channel discharges into the east side of the north wall of the diffusion chamber. The lower supply channel discharges both into the west side of the north wall and the east wall of the diffusion chamber.

2.2.2.7. Gravity AWS to Side Entrance

Attraction water is also supplied directly to the side entrance from the dedicated 24-inch gravity FWS, also called AWS, supply pipe (see below). The flow from this pipe (0 - 58 cfs) ultimately discharges through diffuser screens into the transportation channel on the upstream side of the side entrance Gate and amends the flow coming from pool 1 over the transportation channel gate.


AWS Pump
Lube Water
System Supply
Gravity AWS
Supply
Side Entrance
AWS Flow
Control Valve
Discharge to Lower
Dissipator (below)
Side Entrance AWS

2.2.2.8. AWS Diffuser Screens

The AWS diffuser screens are located flush along the floor of the main entrance pool above the diffusion chamber and in the floor and sidewall at the side entrance. The screens are intended to prevent fish from entering the AWS diffusion basins and to provide a uniform discharge of auxiliary water into the ladder system. The diffuser screens are constructed of stainless steel and have 0.75 inch clear openings.

2.2.2.9. Other AWS Features (Filling Valve, Heavy Duty Flap Gate, etc.)

The AWS system includes other features within the pumphouse such as a heavy duty flap gate located in the vertical wall between the pump intake channel and the lower supply channel (see drawing MB506). The flap gate serves to equalize the water pressure across this wall by allowing flow to pass into the lower supply channel when filling or dewatering the pumphouse. The flap gate is normally held closed due to head differential since the water level in the supply channel is intended to be maintained one foot higher than the pump intake side.

The pumphouse filling gate ("Valve J") is located in the west wall of the Lower (energy) Dissipator (see drawings MB102 and MB301) and is intended to be used to fill the pumphouse with the AWS gravity water after a shutdown. The motorized actuator is located in the southeast corner of the pump room with pushbutton controls on the actuator and is powered from MCC DQ2 in the room.

The side entrance bypass gate ("Valve K") is also located in the north end of the west wall of the Lower Dissipator and is intended to redirect the AWS gravity water from the side entrance to the main entrance via a passage into the lower supply channel. The manual crank operator is located in the northeast corner of the pump room.

The 20-inch, gravity AWS supply pipe in the pump room includes two taps for (1) supplying reservoir water to the pump bearing lubrication water system for the lineshaft bearings and (2) serving as a backup water supply to the Powerhouse water system.

2.2.2.10. Instrumentation

AWS Pump controls are based primarily on the water level in the tailrace. A new level element for the tailrace water level was installed in an existing stilling well located in a sump off of pool 1 and accessible from the pump room (see drawings EC403 and EC501). A new level element for the pumphouse water level was also installed in an existing stilling well pipe located in the pump room (see drawing EC403).

2.2.2.11. Follow on Contract Features

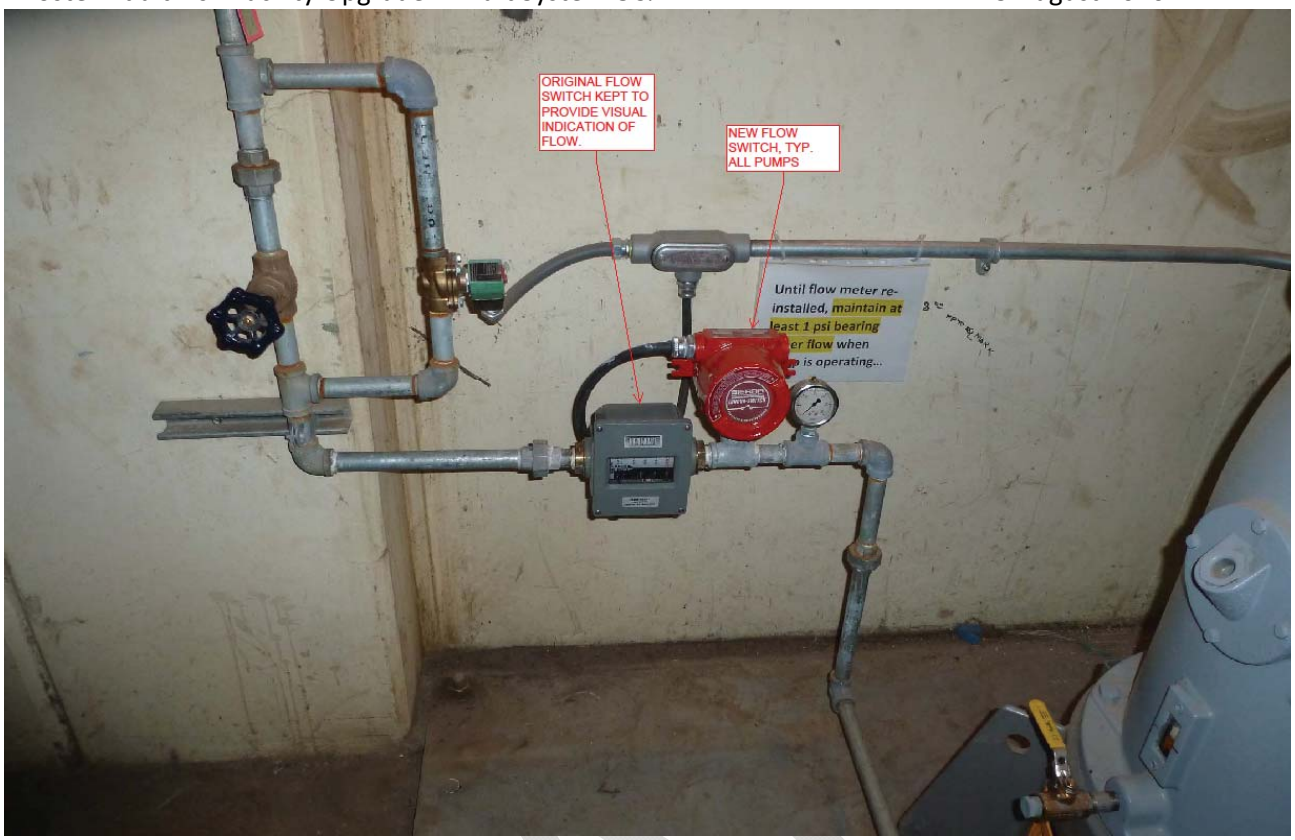
As part of the Follow on Contract, several features of the Auxiliary Water Supply System have been modified. Changes included adding sound absorbing materials in the pump room in order to reduce noise levels in the room, adding an orifice plate to the Gravity AWS Supply Pipe in order to suppress cavitation downstream of the Side Entrance AWS Flow Control Valve, adding a tee and valve in order to ease draining the Gravity AWS Supply Pipe, adding strainer baskets to the AWS Pump Lubrication Water Supply in order to reduce debris loading on the pump bearings, adding new flow switches to the AWS Pump Lubrication Water supplies because previous switches were not reliable.


SOUND ABSORBING MATERIAL ON WALLS
SOUND ABSORBING INSULATION ON GRAVITY AWS PIPE


EXISTING POWERHOUSE COOLING WATER BACKUP SUPPLY
NEW GLOBE VALVE AND GRAVITY AWS SUPPLY PIPE DRAIN. DRAINS TO AERATION CHAMBER


STRAINER BASKET ISOLATION VALVES
STRAINER BASKET BYPASS VALVE
AWS PUMP LUBRICATION WATER SUPPLY PIPE
STRAINER BASKET RETURN PIPE
STRAINER BASKET SUPPLY PIPE


STRAINER BASKET RETURN PIPE
STRAINER BASKET SUPPLY PIPE
DIFFERENTIAL PRESSURE TRANSMITTER
DUPLEX STRAINER BASKETS; ONE CAN BE IN SERVICE WHILE THE OTHER IS BEING CLEANED



2.2.3. **Transport Channel**

The new transport channel is the horizontal connection between the lower and upper fish ladder sections for fish travelling upstream to the Fish Facility. The total length is approximately 494 feet long. The channel is 3 feet wide with walls 8 feet high. From the lower ladder transition at pool 17, the transport channel extends 110.5 feet across the Powerhouse tailrace. The remainder of the transport channel runs overland to connect to the Upper Fishladder section. The invert of the transport channel is 539.7 feet NAVD 88. The channel conveys 30 cfs and the design velocity in the channel is about 2 ft/s with an approximate flow depth of 5 feet.

2.2.4. **Ladder Weirs and Orifices**

The fish ladder channel is 8 feet wide. There are 35 pools separated by 33 ladder weirs. Each ladder weir has a 4-foot, 5-inch long non-overflow weir and a 3-foot, 7-inch long overflow weir located between the fishway pools. A 12-inch wide by 15-inch tall orifice is located on the floor beneath the overflow section. The weir and orifice are constructed of reinforced concrete. The orifice opening is rounded to assist lamprey passage. The crest of the overflow weir is 6-feet above the invert and the non-overflow crest is 2-feet above the overflow crest. The weirs are spaced at 10 foot centers from pool to pool and the ladder invert is sloped at 1 vertical to 10 horizontal. The elevation difference between the crest of the weirs up

the ladder is 1.0-feet. The gravity system (via headbox and presort) must discharge about 30-cfs to maintain 1.0-foot ladder head (design criteria).

2.2.4.1. Lower Ladder

For fish travelling up the ladder, the lower ladder starts from pool 1 (main entrance pool) and Weir 528.6 NAVD 88 (525 NGVD 29 as shown on original as-builts) and terminates at Weir 543.6 NAVD 88 (540 NGVD 29 as shown on original as-builts) and pool 17. The lower ladder has 16 weirs. At pool 17 at the top, the ladder transitions to the tailrace transport channel. Between Weirs 528.6-543.6, the original weirs were replaced with new weirs with the dimensions described above. The positions of the overflow sections in the weirs were switched from the inside to the outside of the channel (or north adjacent to the spillway

stilling basin) to improve the flow characteristics in the transition and bend into the transport channel and in the two existing 90 degree bends. The design flow is 30 cfs with 1 foot head drop between pools.

2.2.4.2. Upper Ladder

For fish travelling up the ladder, the upper ladder guides the fish from the transport channel to the pre-sort pool. The upper ladder starts from pool 19 (transition from transport channel) and Weir 544.7 (NAVD 88) and terminates at Weir 560.7 (NAVD 88) and Pool 35. The upper ladder has 17 weirs. At Pool 35 at the top, the ladder transitions to the pre-sort pool. The design flow is 30 cfs with 1 foot head drop between pools.

2.2.5. Pool 35 – Ladder Head Control with Level Sensor

A level Sensor LT-008 is located in pool 35 between the Finger weir for the pre-sort pool and Weir 560.7 (uppermost weir in fishladder system). The sensor records the water surface elevation in pool 35 to monitor the fishladder head (difference in water surface and overflow weir crest elevations). The PLC will monitor the ladder head from LT-008 to assure that the 1.0 foot ladder head criteria is being maintained within ±0.1 feet tolerence.

2.3. GRAVITY FOREBAY WATER SUPPLY SYSTEM

The Forebay Water Supply (FWS) System provides reservoir water to various demands associated with the Adult Fish Facility, including the fish ladder, and Auxiliary Water System (AWS) through a pair of gravity supply pipes. There are two existing FWS intakes in the dam structure, an upper and lower intake, in the north wall of Penstock No. 2 that route water through two existing supply pipes through the valve room located at EL 591.65 feet (see drawings MA102 and MA301). A vertical trashrack is mounted in guides in front of the intakes for screening the reservoir water (see drawing MA510). The valve room provides for manual isolation and monitoring (temperature and pressure) of the two supply pipes. The upper supply is routed through a 24-inch pipe to serve as attraction water for the side entrance. The lower supply, which conveys the colder temperature water, is routed through a 36-inch pipe to meet demands at the fish facility.

Both pipes are routed through the valve room and down the hopper well to the former holding pool room at EL 573.58 feet where flowmeters are installed with proper straight runs of pipe upstream and downstream (see drawing MA302). The two pipes are buried below the driveway adjacent to the fish ladder structure from the base of the dam down to the vicinity of the Power House where the 24-inch FWS pipe reduces in size and extends into the pump room (see drawing MA502). The flow in this pipe is automatically regulated by a 20-inch rubber-seated ball valve to maintain the flow as monitored by the flowmeter (FIT-002) just outside the holding pool room and in accordance with the control system setpoint.

The 36-inch FWS pipe continues past the east and south sides of the Power House and eventually parallels the upper fish ladder to the Adult Fish Facility. Just upstream of the Headbox (see drawings MA508 and MA509), the pipe is routed through a buried vault where a 24-inch rubber-seated ball valve automatically regulates water flow to maintain the water level in the Headbox in accordance with the control system setpoint (see drawing MA505). Flow into the Headbox is split into ten vertical branches, five on either side, that include manual butterfly valves for adjusting individual pipe flow rates (see drawings MA508 and MP401). At the top of the Headbox, each pipe elbows down to discharge into the top of a packed column to degas and aerate the water supply.

2.2.6. Forebay Intake Screen

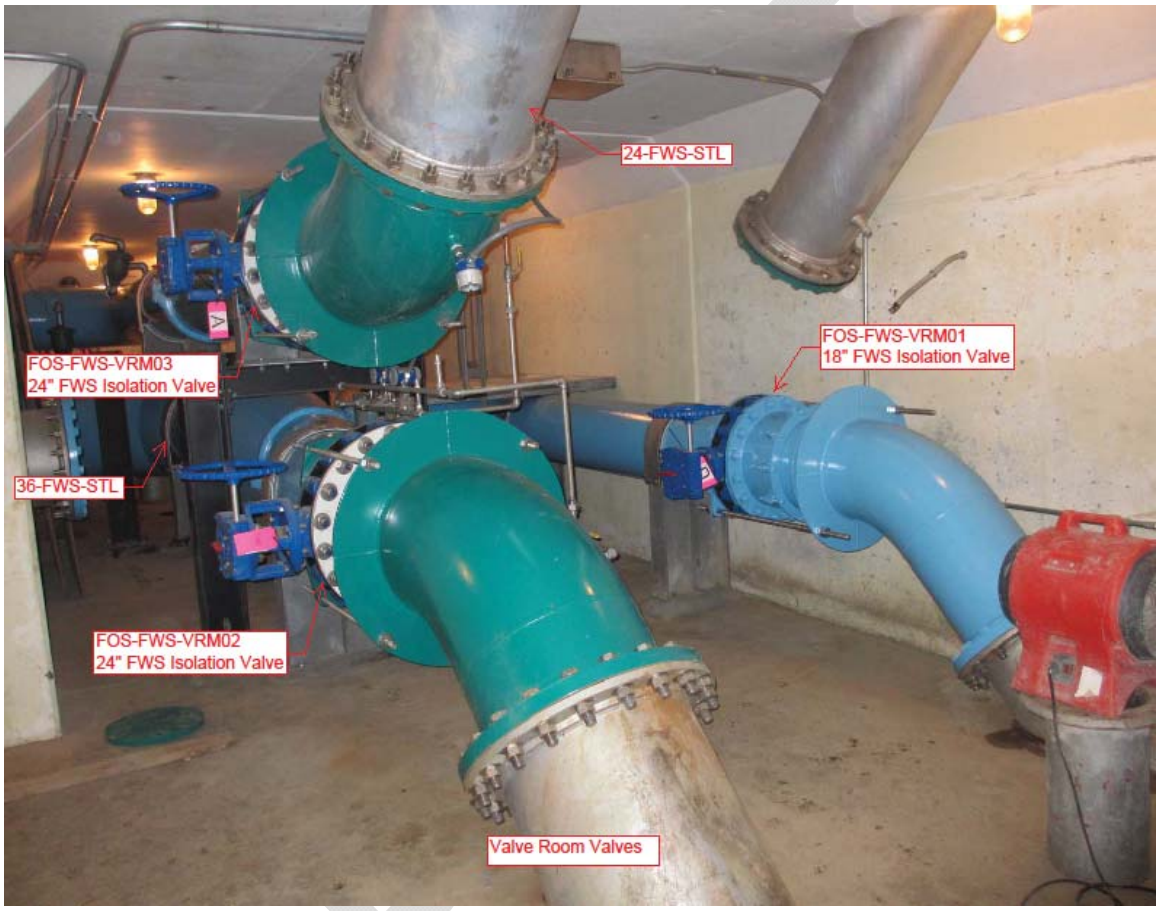
The forebay intake screen for the FWS system is roughly 6 feet wide by 20 feet tall and consists of multiple grating panels with 1½ ”x 3/16” bars set at 15/16” spacing. The trashrack is carbon steel construction that has been hot-dip galvanized and then coated with fusion-bonded epoxy powder coat. The structural frame allows for crane removal of the intake screen using the lifting lug that is extended to dam deck level with a steel alloy chain. The control system estimates the head loss across the trashrack by comparing the pressure values in the FWS pipes to the reservoir water surface elevation value, established by level transmitters (pressure transducers) mounted in the pipes and forebay.

2.2.7. Forebay Intake Bulkhead

A forebay intake bulkhead was fabricated by the Contractor for the project and is available for sealing off the two water intakes from the reservoir. To install the bulkhead (actually two pieces), the trashrack has to be removed first since they share the same guides and dive work is required.

2.2.8. Valve Room

The valve room provides for manual isolation and monitoring of the two FWS supplies (see drawings MA102 and MA301). The upper supply is routed through a 24-inch pipe to serve as attraction water for the side entrance. The lower supply, which conveys the colder temperature water, is routed through a 36-inch pipe to meet demands at the adult fish facility. The original upper and lower FWS supplies extend into the valve room from the ceiling and floor, respectively, as two pairs of 18-inch and 24-inch pipes.



2.2.8.1. Valves

The upper supply is extended off of the existing 24-inch pipe with a manual butterfly valve provided for isolation. The existing 18-inch upper supply is decommissioned at a blind flange. The lower supply is extended off of both the existing 18-inch and 24-inch pipes with individual manual butterfly valves provided for isolation and then manifolded together as the 36-inch FWS pipe. An automatic air/vacuum release valve is located at the high point of both FWS pipes.

2.2.8.2. Instrumentation

The upper 24-inch FWS pipe includes temperature and pressure sensors for monitoring the water supply. The existing lower 18-inch pipe includes a temperature sensor and the lower 24-inch FWS pipe includes a pressure sensor for monitoring the water supply.

2.2.8.3. Follow on Contract Features

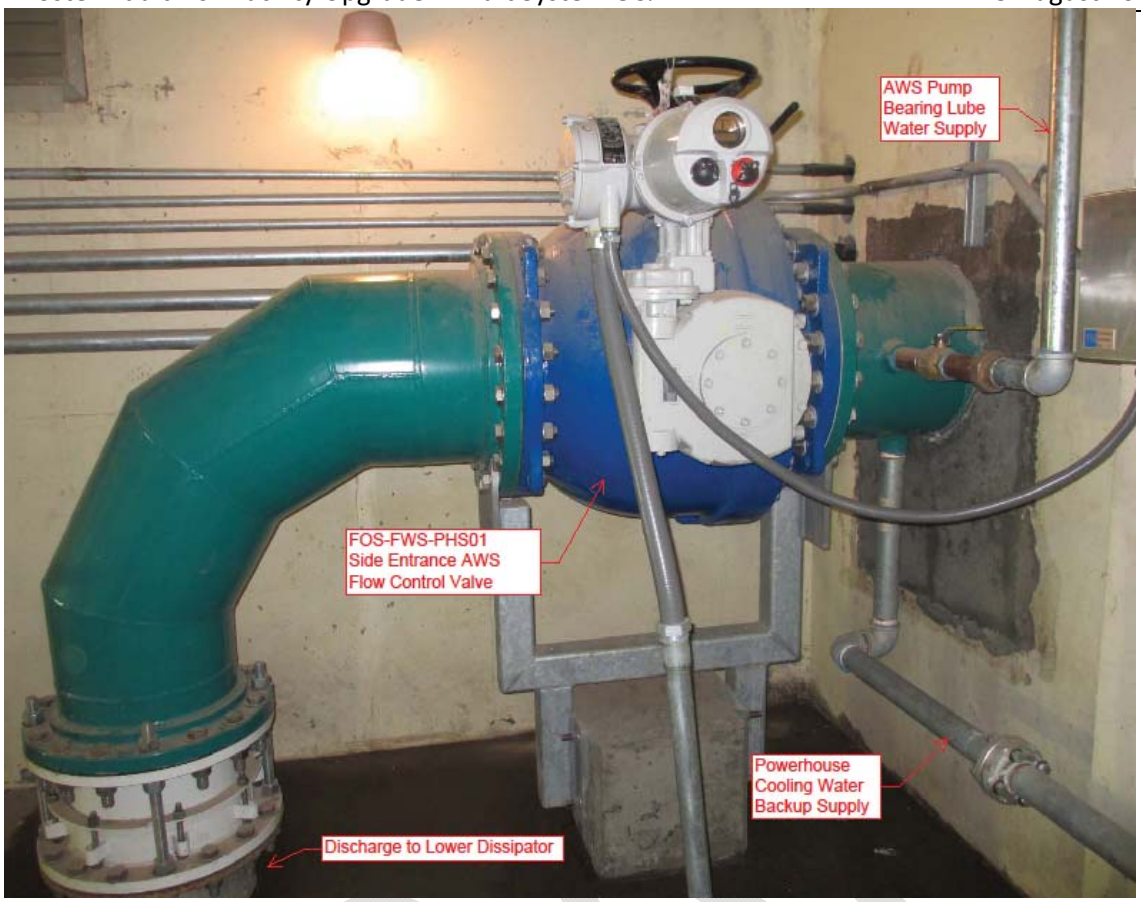
A safety cage was added around the instrumentation piping in order to prevent accidental contact with and subsequent damage to the piping.

2.2.9. Piping to Side Entrance (AWS)

The 24-inch FWS pipe is routed to the side entrance to serve as a gravity attraction water supply. The buried FWS pipe daylights into the pump room where it passes through a flow control valve before discharging through the floor into the Lower Dissipater (see drawings MB102 and MB301). The water flows through an aerator section before passing up through diffusion grating into the transportation channel just upstream of the side entrance gate. This flow can also be directed to either fill the pumphouse or bypass the side entrance and supply attraction water to the main entrance (see Other AWS Features above). After the system was initially put into operation, significant cavitation was observed downstream of the flow control valve in the vicinity of the mitered elbow. As part of the follow on contract, an orifice plate was designed and installed between the new dismantling joint and the existing embedded pipe in order to raise backpressure and suppress the cavitation.

2.2.9.1. Side Entrance AWS Control Valve (FOS-FWS- PHS01)

The flow control valve in the pump room is designed to regulate the flow to the side entrance up to 58 cfs. A 20-inch rubber-seated ball valve is used to automatically regulate the flow rate as monitored by the flowmeter (FIT-002) just outside the holding pool room and in accordance with the plant control system setpoint.



2.2.9.2. Instrumentation

A magnetic flowmeter (FIT-002) is provided in the 24-inch FWS pipe just outside the holding pool room for monitoring and control purposes. The flow signal will be used by the plant control system to regulate the flow control valve position to maintain the established flow rate setpoint.

2.2.9.3. Cathodic Protection

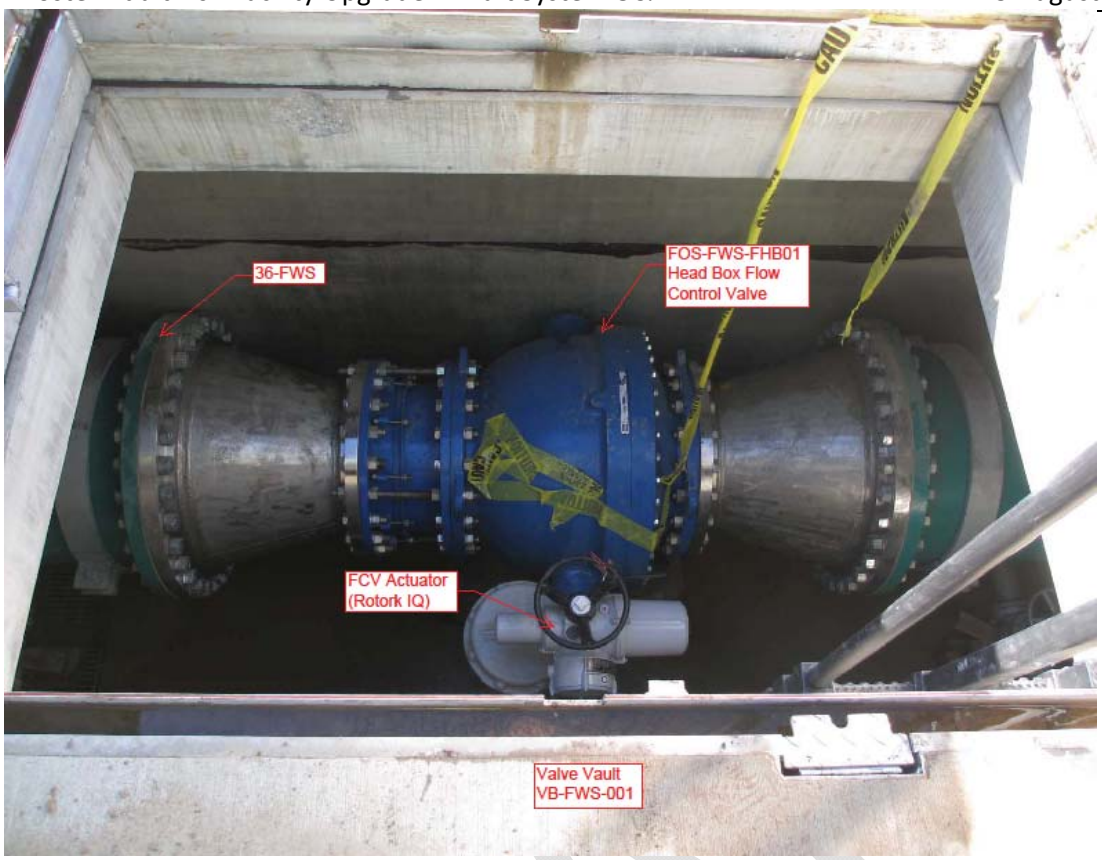
All FWS piping is provided with protective internal and external coatings with System 29, fusion-bonded epoxy. Buried FWS piping is constructed with bonded joints the length of the pipeline and isolation flange joints along with cathodic protection test stations at each end (see drawings MA504, MA508, and MA509). Sacrificial galvanic anodes are installed every 40 feet between the test stations.

2.2.10. Piping to Headbox (FWS)

The 36-inch FWS pipe is routed to the Headbox at the Adult Fish Facility. Upstream of the Headbox, the pipe enters a buried vault where flow passes through a flow control valve that automatically regulates the flow rate to maintain a defined water level in the Headbox (see drawing MA505). The 36-inch splits to supply both sides of the Headbox and branches into ten 14-inch supplies (see drawing MP401). The smaller supplies extend up to the top of the Headbox before elbowing down to discharge into the top of a ten packed columns that degas and aerate the water supply to the fish facility.

2.2.10.1. Headbox Control Valve (FOS-FWS- FHB01)

In the FWS valve vault, a 24-inch rubber-seated ball valve automatically regulates the flow to maintain the water level in the Head Box in accordance with the plant control system level setpoint. A constant water level in the Headbox is desirable for providing a consistent water pressure to demands at the fish facility.



2.2.10.2. Headbox Supply Isolation Valves

Where the 36-inch FWS reduces down to the ten vertical branches, a manual butterfly valve is provided at ground level for adjusting individual flow rates to the packed columns.

2.2.10.3. Instrumentation

A magnetic flowmeter (FIT-001) is provided in the 36-inch FWS pipe just outside the holding pool room for monitoring and control purposes. The flow signal will be monitored by the plant control system and will be used to initiate warning alarms and constrain valve travel if the maximum flow setpoints is reached.

2.2.10.4. Cathodic Protection

All FWS piping is provided with protective internal and external coatings with System 29, fusion-bonded epoxy. Buried FWS piping is constructed with bonded joints the length of the pipeline and isolation flange joints along with cathodic protection test stations at each end. Sacrificial galvanic anodes are installed every 40 feet between the test stations.

2.3. HEADBOX

2.3.1. General Description

The Headbox is a small reinforced concrete water reservoir maintained at a constant water surface elevation for providing a consistent water pressure to demands at the fish facility (see drawing MP401). The water flow to the Headbox is regulated by the upstream flow control valve to essentially match the rate that water is withdrawn from the Headbox (see drawing MA505). To promote fish viability, the quality of the fish facility water supply is improved by passing the reservoir water through packed columns to degas and aerate the water. There are ten columns located on top of the Headbox with individual water supply pipes (see drawing MP402). Each water supply pipe includes a manual butterfly valve for adjusting the water flow to each column given slight variability in piping friction losses.

2.3.2. Packed Columns

The columns (3’ diameter by 5’ tall) are filled with plastic packing media that provides relatively large surface area for promoting gas transfer in the falling water to reduce nitrogen and increase oxygen concentrations. The columns are fabricated of corrugated aluminum pipe with 1-inch aluminum grate lids for retaining the media and helping to distribute the water across the surface.

2.3.3. Instrumentation

A level sensor (LT-007) is provided for control of the headbox flow control valve and is located inside the Headbox (see drawing EF401).

2.3.4. Slide Gates

Stainless steel slide gates have been installed on the interior of the headbox over both of the FWDS supply outlet pipes. These slide gates allow each branch of the FWDS to be isolated independently so that the entire facility and headbox does not need to be dewatered in order to perform certain maintenance tasks at specific parts of the facility. The slide gates are electrically actuated.

2.4. PRE-SORT POOL

Fish jump from the fish ladder, over a finger weir, into the pre-sort pool. The 83-foot long, 13-foot wide,

15-foot tall pre-sort pool is constructed of reinforced concrete. (Normal Operating water volume dimensions are 80-feet by 10-feet wide by 6 feet deep, or 4800 cubic feet.) There is one contraction joint located at the center of the pre-sort pool. The pre-sort pool is sized to hold a maximum of 750 adult fish. Water is supplied to the pre-sort pool through two floor diffusers. During normal operation, the water is 6-feet deep. If water supply is disrupted, the pre-sort pool will maintain 5-feet of depth (as long as the pre-sort valves are closed). The freeboard is to be about 4.3 feet during normal operations.

The design water surface elevation in the pre-sort pool is 562.7 feet NAVD 88.

(However initial operations revealed that the False Weir invert is about 6 - 7 inches too high for the design water level for safe fish passage. This elevation discrepancy is being corrected in upcoming follow-on work. The water level will be about 6 inches higher after the follow-on work.)

2.4.1. Finger Weir

A finger weir is provided at the fish ladder to the pre-sort pool transition. The finger weir is made of aluminum "fingers" and prevents fish from dropping out of the pre-sort pool back into the fish ladder. The finger weir can be adjusted by a hand winch to match any changes to the pre-sort pool level; typically the pre-sort pool water elevation does not change and the finger weir will not need adjustment once the pre-sort pool water level has been set. Fill and vent holes were added to the body of the finger weir during the follow on contract. This allows trapped air to escape and helps the finger weir sink under its own weight when lowering.

1 - Finger Weir

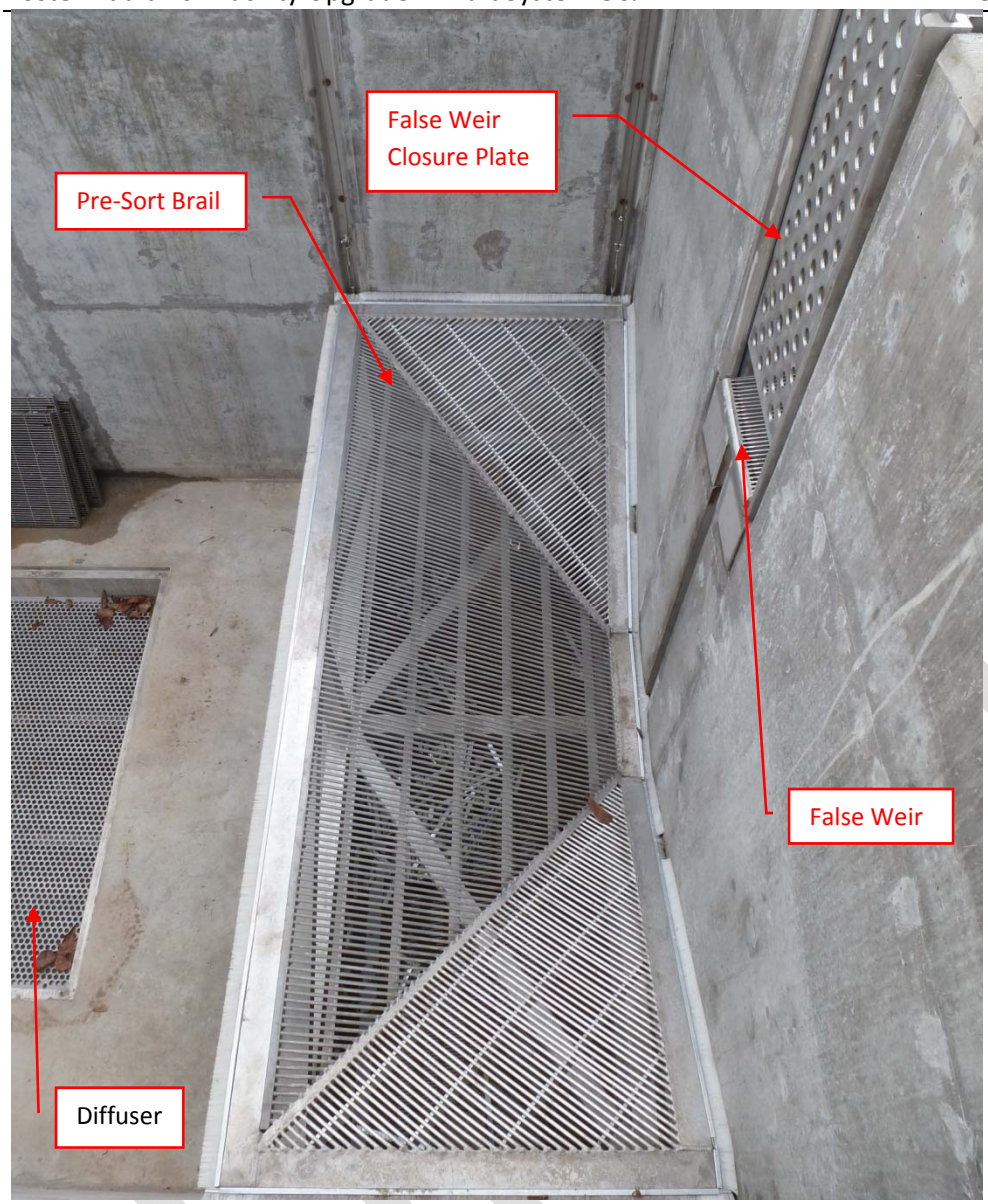
2.4.2. Crowder

The crowder is located in the pre-sort pool. If the fish do not respond to the false weir and jump into the flume on their own, the crowder is used to move the fish toward the false weir. The crowder is powered by electric motors and can be operated from either the pre-sort crowder control cabinet (located on the northeast wall of the pre-sort pool) or the pre-sort control console (located on the work platform at the east end of the pre-sort pool). The crowder has only a vertical barrier screen that lowers into the pool. This reduces the risk of pinching or crushing fish as the screen is lowered into position. During operation, the crowder moves horizontally along the length of the pre-sort pool and forces fish to be concentrated above the pre-sort pool brail.

2 - Pre-Sort Pool Crowder

2.4.3. Pre-Sort Pool Brail

The pre-sort pool brail is recessed into the floor of the pre-sort pool adjacent to the false weir. The brail surface is angled in such a way as to direct fish into the false weir as the brail is lifted vertically through the water column. The brail is operated by an electric motor and can be controlled from either the pre-sort crowder control cabinet or the pre-sort control console.



3 - Pre-Sort Pool Brail

2.4.4. False Weir

The false weir provides a falling water stream that enters the pre-sort pool. The water plunges into the pre-sort pool stimulating the fish to jump. Under normal conditions the fish will jump over the false

weir volitionally, eliminating the need for crowding the fish. Water to the false weir is supplied by a centrifugal pump with a rated capacity of 1795 gallons per minute. The amount of water discharging from the false weir can therefore be controlled by a potentiometer located on the pre-sort control console. The false weir also contains a drain section that prevents overspray from the false weir from travelling down the flume and diluting the anesthetic tank, and a flume supply section that provides water to the flume.

2.4.4.1. False Weir Drain

The center chamber of the false weir is a drain chamber. Overspray from the pumped false weir water supply should enter the drain chamber instead of going down the flume. The drain chamber is piped to

the storm sewer system and is controlled by a manually actuated butterfly valve. The drain valve should be left in the fully open position during normal operations.

2.4.4.2. False Weir Closure Plate

The false weir closure plate is an aluminum perforated plate that excludes fish from entering the flume while still allowing water to pass from the false weir into the pre-sort pool. In addition to shutting off the false weir pump (to discourage volitional jumping), the closure plate can be lowered into position in order to physically prevent fish from entering the flume. It is anticipated that facility operators will lower the closure plate in the event that the anesthetic tank is full of fish and they do not want more coming down the flume until processing the fish in the tank and/or at the end of the work day.

2.4.5. Pre-Sort Pool Piping (Headbox to Pre-Sort Pool)

The pre-sort pool supply valves will be controlled by the PLC based on the water level in the fish ladder

(pool 35). The water supply piping to the pre-sort pool is made of carbon steel pipe that has been coated on the interior and exterior with Paint System no. 29, fusion bonded epoxy. A 30" diameter pipe branched off of the 36" pipe leaving the West side of the Headbox. The 30" pipe is routed north under the pre-sort pool, where it tees into two 20" pipes that supply the east and west pre-sort pool floor diffusers.

2.4.5.1. Supply Valves

The pre-sort pool water supply piping has two 20" butterfly valves that are electrically actuated, one on each floor diffuser supply pipe. These valves can be modulated to vary the amount of water entering the pre-sort pool through each floor diffuser. The valves can be adjusted remotely by the PLC. Past experience has shown that fish are more likely to volitionally use the false weir if the majority of the flow is entering the pool through the floor diffuser closest to the false weir. Therefore, the PLC has been preset to have the West valve 80% open and the East valve 45% open during normal operations. (An interim operation has been set up to assist with false weir and crowding operations to reduce the elevation difference between False Weir invert and pre-sort pool level. Both Pre-sort valves are temporarily opened to 100% to raise the Pres-sort level about 0.4 ft.)

2.4.5.2. Diffusers

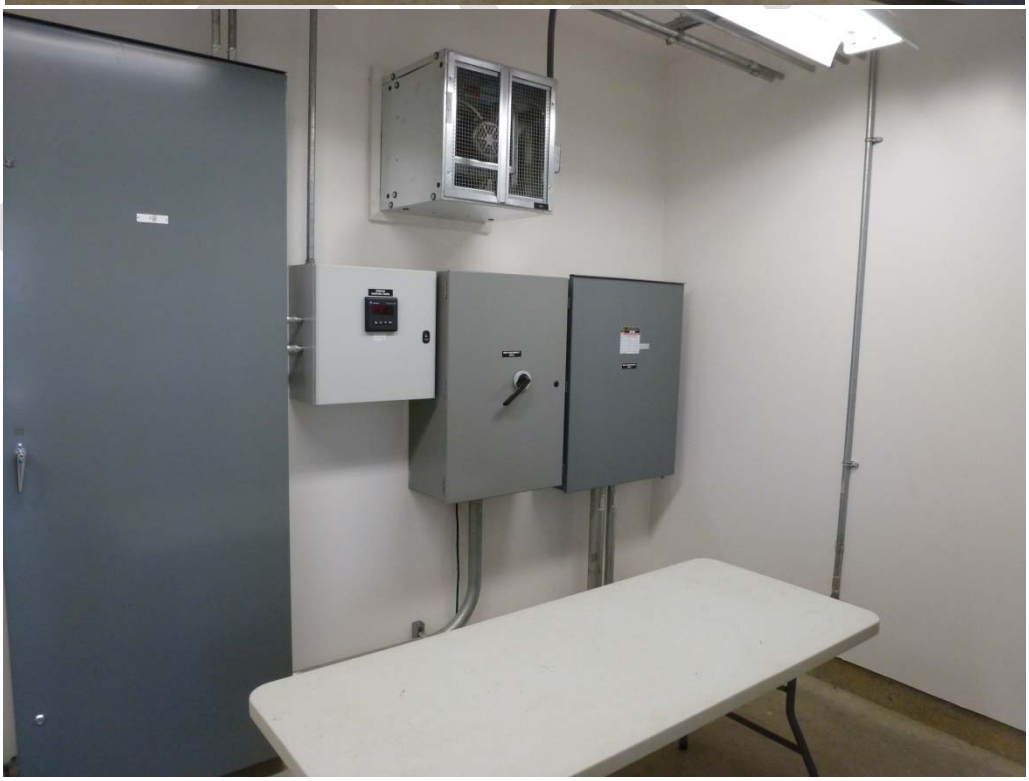
The pre-sort pool diffusers are approximately 2 ft deep and are located at the ends of the pre-sort pool floor. A perforated plate and diffuser grating is located in each diffuser. The perforation plates and diffuser screens are constructed of stainless steel. The perforated plate and diffusers screens are 6 ft by 5 ft. Porosity of the perforated plates is about 51 percent. The diffusers provide hydraulic resistance to flow to reduce any jetting flow that may occur near the outlet of a water pipe.

2.5. SORT FACILITY

After jumping out of the pre-sort pool, over the false weir, fish enter a flume to the sort facility. The sort facility is constructed of reinforced concrete and a fabricated metal building. The ground level of the structure consists of three rooms, including a mechanical/electrical room. The fish sorting equipment is also located on the ground floor of the sort structure.

2.5.1. Mechanical/Electrical Room

This room houses the lighting transformer and panel board for the sort structure electrical loads. Also located here are the PLC cabinet, potable water well pump controller and the intrusion detection panel.



2.5.1.1. Compressed Air

The compressed air system is comprised of a Compressed air pipe, copper type K. The compressed air system operates the anesthetic tank and recovery tank brails, flume switchgates, and long term post sort pool drain valves. There are also connections for pneumatic tools in the service building and one at the North end of the long term post sort pool trolley rails.

2.5.1.2. Washdown Water system

The washdown water system is composed of a 200 gallon (approximate) hydropneumatic tank, an 80 gallons per minute centrifugal pump, and associated piping, pressure switches, and appurtenances. The system supplies pressurized water to 3 frost proof hose bibs in the sorting area. The hydropneumatic tank operates within a pressure range of 30-50 psi.

2.5.2. Pre-Sort Flume to Anesthetic Tank

The transport flume provides fish passage from the pre-sort false weir to the first downstream switch gate. It is fabricated using aluminum and has a U profile. Square bottom to U bottom transitions are provided for the false weir and downstream switch gate.

2.5.3. Switch Gates

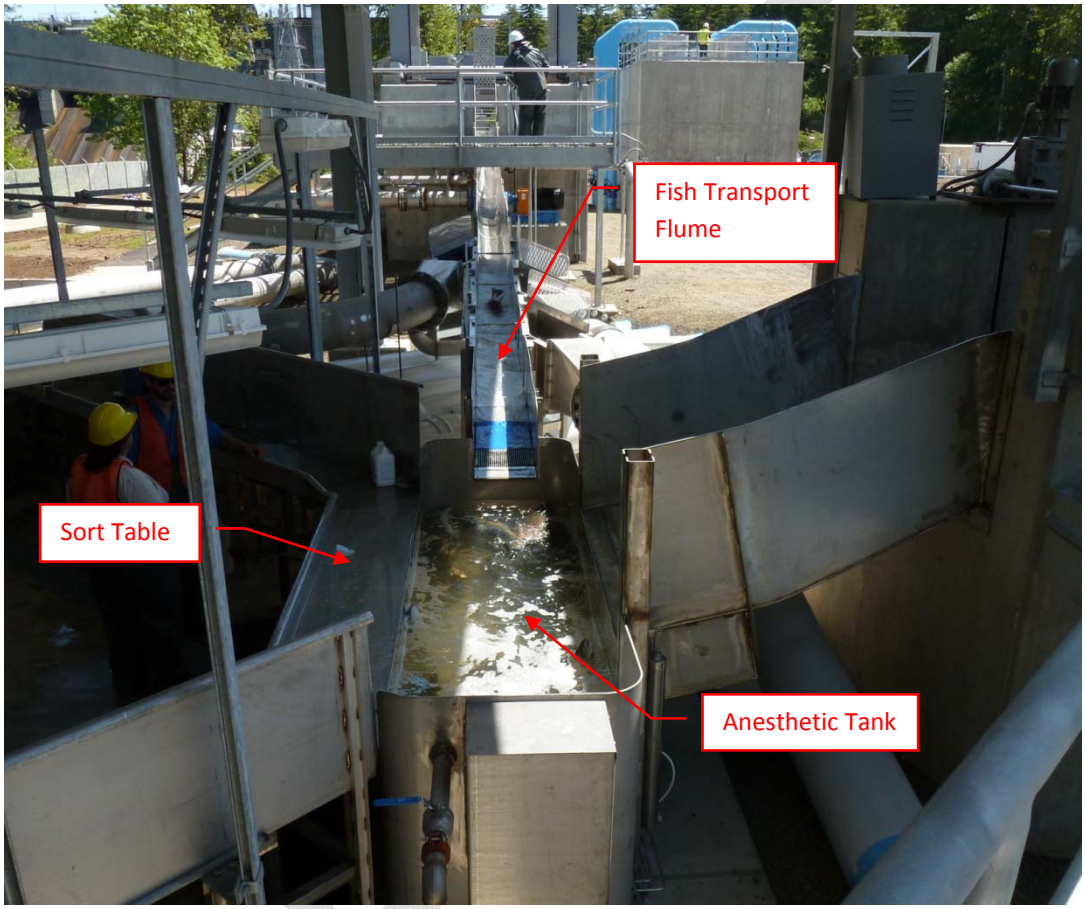
The switch gates are downstream from the fish transport flume. They are fabricated using aluminum and have Composite bushings at hinge points and a single pneumatic cylinder for actuation. There are three switch gates that allow the operator to choose where a fish is deposited; anesthetic tank, return to river pipe, short term post-sort pool 1 and short term post-sort pool 2. Switch gates are operated from the observer platform panel located near the pre-sort false weir. The switch gates are pneumatically actuated.

2.5.4. Anesthetic Tank

The anesthetic tank is a 3'x10' stainless steel tank used to anesthetize fish prior to sorting/spawning. A fish brail forms a false bottom in the anesthetic tank, and can be actuated up by pneumatic cylinders to lift anesthetized fish out of the water for processing. The fish transport flume and the fish lock return flume both run through a dewatering screen before connecting to the anesthetic tank. The anesthetic tank has a fill pipe that is controlled by a manually actuated ball valve, and overflow drain, and a low point tank drain. The low point tank drain is controlled by a manually actuated ball valve and is routed to a bioswale. The anesthetic tank is designed for use with clove oil or Eugenol anesthetic. However, if CO2 is used to anesthetize fish, a tank cover has been provided. Additionally, during the follow on contract, two air stones were added to the bottom of the tank along with tubing, hose, and fittings so that facility operators can supply compressed oxygen and/or compressed CO2 to the tank. Typically, there is one dedicated bottle of each gas piped to its own air stone.

2.5.5. **Sort Table**

The sort table is a large, V-shaped table used for sorting anesthetized fish. The sort table is connected to all 12 of the post-sort pools through watered fish pipes coming through the back wall of the table. The East end of the sort table also connects to the recovery tank. The 12 fish pipes each have a dedicated 4" water supply line, controlled by a 4" ball valve, beneath each fish pipe opening. Note that 3 of these fish pipes are for the future pools. There may be 2 additional short term post-sort pools and 1 more long term post-sort pool added to the facility in the future. The water supply valves on these future pool fish pipes should not be operated. The fish pipes have a blind flange with small drain hole installed at the end of each pipe.

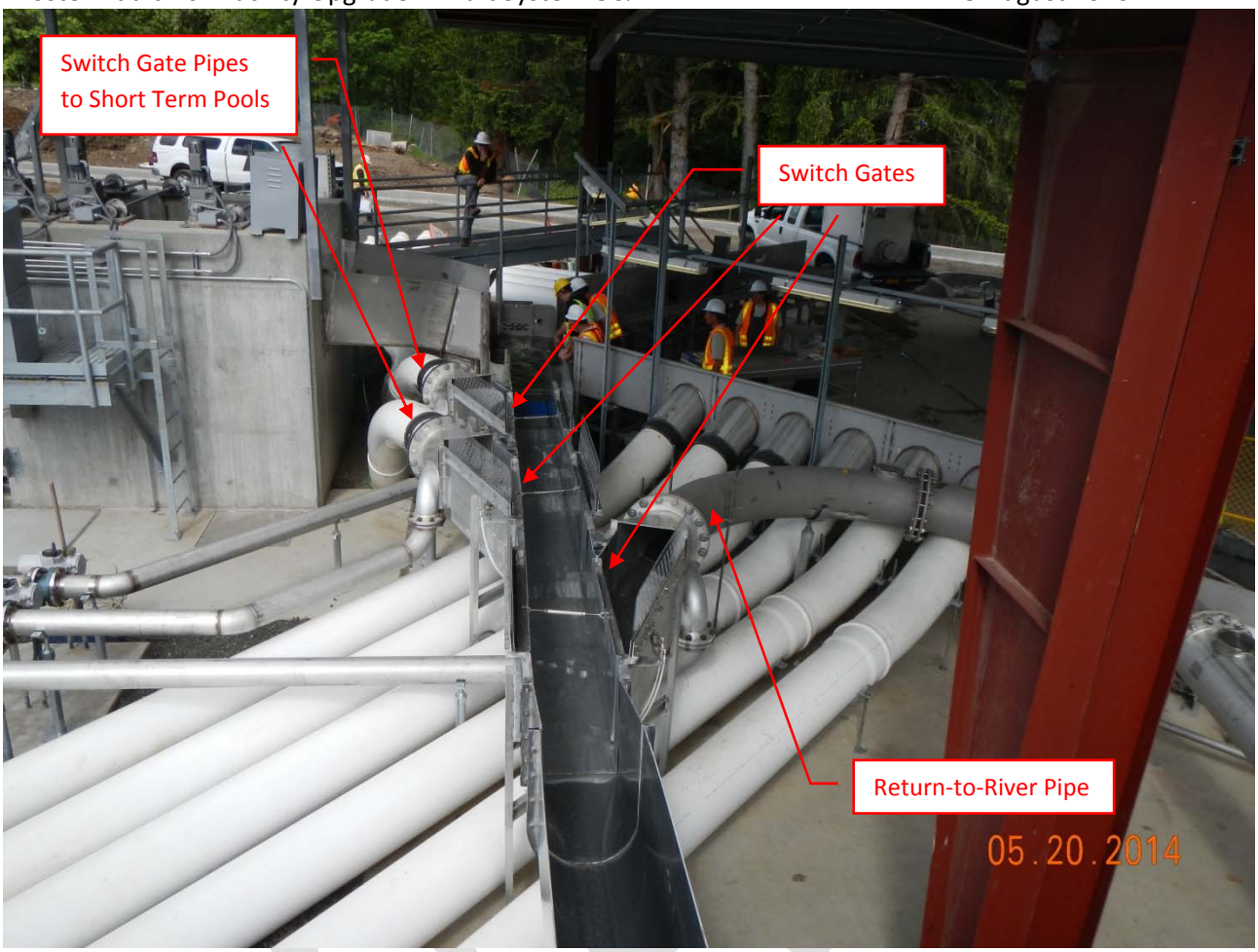


2.5.6. **Fish Transport Pipes**

The fish transport pipes are schedule 40 PVC pipe assembled using bell and spigot connections. They transport the fish from the sorting facility to the post-sort pools; long term or short term based operator preference.

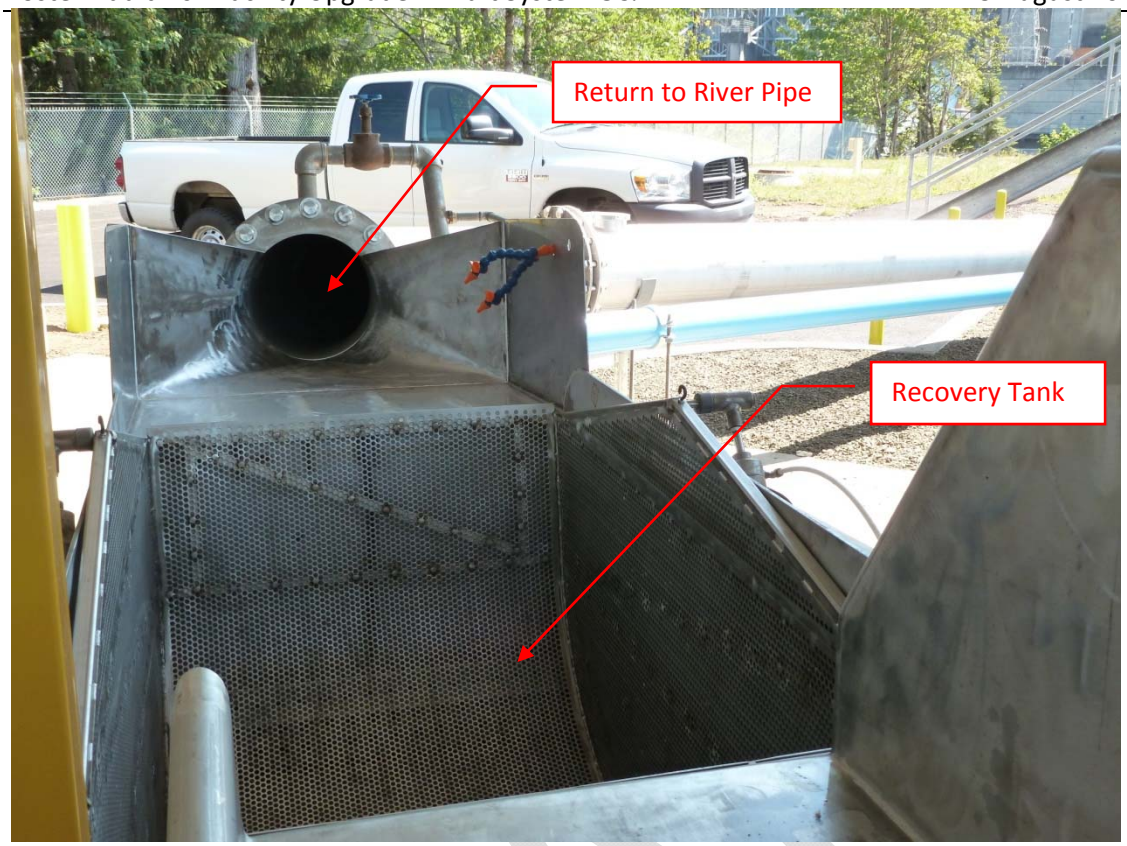
2.5.6.1. Fish Pipes from Switch Gates to Short Term Pools

These fish pipes work with the switch gates to direct the fish from the flume to the short term post–sort pools without being handled by an operator.



2.5.7. **Recovery Tank**

The recovery tank's purpose is to provide a place for fish to recuperate from their anesthetized state before being returned to the river. The tank is stainless steel with a stainless steel fish brail inside of the tank. The brail is actuated by pneumatic cylinders.



2.5.8. **Return to River Pipe**

The return to river pipe is most composed of schedule 40 PVC pipe assembled using bell and spigot connections. Portions of this pipe are stainless steel to accommodate a 6 foot radius. This pipe moves non-target fish from the sorting facility to an out fall location in the river. ESA fish are not allowed in the pipe.

2.5.9. Sort Area Water Supply Piping, Valves, and Appurtenances

2.6. POST-SORT POOLS, SORTING CHANNEL, FISH LOCK AND HOPPER PIT

The post-sort pools, sort channel, and hopper pit are constructed of reinforced concrete. There are 5 long term post-sort holding pools and 4 short term post-sort holding pools. The long term pools are 10-foot wide by 80-foot long and the short term pools are 10-foot wide by 20 foot long. Water enters and exits the post-sort pools through floor diffusers. The long term post-sort pools are sized to hold a maximum 350 adult fish per pool. There is a 6-foot wide by 115-foot long crowding channel located between the long term and short term pools. A hopper pit is located on the south end of the crowding channel and the fish lock is located on the north end of the channel. Fish are crowded from the post-sort pools to the crowding channel and then to the hopper for truck loading or to the fish lock for processing.

2.6.1. Post-Sort Pool Crowders

There are 2 post-sort pool crowders; 1 for the short term pools and 1 for the long term pools. Each crowder has an associated trolley that is used to transport the crowder from one pool to another. The post-sort pool crowders are ride-on type crowders where the operator rides on the crowder while operating it. The trolleys are operated while standing on the crowder when it is parked on the trolley. The trolley is used to move the crowder from one post-sort pool to another. Both the trolleys and crowders are powered by electric motors.

2.6.2. Crowding Channel Crowder

There is one crowding channel crowder. This crowder has two vertical barrier screens; one on the north end for crowding fish into the fish lock, and one of the south end for crowding fish into the hopper. The crowder is a ride on type crowder and is operated by a pushbutton pendant.

2.6.3. FWS Piping (Headbox to Post-Sort Pools)

The piping that conveys water from the headbox to the post-sort pools comes from the 30 inch opening on the south side of the southwestern corner of the headbox. A 24 inch pipe tees off the 30 inch main immediately after exiting the headbox and is routed to the northwest in order to supply the switch gates, fish lock, the pipe then reduces to 20 inch and turns south to supply the short term post-sort pools. The 30 inch pipe continues south, reduces to 24 inch, and supplies the long term post-sort pools, hopper pit, and truck fill pump. The 30 and 24 inch pipes are carbon steel that have been coated on the interior and exterior with a fusion bonded epoxy paint system. 8 inch pipes branch off the 24 inch main to supply each individual short term post-sort pool while 10 inch pipes branch off and supply each long term post-sort pool and the hopper pit. These branch pipes are made of stainless steel as they pass through the short term and long term supply vaults, and then transition to PVC under the post-sort pool structure.

2.6.4. Recirculation Water System

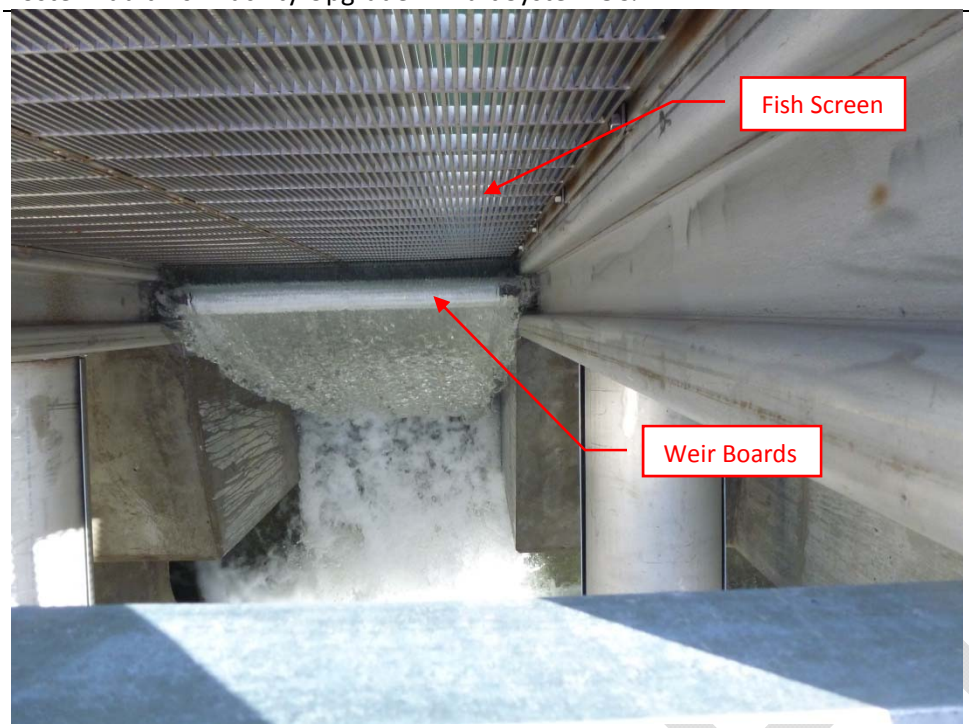
The recirculation system consists of two 250 gpm centrifugal pumps, piping, isolation valves, appurtenances, and an electrical control panel. The recirculation system serves two functions. The first is to drain water from various locations to back to the river via the storm sewer system. The short term pools and diffuser pits, long term pools and diffuser pits, and hopper pit can all be drained back to the river by the recirculation pumps. The second function is to introduce a treatment chemical and recirculate it within any one of the long term post-sort pools. The treatment chemical is introduced, along with water from the selected pool on the suction side of the pump, the mixture is then discharged to the pool through a series of wall mounted sprayers. The recirculation system is located in the recirculation vault at the southeast corner of the post-sort pool area. All post-sort pools, the hopper pit, and the chemical intake are plumbed to a manifold on the suction side of the pumps. The discharge side of the pumps is a manifold consisting of lines to each long term post-sort pool sprayer system, and the drain to river line. An isolation valve is present on each line such that water can be drawn from one source and discharged to one location. Indeed, the system is designed draw water from only one source and discharge it to one location. The two pumps are redundant and the system is designed to function using only one pump at a time.

2.6.5. Diffusers

There is one post-sort pool floor diffuser per pool. The diffuser openings in the long term post-sort pools are are 3-foot wide by 3-foot long. The diffuser openings in the short term post-sort pools are 18” wide by 18” long. The diffuser opening is covered by a grating and a perforation plate is located under the grating. The grating and perforation plate are constructed of stainless steel.

2.6.6. Removable Fish Screens and Weir Boards

There are 9 removable screens, one at the end of each post-sort pool. The removable screens are constructed of a stainless steel frame and stainless steel bar grating. The porosity of the removable screens is 75%. There are 9 overflow weir boards at the end of each post-sort pool. The overflow weir boards are constructed of aluminum. There is one aluminum weir board lifting beam that can be used to latch onto a weir board and remove it from the slot.

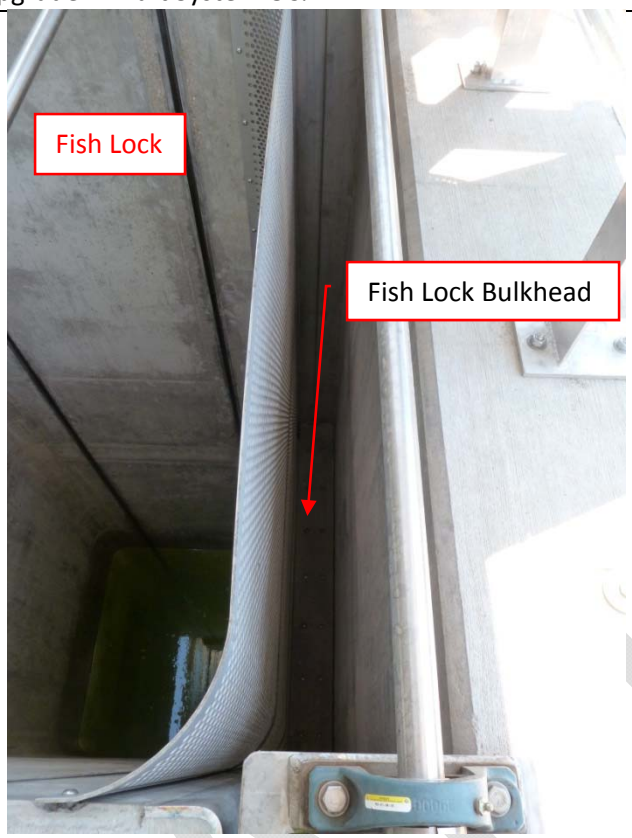


2.6.7. Post-Sort Pool Bulkheads and Hoists

These bulkheads provide separation between holding pools and the crowding channel. They can provide a hydrostatic seal in both directions. The bulkheads are moved using a pendant controlled hoist and are not designed to be moved under differential pressure.

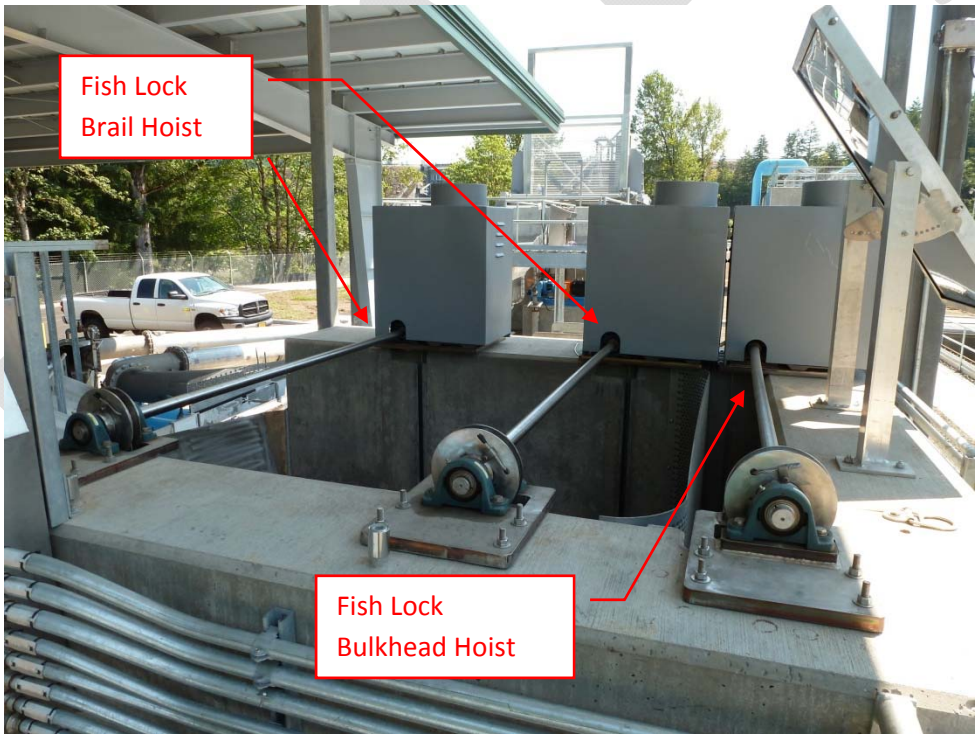
2.6.8. **Fish Lock Bulkhead and Hoist**

The fish lock bulkhead is used to seal a 6 foot by 6 foot column space at the end of the crowding channel. It is mostly aluminum in composition with composite rub blocks and J-bulb seals that work to seal the bulk head against stainless steel guides.



2.6.9. **Fish Lock Brail and Hoist**

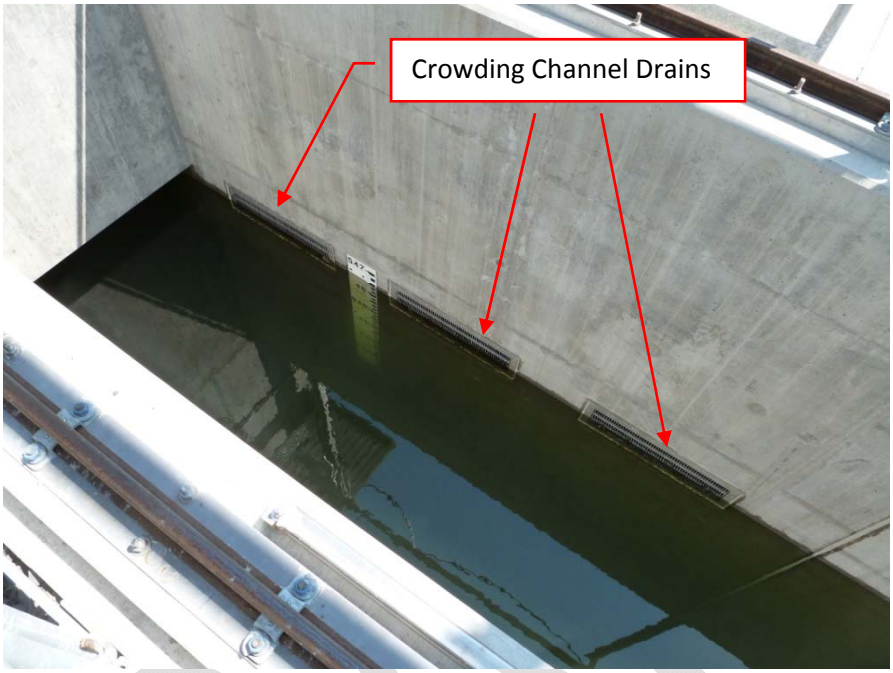
The fish lock brail is fabricated from stainless steel components. There is a perimeter brush that keeps fish from the ancillary space between the brail and the lock wall.



2.6.10. Crowding Channel Drain System

The water level in the crowding channel is maintained by overflow drains in the walls at the North end of the channel near the fish lock. The elevation of the overflow drains is such that the maximum was depth is nominally 6 feet deep. The Crowding channel can be drained one of three ways. First, if the fish lock bulkhead is open, the channel can be drained by opening the fish lock drain valve (FOS-FWDS-FLK02). Second, one or more post-sort pool bulkheads can be opened so that the channel drains through the post-

sort pool(s) as the pool(s) drains after weir boards are removed. Lastly, the channel could be drained by the recirculation pumps by opening the hopper pit drain valve is discharging the pumps to the river drain. This third method is not preferred nor recommended as it would add undue wear and tear on the recirculation pumps.



2.7. FISH TRANSFER SYSTEM AND LOADING EQUIPMENT

2.7.1. Hopper Crane

The hopper crane is provided for raising the fish hopper from the hopper pit at the south end of the crowding channel and moving it to the driveway to mate up with the fish transport truck. The hopper crane is a pendant-controlled (H4 Duty Class) monorail trolley and hoist rated for 7.5 tons and mounted in an underhung configuration. The crane has two-speed controls for both raising and lowering the load and moving the trolley along the monorail beam. The pendant provides pushbuttons for on/off, hoist up/down, trolley north/south, and crowder bypass, along with a 3-position bypass selector switch for testing the upper limit switch. The hoist has been set up with multiple safety devices including upper and lower geared travel limits and upper (gravity contact) limit switch. The hoist trolley will travel the length of the beam with bumper stops at either end as safety stops. The trolley will traverse at 65 or 22 fpm and the hoist will raise/lower at 15 or 5 fpm depending on how far the respective two-position pushbuttons are depressed.

2.7.2. **Hopper Loading Structure**

The hopper loading steel-frame structure extends from the hopper pit to the fish truck loading station in the driveway. It is fabricated using A992 structure steel shapes and A572 Grade 50 for fabricated brackets and bracing. Stainless steel wire ropes with adjustable turnbuckles are used to shore up the structural bracing. A325 structural bolts used in combination with load sensing washers are used for structural component assembly. A monorail beam extends overhead from the hopper pit to the driveway area.

2.7.3. **Fish Hopper**

The Fish Hopper is used to transport ESA fish from the Crowding Channel to the fish truck by “water to water” transfer. The Hopper is primarily fabricated from 6061-T6 aluminum. The hopper footprint is 5’-10” square and its height is 15’-7½”. When stowed in the Hopper Pit, the portion of the Hopper extending above the channel floor elevation has one side open towards the Crowding Channel that interfaces with the Crowding Channel Crowder. The Crowder screen forms the fourth wall of the Hopper to retain fish inside

while the Hopper is stowed. As the Hopper is raised, the water drains out through the perforated sides and the fish are retained in the solid-wall-sided bottom. A concrete storage "box" is located at the hopper pit end of the crane for storing the Hopper above ground. General steps for using the hopper is as follows:

- The hopper is lowered into the crowding channel hopper pit.
- Fish are crowded down the crowding channel into the hopper with the screen panel sealing off the Hopper Pit area. The crowder makes contact with the limit switch at the end of the channel, which activates the hopper crane controls.
- The hopper is lifted out of the pit, moved along the monorail, and lowered onto the truck that has previously been filled with water.
- The hopper valve is opened to allow water to pass into the empty space in between and equalize pressure across the hopper door.
- The hopper door actuation lever is pulled down, opening the hopper door located at the bottom of the hopper and creating the water-to-water passage with the truck.
- The drain valve on the truck tank is opened to lower the water level into the truck and effectively transfer all fish into the truck.
- The drain valve is closed, the hopper door closed, the hopper disconnected from the truck, and the hopper replaced back in the Hopper Pit.

2.7.4. **Fish Truck**

The fish truck consists of a Freightliner truck chassis and a custom 1500 gallon stainless steel tank for holding fish. The tank was manufactured and assembled onto the chassis by West-Mark, Inc. in California. The tank includes features such as baffles, vents that can seal in order to minimize leakage when the water to water connection with the hopper is made, aerators, and a pneumatically actuated knife gate outlet. The trucks for Foster Fish Facility and Minto Fish Facility were procured under the same contract and are identical.

2.7.5. Truck Fill Station

The truck water fill station provides a pressurized water supply for quickly filling the fish truck prior to loading fish. Trucks are positioned at the fill station in the driveway adjacent to the Hopper Crane with the tank hatch beneath the overhead fill pipe outlet before starting the booster pump to deliver the water. The truck fill pump is operated by manual start/stop pushbuttons at the local control station and the water level monitored by visual observation of the truck tank sightglass. There is a butterfly valve on the discharge side of the pump that should be throttled in order to maintain a desired pressure of 8 psi on the pump which maintains a desirable operating condition for the pump. The truck fill station has provisions for freeze-protecting the water piping by closing a supply isolation valve and opening a drain valve plus draining the pump volute.

2.8. Drainage System

The site drainage system uses a system of catch basins, ditch inlets, manholes, and piping to convey stormwater and facility process water generated by the site to either the river or to one of three rain gardens.

2.8.1. Outfall Structure

The outfall structure is a 50 foot wide concrete bubbler type structure. The invert elevation of the pipe into the bubbler structure is 7.0 feet below the exit weir of the structure. When the bubbler structure is operating, head generated by the upstream system raises the water surface elevation within the bubblier structure until it crests over the weir. The bubbler structure conveys storm and discharge water to the river after it reduces the velocity of the water and broadens its flow width to reduce scour of the downstream riprap pad. Water tributary to the outfall structure includes: treated stormwater generated by the northwestern portion of the site near the sorting/spawning facility; the sorting/spawning facility foundation drains; the post sort pools; the head box; and the numerous vault floor drains.

Outfall Structure

2.8.2. Facility Drains

2.8.2.1. Post-Sort Pools and Vaults

The post-sort pools and vaults drain to the storm system in the northwestern section of the facility which, in turn, flows to the outfall structure and into the river.

2.8.2.2. Fish Truck Discharge

The fish truck discharge is located to the east of the truck fill station. It consists of a curb opening, riprap pad, and 2 inch underdrain. The underdrain discharges into sanitary sewer manhole #2. If the underdrain gets overwhelmed, excessive water drains to the adjacent low field and into a ditch inlet which conveys that water to the south rain garden

2.8.3. Rain Gardens

There are three rain gardens onsite: an east rain garden, a south rain garden, and a west rain garden. The east rain garden is located near the parking lot for the administration building. The south rain garden is located to the south of the long term post-sort pools. The west rain garden is located to the west of the sorting/spawning facility. Polluted rainwater flows into the rain gardens and is treated by the amended soils and root systems before infiltrating into the substrate.

South Rain Garden looking south

South Rain Garden looking north

West Rain Garden

East Rain Garden

2.8.4. Anesthetic Pond

The anesthetic pond is located between the sorting/spawning facility and the sort-term post-sorting pool. The anesthetic tank in the sorting/spawning facility drains to the anesthetic pond were the clove oil is allowed to evaporate and the remaining water is treated by the amended soils and root systems before infiltrating into the substrate.

Anesthetic Pond

2.8.5. Water Quality Catch Basins

There are two water quality catch basins onsite. One water quality catch basin is located north of the sorting/spawning facility. The other water quality catch basin is located north of the administrative building. The water quality catch basins are single filter StormFilter catch basins manufactured by Contech Engineered Solutions. Treated stormwater is discharged either directly into the river or into a storm drainage system which outfalls into the river.

Water Quality Catch Basin north of the Sorting/Spawning Facility

2.9. Sanitary Sewer

The site is served by a municipal sanitary sewer system operated and maintained by the City of Sweet Home, OR.

2.9.1. Oil/Water Separator

An oil/water separator removes petroleum based pollutants from the effluent from the maintenance building floor prior to discharging into the onsite sanitary sewer system. It is located to the south of the maintenance building.

2.10. Potable Water System

Potable water is provided to the site by the City of Sweet Home, OR.

2.11. Fire Protection Water System

A 6 inch fire service addition to the site was constructed on the western side of the site. Included in the fire service are two fire hydrants, one to the west of the sorting/spawning facility and the other to the west of the maintenance building.

2.12. Ancillary Structures

2.12.1. Maintenance Building

The Maintenance Building provides an office, break room, toilet room, and janitor's closet as well as a maintenance/storage area within the building. The building has three exterior doors and two roll-up doors into the maintenance/storage area. All spaces have HVAC for conditioned air delivery for ventilation and heating.

2.12.2. **Site Host Pad**

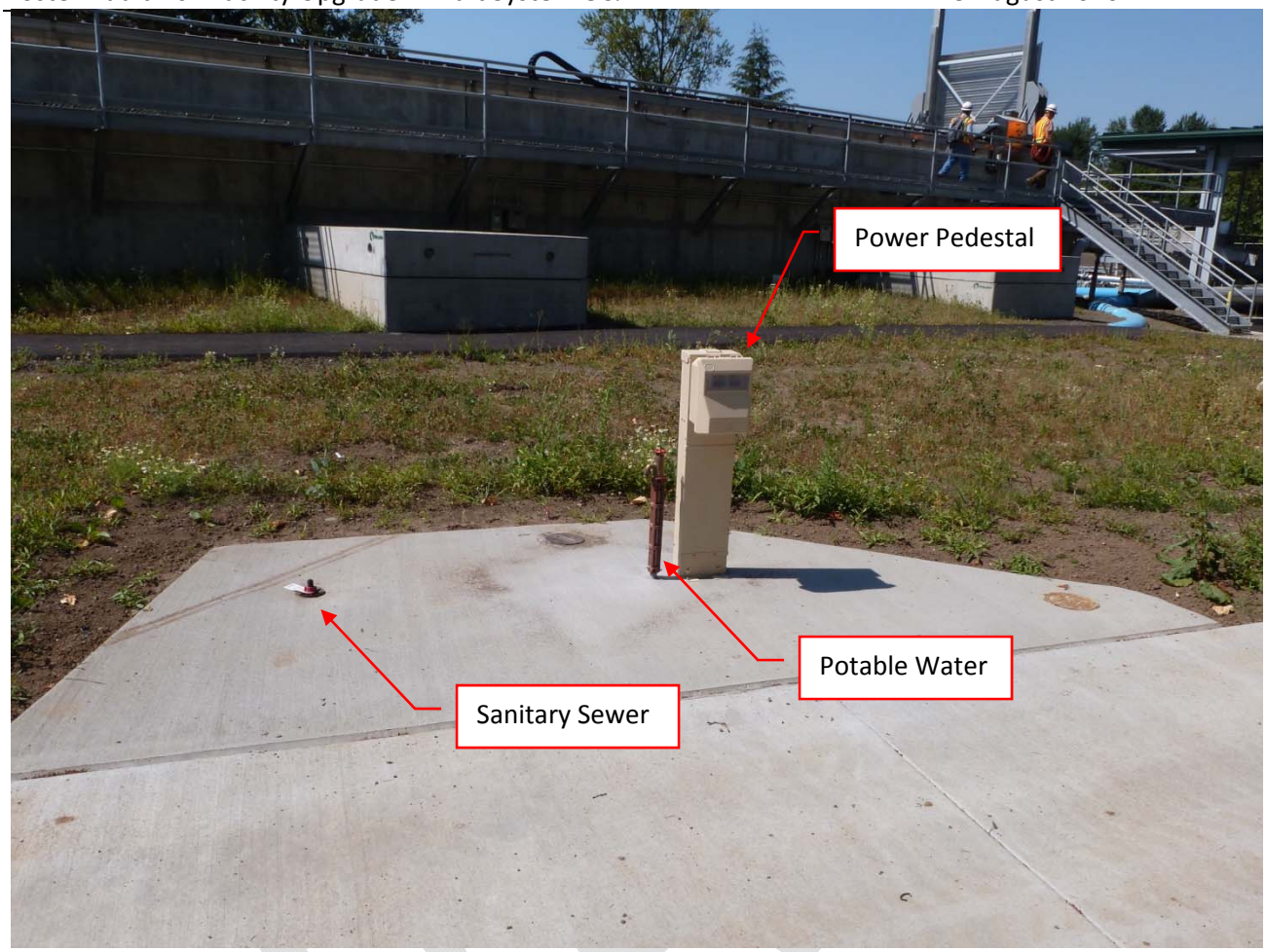
The site host structure includes a prefabricated metal structure and a reinforced concrete slab on grade.

2.12.2.1. Power Pedestal

Power to the site host is provided from mini-power center MPC-2 (located in the IPS). The power pedestal provides receptacles for 50A (240V) and 30A (120V) service as well as a duplex 20A, 120V convenience receptacle. Circuit breakers are provided for each circuit.

2.12.2.2. Potable Water

Potable water is provided at the site host structure. A hose bib is provided as part of the power pedestal.



2.12.2.3. Sanitary Sewer

A sanitary sewer dump connection is provided at the site host structure.

2.12.3. Chemical Storage Building

The Chemical Storage Building provides a protected environment for safely storing Formalin fish treatment chemical while providing for worker safety. The pre-fabricated metal building is continuously ventilated to eliminate any potential for formaldehyde gas buildup and heated to maintain proper chemical temperature. The building includes built in secondary containment below a grated floor and a dry-chemical fire suppression system. An emergency eyewash/safety shower is included within the building with a hot water tank provided for supplying tepid water.

2.13. FACILITY ENTRANCE GATES

Vehicle access to the facility is restricted by two gates (bar gate and security gate). Each gate is operated by a motor operator. Motor operators are controlled either through a wireless remote control or keypads for both entry and exit. Facility personnel are able to open the gates with remote controllers without leaving their vehicles. Others are required to leave their vehicle and enter a code on the keypads to gain entry and to exit. The outer most gate (bar gate) has the capability to remain open during operation hours and then shut for after-hours security.

2.14. POWER

2.14.1. Station Service Supply

2.14.1.1. Backup Power System

The Emergency Generator brand name MTU Onsite Energy Rated at 600 KW.

The engine portion, manufactured by MTD Detroit Diesel, is a Model DS600D6SRA

Engine features include:

- V12 1600 series 4 Cycle Diesel engine with 21.0 Liter displacement.
- Common Rail fuel injection
- 24 Volt Charging alternator and battery system
- 24 Volt starting motor
- Rated RPM 1800
- Max power 896 bhp
- Electronic Isochronous Governor
- Thermostat controlled water Jacket heater with pump assist
- Recommended fuel #2 diesel
- Battery Cold cranking amps 1000
- Fuel Consumption 40 gal/hr at 100% load

The Generator Portion, manufactured by Marathon, is a model 572RSL4031

Generator features include:

- 480V/277V
- PMG (Permanent Magnet Generator)
- 3 Phase 4 Lead WYE
- PF 0.8
- 60 HZ
- 600 KW
- 750 KVA
- 902 AMPS
- 4 Pole, rotating field
- Sustained short circuit current of up to 300% of rated current for up to 10 Seconds
- Digital, Solid State, Volts per-Hertz Regulator/ ± 25% Voltage Regulation
- Brushless Alternator with Brushless Pilot Exciter

Liquid Capacities and specifications

- Total oil System 19.3 Gal / Delo SAE 15W/40W
- Engine water jacket capacity 17.2 Gal
- System Coolant capacity 28.1 Gal / Castrol Antifreeze NF Premix (45%)
- Primary fuel filter – RACOR 2020 PMOR 30 Micron Available thru NAPA (1 ea)
- Secondary fuel filter – MTU Fuel filter Part No. x57508300028 (1 ea)
- Oil filter – MTU oil filter Part No. x57518300024 (4 ea)

The MTU GENSET is equipped with a Digital Control Panel, its functions is to provide start and stop capability of the generator and monitor Engine and Generator parameters and provide protection functions it also includes the following features:

- Digital metering

- CAN Bus ECU Communications
- Windows-Based software
- Remote Communications to RDP-110 remote annunciator
- 16 Programmable Contact inputs
- Up to 11 Contact Outputs
- Event Recording
- Backup battery for Date and time monitoring
- Internal Dial-Out Modem with remote Dial-Out and Dial in Capability
- Generator protection includes:
    - Under voltage (27)
    - Over voltage (59)
    - Reverse Power (32)
    - Over frequency (81U)
    - Phase Imbalance (47)
    - Generator Overcurrent (51)

- Engine Protection includes:

  Alarms (Shutdowns)
    - Low Oil Pressure
    - High Coolant Temperature
    - Low Coolant level
    - Low Fuel Level
    - Overspeed
    - Overcrank
    - Engine Sender unit Failure
    - Emergency Stop
    - Battery Charger Failure
    - Critical Low Fuel Shutdown

- Pre-Alarm (Warnings)
    - Low Oil Pressure
    - High Coolant Temperature
    - Low Coolant Temperature
    - Battery Overvoltage
    - Weak Battery
    - Battery Charger Failure
    - Engine Sender unit Failure
    - Engine KW Overload (3 levels)
    - Maintenance Interval timer
    - Low Coolant Level
    - Low Fuel Level
    - Fuel Leak Detect
    - High Fuel Level

2.15. Industrial Control System (ICS)

2.15.1. Programmable Logic Controller (PLC)

There is a single controller (CPU) with distributed I/O located throughout the system. All graphic terminals, digital power meters, valve/gate actuators, and related analog and discrete I/O devices are connected to the PLC system.

2.15.2. Graphic Terminals

Graphic terminals are used to adjust and monitor various devices and systems of the fish collection system. Reference chapter 8 for additional information.

2.15.3. Water Level Sensors

All water level transmitters are submersible and not field adjustable.

2.16. Pavement

2.16.1. Asphalt Concrete

Hot mix asphalt was installed at all locations and drive aisles that expect regular vehicular traffic. The typical asphalt section for the site is 3 inches of asphaltic concrete over 8 inches of rock.

2.16.2. Portland Cement Concrete

The site host structure consists of 8 inches of portland concrete cement over 6 inches of gravel base rock.

2.16.3. Gravel

Where traffic, both vehicular and pedestrian is anticipated to be minimal, the surface was covered with 3 to 6 inches of gravel.

2.16.4. Grass Pavers

The maintenance way to the south of the fish ladder was covered with a cellular grass retention product to increase the bearing strength of the surface to allow for occasional maintenance vehicle traffic.

2.17. Landscaping

The site is conservatively landscaped with lawn, shrubs, and trees, most of which should be of fairly low maintenance.

3. Chapter 3: Theory of Operation

An executive summary of the facility operation will be added here for the final SOMM.

3.1. Theory of Operation

The Foster Adult Fish Facility Upgrade provides an improved fish ladder including a new ladder section routed to the new adult fish facility where fish holding pools were added, all for improved fish collection, monitoring, and transport. Associated upgrades include (1) two new gravity water supply pipelines for supplying side entrance attraction water and for meeting adult fish facility water demands including the fish ladder supply, (2) a modernized auxiliary water supply pumping system for providing attraction water at the fish ladder main entrance and side entrance including new control gates and electric hoist actuators, and (3) an updated control system with new instrumentation and touch screen controls.

3.1.1. Forebay Water Supply System

The Forebay Water Supply (FWS) System is designed to provide a gravity supply of reservoir water for meeting facility water demands including fish ladder flow, attraction water for the side entrance, and the adult fish facility. The supply for the FWS system relies on the existing intakes in the sidewall of Penstock No. 2. Reservoir water passes through a trashrack at the two intakes that are located approximately 10 feet and 24 feet below minimum reservoir WSEL. The intakes at these elevations avoid the majority of floating debris and tap the cooler water layers with the deeper intake dedicated to the fish facility. A new trashrack with 3/4-inch gaps between bars excludes debris and larger fish from the water supply. The upper intake is dedicated to supplying attraction water to the side entrance through a 24-inch diameter steel pipe. The lower intake is dedicated to supplying water to the fish facility including the fish ladder through a 36-inch steel pipe. The water supplies to the two pipelines can be isolated with manual butterfly valves in the valve room at EL 591.65 in the dam structure. Air/vacuum release valves are provided at the pipe high points in the valve room to automatically purge air for watering up and during operations and to allow air entry to prevent vacuum formation during pipeline draining.

The FWS system includes new pressure and temperature sensors installed in the piping in the valve room. The control system will compare the pressure values for the two FWS pipes (PIT-001 and PIT-002) to the forebay water surface elevation (LT-005) as a measure of head differential across the trashrack and will alarm to alert operators to potentially excessive debris buildup. Water temperatures will also be monitored in each FWS pipe (TIT-001 and TIT-002) and recorded by the control system.

The 24-inch FWS pipe to the side entrance is routed down through the old hopper well and across the former holding pool and former upper fish ladder before going below grade to the pump room. A magnetic flowmeter is located just outside the holding pool room for establishing the flow rate used in the flow control loop. A flow control valve (rubber-seated ball valve) is located in the pump room and automatically regulates the side entrance attraction water flow to the flow setpoint, typically between 19.4 -58.3 cfs. The control system constrains the side entrance attraction water flow to no greater 63 cfs to avoid excessive velocities in the pipeline. Out of the flow control valve, flow discharges into the existing Lower Dissipator before passing through an aeration passage and discharging up through diffusion grating in the transportation Channel just upstream of the side entrance.

The 36-inch FWS pipe to the side entrance is also routed down through the old hopper well and across the former holding pool and former upper fish ladder before going below grade to the Headbox. A magnetic flowmeter is located just outside the holding pool room for establishing the flow rate for control system alarming. A flow control valve (rubber-seated ball valve) is located in a buried vault upstream of the Headbox and automatically regulates the supply to maintain a constant level (elevation 569.5 feet NAVD88) in the Headbox. This setpoint will be set to average 6 inches below the overflow weir wall with a level tolerance of ±0.2 feet. When the headbox level moves outside tolerance (569.5 ±0.2 feet), the control ball valve will adjust to either raise or lower the inflow rate to bring the Headbox level back within tolerance. This level control loop will match supply to demand and maintain a relatively constant supply pressure for demands at the fish facility. The control system will also monitor the flow rate and automatically constrain valve position and alarm for high flow to avoid excessively high pipe velocities. An emergency overflow is provided in the Headbox for a control valve failure situation to safely bypass water flow over a weir wall and out a 36-inch gravity drain pipe that discharges to the drain system and eventually the river. Out of the flow control valve, the FWS supply pipe branches to either side of the Headbox and then tees off as 14-inch supplies to each of ten packed columns located on top of the Headbox. Manual butterfly valves are provided for fine tuning relative flows to the columns or for isolation purposes. Manual drain valves are provided on each supply pipe for draining the pipe for maintenance purposes while isolated and the remainder of the system is active.

The flow control valves have local pushbutton control on the electric actuator mounted on the valve. For manual control, the actuator Local-Stop-Remote knob would be placed in LOCAL and the Open/Stop/Close knob manipulated as desired to position the valve in accordance with flow or level readings. For automatic control, the actuator Local-Stop-Remote knob would be placed in REMOTE and the control system will automatically position the valves in accordance with the control system set point.

3.1.2. Facility Water Distribution System (FWDS)

Two supply pipes (30-inch and 36-inch) exit the Headbox. The 30-inch FWDS pipe provides a fresh water supply to all of the short-term and long-term holding pools as well as the fish lock, crowding channel, and truck fill station. The 36-inch FWDS pipe supplies water to the pre-sort pool, upper fish ladder, pre-sort pool false weir and distribution flume, fourteen fish transfer pipes, recovery tank and two fish return pipes, and spawning and sorting tables.

The Presort valves (FOS-FWS-PSS01 and FOS-FWS-PSS02) will be set in fixed position determined in initial startup so that at design operating Headbox level (569.5 feet), the ladder head recorded at LT-008will be 1 foot. The Presort valves will be left in manual remote operating mode, so that either valve may be corrected in the future. With a headbox level within tolerance (569.5 ±0.2 feet)If the Presort valves are properly set in fixed position, then the ladder head should easily stay within criteria (0.9 -1.1 feet). If the ladder head is goes out of criteria, the PLC will send an alarm and one or more of the Presort Valves can be adjusted.

Ladder head = Pool 36 Water surface elevation (LT-008) – Weir 35 crest elevation

Ladder head = LT-008 reading - 5 60.7 feet NAVD88

The FWDS has numerous valves, some electrically actuated, some manually operated, that allow facility operators to supply water to specific areas as needed and to conserve water when it isn't needed. Each

post sort pool has its own manually operated supply valve. The post sort pool supply pipes are outfitted with flow meters in order to allow the operator to provide the desired flow rate to each pool. The water supply to each fish pipe running from the sort table to the post sort pools are controlled by manual ball valves. The fish lock supply and drain pipes utilize electrically actuated valves that can be remotely operated in order to avoid repeated entry to the fish lock valve vault. Slide gates were added to both FWDS supply outlets from the headbox. This allows a portion of the FWDS to be dewatered for maintenance while the other portion continues operation. For example, if a post sort pool supply valve had to be replaced during the fish collection season, the post sort pool leg of the FWDS could be isolated using the slide gate while the pre sort pool leg of the FWDS could continue to provide flow for the fish ladder and presort pool. Alternately, the fish ladder could be dewatered for maintenance while fish could continue to be held in the post sort pools.

3.1.3. Auxiliary Water Supply (AWS) System

The auxiliary water supply (AWS) pumping system has been redesigned to retain essentially the same capacity and functionality as the original design. Four new AWS vertical axial flow pumps have been installed to provide a minimum of 41.7 cfs each for the future condition if pump intake screens were installed. This flow rate is the same capacity as the original AWS pumps. In the near-term, the AWS pumps will be capable of delivering a minimum of approximately 45 cfs each as attraction water to the fish ladder entrances.

The AWS Pumps convey water from the tailrace and ultimately discharge it into the main entrance pool (pool 1) to amend the fish ladder flow with attraction water exiting both entrances. The pumps draw tailrace water through a pump intake trashrack, below the main entrance, that was replaced with a new fabrication having 5/8-inch gaps between vertical grating bars. The tailrace water passes through the pump intake channel to the pumphouse and then flows vertically up into the pump bays. New flow modifiers were added in these passages with vertical and horizontal flow vanes to straighten the flow and promote improved approach velocities towards the pump intakes. The pump bays themselves were also upgraded with metal corner fillets and central flow splitter with perforated splitter plate. These improvements were all provided to greatly reduce the potential for swirling, vortex formation, and other unstable flow conditions that could lead to cavitation and reduced pump performance.

The AWS Pumps are controlled to automatically operate in sequence depending on Table 1 in Section **Error! Reference source not found.**. One pump will generally run at all times even for very low river flows (below 240 cfs; WSEL 528.0). An additional pump will always be run whenever the side entrance is in operation (Tailwater levels > 528.6 feet). So, a minimum of two pumps will be running at most times. A third pump will start when the tailrace reaches WSEL 529.3 and a fourth at WSEL 530.0. There will be a deadband of 0.1 feet in the operational setpoints depending on whether the tailwater is rising or falling. This is done to avoid unnecessary pump starts and stops in the case of a tailwater oscillating back and forth around a particular setpoint level.

The pumps discharge through flap gates, which prevent backflow when a pump is not in operation, into the upper supply channel (Pump No. 1 only) and lower supply channel (Pumps Nos. 2-4). The attraction water flows up into pool 1 through floor diffuser grating. The control gates work to regulate the water levels in pool 1 and at the entrances relative to the river level.

The AWS Pumps have local control panels mounted on the wall adjacent to each pump and powered from MCC DQ2 in the pump room. The pumps are provided with both soft starters and emergency contactors, for starting pumps by bypassing the soft starters using the hand-switch on the pump control panel. The pumps typically run in Automatic Normal mode with the Hand-Off-Auto (HOA) switch in AUTO. In Manual Normal mode, place the HOA in HAND the pump will run. The pump water lubrication system is interlocked to function whenever a pump starts. The solenoid valve on the individual water (FWS) supply line to that pump will open and the flow switch gauge should indicate flow passing down through the pump enclosure tube to lubricate the composite line-shaft bearings. If the flow switch is not activated an alarm will be initiated and the pump will be stopped. The pumps are also outfitted with vibration sensors mounted to the motor housing that will alarm for high vibration and alarm and turn off the pump for high-high vibration. The control system also monitors the head (pressure) differential between the tailrace (LT-003) and the pumphouse (LT-006) to alert operators to the trashrack possibly being clogged with debris. If the head differential exceeds 6.0 feet, an alarm will be initiated and all pumps will be stopped.

3.1.4. Fish Ladder Gates

Three automated vertical lift, or roller, gates, the main entrance gate, side entrance gate, and transportation channel gate, are provided to control water levels in pool 1 and the transportation channel relative to the river (tailrace) level. The main and side entrances were provided with new orifice gates that will typically serve as submerged weir gates. The transportation channel gate was refurbished and serves as a submerged weir gate. All gate operators were replaced with new wire rope drum hoists with electric actuators and refurbished sheaves.

All three gates can be positioned manually through either remote or local controls but will typically be controlled automatically to maintain a set head differential between water surface elevations as follows:

- The main entrance gate (RG-001) is used to regulate the WSEL differential between pool 1 (LT-002) and the tailrace (LT-003). The differential can be set between the range of .5 to 2 feet but will normally be set for 1.0 -1.5 foot, or 1.25 feet ±0.15 feet.
- When the side entrance is in operation, the transportation channel gate (TG-001) is used to provide about 0.25 feet differential between the main entrance pool (pool 1) and the transportation channel (LT-004). The gate invert will be positioned approximately 2.0 feet below the main entrance tailwater elevation (LT-003). The differential can be set between the range of 0 to 5 feet but will normally be set for 2.0 feet.
- The side entrance gate (RG-002) is used to regulate the WSEL differential between the pool 1 (LT-002) and the side entrance pool (LT-004). The differential can be set between the range of 0 to 2 feet but will normally be set for 0.25 feet ± 0.05 feet.. When the side entrance is not in operation, the transportation channel gate will be raised to stop all flow through the transportation channel to the side entrance. Also if the difference in tailwater elevations between side and main entrances exceed 0.75 feet (LT-005 – LT 003 > 0.75 feet), then the side entrance gate will also be closed (i.e. raised out of water).
- All gate operators have local pushbutton control on the electric actuator driving the drum hoist. For manual control, the actuator Local-Off-Remote knob would be placed in LOCAL and the Open/Stop/Close pushbuttons manipulated as desired to position the gate in accordance with WSELs and/or the gate position indicator. For automatic control, the actuator Local-Off-Remote

knob would be placed in REMOTE and the control system will automatically position the gates in accordance with the system setpoint.

3.1.5. Pumphouse Dewatering and Filling

The fish ladder and pumphouse were not designed to be dewatered individually. The drainage sump, located in the same well as the floatwells, drains the fish ladder supply channels and pumphouse simultaneously through the Powerhouse. Therefore, dewatering requires complete shutdown of fish passage and placement of bulkheads at the fish entrances and pump intake. Should it ever be considered necessary to dewater the pumphouse with a portable pump and with the fishladder left in operation it is recommended that the differential head between the supply channel and pumphouse be limited to a maximum of 20 feet. To safeguard the pumphouse and limit the horsepower requirement for the AWS Pumps, the control system monitors the head differential between the pumphouse (LT-006) and the main entrance pool (LT-003) and initiates an alarm and stops all pumps when the differential reaches 3.0 feet. An appreciable differential between the pumphouse and the supply channel cannot develop because of the 36-inch heavy duty flap gate located in the common wall near the floor of the two chambers. When the fish ladder and pumphouse are empty, they should be filled by opening in sequence the pumphouse filling gate ("Valve J") and the side entrance FCV (FOS-FWS-PHS01). This introduces forebay water into the pumphouse and the supply channel fills simultaneously through the 36-inch flap gate.

4. Chapter 4: Operations

4.1. System Operations

4.1.1. Facility Startup

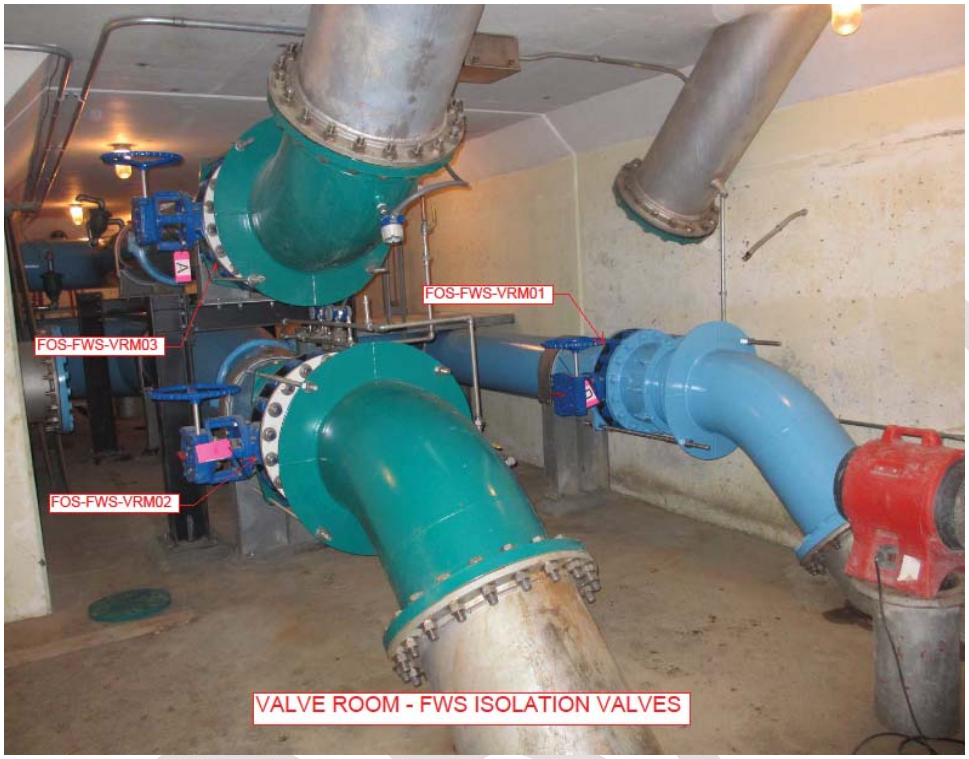
To start up the Foster Adult Fish Facility, first complete all items in the Pre-Activation Checklist (Section 4.1.1.1) below. Note that these procedures include watering up the entire facility after a complete dewatering for thorough equipment/facility inspection and/or repairs. For typical operations during shutdown periods, the facility will likely be only partial dewatered (e.g., pumphouse watered and the 36-FWS to Fish Facility in service but fish ladder dewatered and the 24-FWS to the side entrance not in service). Typically, Automatic Startup (section 4.1.1.3) will be implemented following shutdown periods. When automatic startup it is not possible or desirable, Foster Adult Fish Facility startup can be done manually. To start up Foster Adult Fish Facility manually, complete all items in the Pre-Activation Checklist (section 4.1.1.1) and then follow the procedures in the Manual Startup section (section 4.1.1.2).

4.1.1.1. Pre-activation Checklist includes Watering-Up

Before facility startup perform the following:

1. Confirm that all applicable equipment is properly lubricated.
    a. AWS Pump gear drives
    b. FWS flow control valve actuators
    c. Roller gate drum hoist actuators and wire rope sheaves
2. Confirm that instrumentation is ready for operation.
3. Confirm that all electrical equipment and devices are powered.
4. Water up FWS pipelines to FCVs:
    a. Close FWS isolation valves FOS-FWS-VRM01, -VRM02, and –VRM03 in the valve room.
    b. Open each bulkhead purge valve to allow FWS intake piping upstream of the valve room to fill with water and for pressure to equalize across the bulkhead.
    c. Remove the bulkhead for each intake and install the FWS intake trashrack.
    d. Close the FCVs FOS-FWS-PHS01 in the pump room and FOS-FWS-FHB01 in the Headbox Valve Vault (VB-FWS-001).
    e. Close the manual drain valves FOS-FWS-FHB02 and -FHB03 on the 36-FWS in the Valve Vault.
    f. Close the manual gate valve on the 20” FWS pipe in the AWS pump room that drains the pipeline to the aeration chamber.
    g. Close the manual ball valve on the 20” FWS pipe in the AWS pump room that supplies lubrication water to the AWS pump bearings.
    h. Close the manual gate valve on the 20” FWS pipe in the AWS pump room that supplies backup cooling water to the Powerhouse.
    i. Confirm that the isolation valves for the two air vacuum release valves FOS-FWS-VRM04 and –VRM05 are fully open. Air will vent from the air vacuum release valves during filling and will automatically seal closed when the pipelines are full.

j. Slowly open the isolation butterfly valves in the valve room to partially open positions to slowly fill the 36-FWS and 24-FWS pipes. *[CAUTION: Do not allow these valves to open or close in less than 60 seconds.]*
    i. Open the 18-inch isolation valve FOS-FWS-VRM01 for the 36-FWS to a maximum 12% open position.
    ii. Open the 24-inch isolation valve FOS-FWS-VRM03 for the 24-FWS to a maximum 3% open position.



k. After pipelines are completely filled, fully open all three FWS isolation valves.

5. Water up pumphouse:
    a. Raise the main entrance, side entrance, and transportation channel gates to establish weir elevations slightly below the tailrace WSEL.
    b. Open the pumphouse filling gate (Valve J) in the pump room.
    c. Fill the pumphouse with water from the 24-FWS pipe:
        i. Slowly open FOS-FWS-PHS01 to no greater than 65% Open and allow the pumphouse to fill with water to equalize pressure across the pump intake channel and main entrance bulkheads. *[CAUTION: Do not allow these valves to open or close in less than 60 seconds.]*
        ii. The heavy duty flap gate will open to also allow the lower and upper supply channels and main entrance pool to fill along with the pump intake channel.
        iii. Monitor pumphouse WSEL (LT-006 in pump room) using the HMI.
    d. After the pumphouse has filled with water to approximately the tailrace WSEL:

i. Close FOS-FWS-PHS01. *[CAUTION: Do not allow FCV to open or close in less than 60 seconds.]*
ii. Close the pumphouse filling gate.
iii. Remove the pump intake channel bulkhead.
iv. Install the pump intake channel trashrack.
v. Remove the main entrance bulkhead

e. The pumphouse including supply channels and main entrance pool should now be fully watered and ready for operation.

6. Water Up 36-FWS Supply to Headbox:
   a. Ensure the air release valves in the short term post-sort pool supply vault, FOS-FWDS-AIR02, and in the west pre-sort pool valve vault, FOS-FWDS-AIR01, are functional and that their isolation valves are open.
   b. Close all other FWDS valves downstream of the headbox with the exception of the switch gate supply valves, FOS-FWDS-PSF01, FOS-FWDS, PSF-02, and FOS-FWDS-PSF03. These valves shall be opened in order to let air vent from the FWDS pipe while it is filling with water.
   c. Open the ten supply valves to the packed columns (FOS-FWS-FHB04 through –FHB13) and close the ten drain valves (FOS-FWS-FHB14 through –FHB23).
   d. Slowly open FOS-FWS-FHB01 to 50% open position to allow the remainder of 36-FWS to fill. *[CAUTION: Do not allow valve to open or close in less than 60 seconds.]*
   e. Allow all ten supply lines to discharge freely into the packed columns and allow the Headbox to fill up to 6 inches below the overflow weir.
   f. Close the switch gate supply valves, FOS-FWDS-PSF01, FOS-FWDS, PSF-02, and FOS-FWDS-PSF03 when water begins flowing out into the switch gates.
   g. Monitor Headbox WSEL (LT-007) using the HMI.
   h. Slowly close FOS-FWS-FHB01. *[CAUTION: Do not allow valve to open or close in less than 60 seconds.]*
   i. The 36-FWS supply to the Fish Facility is now ready for operation.

7. FWDS
    a. Air may have been trapped in the FWDS piping while it was filled with water. Open the fish pipe supply valves at the sort table in order to bleed off trapped air, FOS-FWDS-STB01 through –STB13. Close the valves once water starts flowing out.
    b. Set FOS-FWS-FHB01, the FWS 24-inch Ball Valve, to discharge approximately 30 cfs (or known desired ladder flow) recorded at Flow Meter FIT-001.
    c. Close pre-sort pool drain valve (FOS-FWDS-PRE01 located in Vault VB-FWDS-001 – see MP 424-425)
    d. Set Presort Valves FOS-FWDS-PSS01 and FOS-FWDS-PSS02 to normal fixed positions: 45% east and 80% west valve (calibrated during initial startup)
    e. Allow upper ladder system to fill (about 30 minutes).
    f. Record Headbox Level (LT-007) and set in auto mode.
    g. The FWDS is now watered up and the fish ladder operational.

4.1.1.2. Manual Startup

Once all items in the Pre-Activation Checklist (section 4.1.1.1) have been completed, follow the procedures below to implement Manual Startup of the Foster Adult Fish Facility. (Note: Automatic Startup should be used when possible.)

1. Verify all automated control processes are in Manual Mode by using any graphic terminal.

2. Prepare AWS pumps (pump room):
    a. Confirm water lubrication system isolation valve is OPEN on bottom of 24-FWS in southeast corner of pump room.
    b. Confirm all four AWS Pump control panels are powered up; white POWER lights should be lit.
    c. For all control panels place the HOA switch in AUTO.
    d. Confirm that LT-002, LT-003, and LT-004 are functional by viewing the HMI “ANALOG SENSORS” status screen. (A value of -99.9 indicates sensor trouble.)

3. For the side entrance water supply:
    a. In the pump room, confirm that actuator PHS-001 is powered - or switch respective circuit breaker at DQ2 to ON.
    b. Place LOCAL/STOP/REMOTE knob on actuator PHS-001 (FCV FOS-FWS-PHS01) in STOP.

4. For the Headbox water supply:
    a. Confirm that actuator HBO-003 is powered - or switch respective circuit breaker at FQ3 (Service Building) to ON.
    b. Confirm that LT-007 works by checking the HMI “ANALOG SENSORS” status screen.
    c. In the Valve Vault, place LSR knob on actuator HBO-003 (FCV FOS-FWS-FHB01) in STOP.

5. For the Fish Ladder Gates:
    a. Confirm that the gate actuators are powered at DQ2 (circuit breakers are ON) and digital displays on actuators are ON.
    b. Confirm that the transportation channel gate is positioned below the water surface.
    c. Confirm that the main entrance and side entrance gates are positioned with the invert of the gate orifice below the water surface.
    d. Place the LOR knob on the gate actuators to the OFF position.

6. Next, manually start and position the following devices in the order listed. If the control system is functional, it will be possible to switch to Automatic control afterwards if desired. In Automatic mode the pumps will automatically start/stop and valves will be modulated in accordance with control set points. In Manual mode operators need to monitor water parameters (e.g., water elevations and flow rates) to regulate the pumps and valves for maintaining proper operating conditions.
    a. AWS Pumps (FOS-AWS-PMP01 thru –PMP04).
        i. Determine tailrace level (LT-003) at a graphic terminal or river staff gauge.
        ii. Establish the number of pumps required to run in accordance with Table 1.
        iii. At the AWS Pump Control Panels, place the HOA switch in HAND for the number of pumps needing to run.
        iv. Confirm that the lubrication water is flowing and functioning properly (i.e. solenoid valve opens and water flow indicated) when the respective pump starts.

Table 1 – Operating Setpoints for Tailwater Elevation (LT-003) for AWS Pumps and FB Water Supply Discharge to Side Entrance

OPERATING SETPOINTS FOR CHANGES IN NUMBER OF AWS PUMPS AND FOREBAY SUPPLY DISCHARGE TO SIDE ENTRANCE					
Falling Tailwater			Rising Tailwater		
	PLC Reduction to:			PLC Increase to:	
LT-003 Elevation (ft)	AWS Pumps	FB supply discharge (cfs)	LT-003 Elevation (ft)	AWS Pumps	FB supply discharge (cfs)
536.0	4	58.3	536.1	4	58.3
530.0	3	38.9	530.1	4	58.3
529.3	2	19.4	529.4	3	38.9
528.0	1	0	528.1	2	19.4
526.1	0	0	526.2	1	0

    b. FWDS (details steps needed in order to move fish from pre-sort pool to a post-sort pool)
        i. Open the anesthetic tank supply valve (FOS-FWDS-ANS01) in order to fill the anesthetic tank. Close the valve once the tank is full.
        ii. Partially open the flume supply valve (FOS-FWDS-PRE03) using actuator PSF-01 to supply required flow to wet the distribution flume.
        iii. Select post-sort pools for usage and open supply valves (FOS-FWDS-LTM01 thru LTM05 and FOS-FWDS-STM01 thru STM04) to fill the pool(s). Ensure post sort pool bulkheads are closed and weirboards are in place. Observe the reading from the applicable flow meter and adjust the pool supply valve in order to reach the pool design flow or desired operational flow. The design flow for the long term post-sort pools and the hopper pit is 1500 gallons per minute. The design flow for the short term post-sort pools is 250 gallons per minute.
        iv. Open the fish pipe ball valve(s) (FOS-FWDS-STB02 thru STB13) at the sorting table that corresponds to the post-sort pool(s) that are filling and that fish will be placed in. Design flow for the fish pipes is approximately 550 gpm. Use discretion when setting the valve opening. Flow rate should be sufficient to meet the biological needs of fish, but avoid putting so much flow through the fish pipes that

it overwhelms the dewatering device at the end of the pipe and flows into the post sort pool as this could cause false attraction and cause fish to jump at the wall.

v. Open the false weir drain valve (FOS-FWDS-PRE04).
vi. Open the false weir supply valve (FOS-FWDS-PRE02) in the West Pre-sort pool vault.
vii. Start the false weir pump and increase flow until desired flow over the false weir is achieved.

c. Headbox water supply (FOS-FWS-FHB01).
   i. In the Valve Vault, place LSR knob on actuator HBO-003 (FOS-FWS-FHB01) in LOCAL. Initially open the valve to 25% open position by moving the Open/Close knob to the OPEN position; the actuator will continue to drive the valve open but the knob will return to the neutral position when let go. When the actuator display shows "25%", stop the valve by placing the LSR knob in STOP. [CAUTION: Do not fully open the valve in faster than 60 seconds.]
   ii. Monitor the flow rate in the 36-FWS pipe (FIT-001) either through the HMI "ANALOG SENSORS > FLOW SENSORS" control screen or visually on display at the FIT-001 transmitter outside the holding pool room. [CAUTION: Do not exceed 69 cfs flow rate to avoid high velocity conditions.]
   iii. Monitor the Headbox water level reading for LT-007 at the HMI "ANALOG SENSORS" screen, "HEADBOX VALVE" screen, or visually observe the staff gauge inside the Headbox.
   iv. Adjust the flow control valve position to match Headbox water supply to water demands at the Fish Facility (e.g., supply to pre-sort pool to establish flow down fish ladder). In Manual mode, the water can be allowed to overtop the overflow weir wall and discharge excess water through the drain to the river. In Auto mode, the water level will typically be regulated to ~6 inches below the top of the overflow weir wall.
   v. For recommended adjustments based on Headbox level (LT-007), refer to Table 2
   vi. Regularly check the Headbox water level especially after any change in water demands at the Fish Facility.

Table 2- Manual Adjustments to FWS Ball Valve

PLC for FWS 24-Inch Valve Operation								
HBL = Headbox Water Level = LT-007 (Target 569.5 feet ± 0.2 feet)								
Change Condition:							Action	Change in FWS Discharge
IF HBL ≤	568.8	ft					Increase FW flow	9.6 cfs
IF HBL is between	568.8	ft and	568.9	ft			Increase FW flow	7.0 cfs
IF HBL is between	568.9	ft and	569.0	ft			Increase FW flow	5.5 cfs
IF HBL is between	569.0	ft and	569.1	ft			Increase FW flow	4.1 cfs
IF HBL is between	569.1	ft and	569.2	ft			Increase FW flow	2.8 cfs
IF HBL is between	569.2	ft and	569.3	ft			Increase FW flow	1.7 cfs
IF HBL is between	569.3	ft and	569.7	ft			no change	0.0
IF HBL is between	569.7	ft and	569.8	ft			Decrease FWS Flow	-1.7 cfs
IF HBL is between	569.8	ft and	569.9	ft			Decrease FWS Flow	-2.8 cfs
IF HBL is between	569.9	ft and	570.0	ft			Decrease FWS Flow	-4.1 cfs
IF HBL is between	570.0	ft and	570.1	ft			Decrease FWS Flow	-5.5 cfs
IF HBL is between	570.1	ft and	570.2	ft			Decrease FWS Flow	-7.0 cfs
IF HBL ≥	570.2	ft					Decrease FWS Flow	-9.6 cfs

d. Side entrance attraction water supply (FOS-FWS-PHS01).
    i. In the pump room, place LSR knob on actuator PHS-001 (FOS-FWS-PHS01) in LOCAL. Initially open the valve to the 60% open position by moving the Open/Close knob to the OPEN position; the actuator will continue to drive the valve open but the knob will return to the neutral position when let go. When the actuator display shows "60%", stop the valve by placing the LSR knob in STOP. [CAUTION: Do not open the valve in faster than 60 seconds.]
    ii. Monitor the flow rate in the 24-FWS pipe (FIT-002) either through the HMI "ANALOG SENSORS" status screen or on the FIT-002 transmitter display, which is located outside the holding pool room. [CAUTION: Do not exceed 58 cfs flow rate to avoid high velocity conditions.]
    iii. Note tailwater elevation (LT-003) and refer to Table 1 to determine required discharge in 24-inch FWS supply to side entrance.
    iv. Adjust the position of FOS-FWS-PHS01 to establish appropriate discharge (± 5 cfs) in the 24-FWS supply to the side entrance.
e. Fish ladder gates (RG-001, RG-002, TG-001).
    i. Operators will likely want to wait until a stable water flow (30 cfs) is established down the fish ladder and emptying into pool 1.
    ii. Determine WSELs in pool 1 (LT-002), tailrace (LT-003), transportation channel (LT-004), and stilling basin (LT-005) through the HMI "ANALOG SENSORS" status screen or by observing the staff gauges in the river and water passages.
    iii. Raise the main entrance gate (RG-001) to establish the entrance head (water surface in pool 1 (LT-002) - tailrace (LT-003)) is 1.0 -1.5 feet (1.25 feet, optimum) above the
        1. At the gate actuator place the LOCAL/OFF/REMOTE switch in LOCAL.
        2. Push the CLOSE button to raise the gate. Push the STOP button when the water level approaches the correct WSEL in pool 1.
        3. Adjust the gate position as necessary using the OPEN/STOP/CLOSE buttons to fine tune the water surface differential.
        4. See Table 3 for recommended adjustment of RG-001 based on entrance head reading.

    iv. Position the transportation channel gate (TG-001) to set the weir invert 2.0 feet below the tailwater elevation (LT-003) at the main entrance.
        1. At the gate actuator place the LOR switch in LOCAL.
        2. Push the OPEN button to lower the gate. Push the STOP button when the gate invert approaches the correct elevation.
    v. Raise the side entrance Gate (RG-002) to establish a water surface in pool 1 (LT-002) that is 0.25 feet (or 3 inches) (±0.05 feet) above the water surface level in the side entrance pool (LT-004).
        1. At the gate actuator, place the LOR switch in LOCAL.
        2. Push the CLOSE button to raise the gate. Push the STOP button when the water level approaches the correct WSEL in the transportation channel.
        3. Adjust the side Entrance gate and transportation channel gate positions as necessary using the OPEN/STOP/CLOSE buttons to fine tune the water surface differentials.
        4. See Table 4 for recommended adjustment of RG-002 based on differential reading.

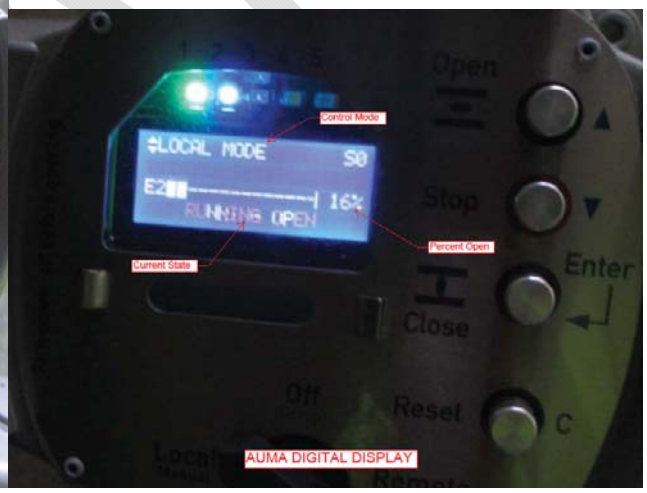
vi. Because each of these gates influences the water flow exiting the fish ladder and the relative position of each of the other gates, repeat these steps for each gate until stable water surface elevations are achieved.

Table 3 – Manual Operation of Entrance Weir Gate to Regulate Entrance Head (DH) and Minimum Pool 1 Depth

PLC for Main Entrance Gate Operation (RG-001)							
DH = Entrance head = LT-002 - LT-003							
Change Condition:					Action	Change in Invert	
IF DH ≤	0.5	ft			Raise Weir Gate	+3	Feet
IF DH is between	0.5	ft and	0.8	ft	Raise Weir Gate	+1.7	Feet
IF DH is between	0.8	ft and	1.0	ft	Raise Weir Gate	+1.1	Feet
IF DH is between	1	ft and	1.1	ft	Raise Weir Gate	+0.6	Feet
IF DH is between	1.1	ft and	1.4	ft	no change		
IF DH is between	1.4	ft and	1.5	ft	Lower Weir Gate	-0.5	Feet
IF DH is between	1.5	ft and	1.7	ft	Lower Weir Gate	-0.8	Feet
IF DH is between	1.7	ft and	2.0	ft	Lower Weir Gate	-1.3	Feet
IF DH ≥	2.0	ft			Lower Weir Gate	-1.6	Feet
Y = Pool 1 Depth = LT-002 - Invert Elevation 522.58 feet							
Change Condition:					Action	Change in Invert	
IF Y ≤	5.5	ft			Raise Weir Gate	0.8 feet	
IF Y is between	5.5	ft and	5.8	ft	Raise Weir Gate	0.4 feet	
IF Y is between	5.8	ft and	6	ft	Raise Weir Gate	0.2 feet	

Table 4 – Manual Operation of Side Entrance Weir Gate to Regulate Differential between Pool 1 & Side Entrance Pool

PLC for Side Entrance Gate Operation								
DH = Head Difference Between Pool 1 & Side Entrance Pool (Target = 0.25 feet)								
DH = Head over Telescoping Gate = LT-002 - LT-004								
Change Condition:						Action	Change in Weir Level	
IF DH ≤	0.1	ft				Lower Weir Gate	-0.35	Feet
IF DH is between	0.1	ft and	0.2	ft		Lower Weir Gate	-0.1	Feet
IF DH is between	0.2	ft and	0.3	ft		no change		
IF DH is between	0.3	ft and	0.4	ft		Raise Weir Gate	0.1	Feet
IF DH ≥	0.4	ft				Raise Weir Gate	0.4	Feet



4.1.1.3. Automatic Startup

Once all items in the Pre-Activation Checklist (section 4.1.1.1) have been completed, follow the procedures below to implement Automatic Startup of the Foster Dam Adult Fish Facility.

1. Automatic Startup assumes the control system is fully functional. At any graphic terminal verify applicable control loops are in Manual mode.
2. Prepare AWS pumps (pump room):
    a. Confirm water lubrication system isolation valve is OPEN on bottom of 24-FWS in southeast corner of pump room.
    b. Confirm all four AWS Pump control panels are powered up; white POWER lights should be lit.

c. For all control panels, place the HOA switch in AUTO.
d. Confirm transmitters LT-002, LT-003, and LT-004 are functional by viewing the HMI "ANALOG SENSORS" status screen. (A value of -99.9 indicates sensor trouble.)

3. For the side entrance water supply:
   a. In the pump room, confirm that actuator PHS-001 is powered - or switch respective circuit breaker at DQ2 to ON.
   b. Place LSR knob on actuator PHS-001 (FCV FOS-FWS-PHS01) in STOP.
4. For the Headbox water supply:
   a. Confirm that actuator HBO-003 is powered - or switch the respective circuit breaker at FQ3 (Service Building) to ON.
   b. Confirm LT-007 works by checking the HMI "ANALOG SENSORS" status screen. (A value of -99.9 indicates sensor trouble.)
   c. In the Valve Vault, place LSR knob on actuator HBO-003 (FCV FOS-FWS-FHB01) in STOP.
5. For the Fish Ladder Gates:
   a. Confirm that the gate actuators are powered at DQ2 (circuit breakers are ON) and digital displays on actuators are ON.
   b. Confirm that the transportation channel gate is positioned below the water surface.
   c. Confirm that the main entrance and side entrance gates are positioned with the invert of the gate orifice below the water surface.
   d. Place the LOR knob on the gate actuators to the REMOTE position.
6. At any HMI, place the following devices in AUTO in the order listed; devices will automatically start or modulate in accordance with control setpoints:
   a. AWS Pumps (FOS-AWS-PMP01 thru –PMP04). Place all four pumps in AUTO and press the "AUTO CONTROL" button if the status light indicates "READY". The number of pumps running will be automatically established based on tailrace WSEL. Reference chapter 8 for additional information.
   b. FWDS (details steps needed in order to move fish from pre-sort pool to a post-sort pool)
      i. Open the anesthetic tank supply valve (FOS-FWDS-ANS01) in order to fill the anesthetic tank. Close the valve once the tank is full.
      ii. Partially open the flume supply valve (FOS-FWDS-PRE03) using actuator PSF-01 to supply required flow to wet the distribution flume.
      iii. Select post-sort pools for usage and open supply valves (FOS-FWDS-LTM01 thru LTM05 and FOS-FWDS-STM01 thru STM04) to fill the pool(s). Ensure post sort pool bulkheads are closed and weirboards are in place. Observe the reading from the applicable flow meter and adjust the pool supply valve in order to reach the pool design flow. The design flow for the long term post-sort pools and the hopper pit is 1500 gallons per minute. The design flow for the short term post-sort pools is 250 gallons per minute.
      iv. Open the fish pipe ball valve(s) (FOS-FWDS-STB02 thru STB13) at the sorting table that corresponds to the post-sort pool(s) that are filling and that fish will be placed in. Design flow for the fish pipes is approximately 550 gpm. Use discretion when setting the valve opening. Flow rate should be sufficient to meet the biological needs of fish, but avoid putting so much flow through the fish pipes that it overwhelms the dewatering device at the end of the pipe and flows into the post sort pool as this could cause false attraction and cause fish to jump at the wall.
      v. Open the false weir drain valve (FOS-FWDS-PRE04).
      vi. Open the false weir supply valve (FOS-FWDS-PRE02) in the West Pre-sort pool vault.

vii. Start the false weir pump and increase flow until desired flow over the false weir is achieved.

c. Headbox water supply flow control valve (FOS-FWS-FHB01). The Headbox FCV will automatically modulate the FWS flow to maintain a WSEL in the Headbox that is at elevation 569.5 feet, approximately 6 inches below the top of the overflow weir wall. The discharge will be held below 69 cfs.

d. Side entrance attraction water supply flow control valve (FOS-FWS-PHS01). The side entrance FCV will automatically modulate the FWS flow delivered to the side entrance to maintain the flow setpoint, typically 19.4 - 58.3 cfs.

e. Fish ladder gates (RG-001, RG-002, TG-001). The vertical lift gates will be automatically positioned to maintain the head differential across the gates.

4.1.2. Normal Facility Operation

4.1.2.1. Normal Operating Criteria

The following information details operational criteria for operation of the facility. Any deviation observed should be reported to the engineering design branch at Block 300.

LADDER

- Ladder entrance head is 12 inches, operationally 1.0 feet ±0.1 feet
- Pool 1 WSEL = 1.0 – 1.5 feet above tailrace WSEL, operationally 1.25 feet ±0.15 feet.

HEADBOX

- Headbox operating water level = 569.5 feet ±0.25 feet. (22.5 Ft. deep +/- 0.25 Ft.)

4.1.2.2. Manual Normal Operation

When automatic operation is not possible or desirable, Foster Adult Fish Facility operation can be accomplished manually. To operate the Foster Adult Fish Facility manually, follow the procedures below. (Note: Automatic Normal Operation should be used when possible.) For the facility to operate satisfactorily, the normal operating criteria in section 4.2.1 must be met. These instructions assume that the Pre-Activation Checklist items have been completed and that water systems are watered up.

In the event the control system is out of service and cannot automatically control the gates, pumps, or valves; there are a number of staff gauges for manual verification of water levels. Operations personnel will need to verify the facility is running within ESA fish criteria during this time.

4.1.2.2.1. Gravity Forebay Water Supply (FWS) System

The FWS System can be operated in manual either locally at the actuator, or remotely via any graphic terminal as follows.

1. FWS attraction water supply to the side entrance – Local Manual:
    a. Confirm the current side entrance attraction water flow rate value and flow control valve (FOS-FWS-PHS01) position on the “SIDE ENTRANCE VALVE” control screen at HMI-3 in the pump room. If the control system is not functional, operators will have to rely

on the valve's characteristic curve that should be developed to document flow versus % valve opening at typical reservoir water surface elevations.

b. In the pump room, place the red Local/Stop/Remote (LSR) selector knob on the actuator housing (PHS-001) for the side entrance flow control valve in LOCAL.
c. Note the tailwater elevation (LT-003) and refer to Table 1 (in Section **Error! Reference source not found.**) to determine the desired discharge for the 24-inch FWS supply to the side entrance.
d. Move the black Open/Stop/Close selector knob on the valve actuator housing into the OPEN or CLOSE position as desired to open or close the FCV; the knob will return to the neutral position when released but the actuator will continue to drive the valve.
    i. If the control system is functional, monitor the side entrance attraction water flow value ("20" Pipe Discharge Rate (CFS)") on the "SIDE ENTRANCE VALVE" control screen or "ANALOG SENSOR" status screen. Adjust the FCV position using the actuator buttons to establish the desired flow rate to the side entrance, typically 19 - 58 cfs.
    ii. If the control system is not functional, adjust the FCV position in accordance with the valve's characteristic curve to establish the desired flow rate to the side entrance, typically 19 - 58 cfs.
e. CAUTION: If there is already water flowing in the pipe, do not close the valve in faster than 60 seconds.
f. NOTE: For complete power failure, it is possible to operate the FCV using the actuator handwheel. To engage the handwheel drive on the actuator housing, turn the Hand/Auto lever clockwise while turning the handwheel. The lever can be released and the handwheel will remain engaged until operated electrically when it will automatically disengage and return to motor drive. Turn the handwheel and monitor the local position indicator to achieve desired valve position.

2. FWS attraction water supply to the side entrance – Remote Manual:
    a. Confirm the current side entrance attraction water flow rate value and flow control valve (FOS-FWS-PHS01) position on the "SIDE ENTRANCE VALVE" screen at HMI-3.
    b. In the pump room, confirm that the red Local/Stop/Remote (LSR) selector knob on the actuator housing (PHS-001) is in REMOTE.
    c. On the "SIDE ENTRANCE VALVE" control screen, click on the MANUAL CONTROL button and then the KEY PAD button. Enter the desired percentage opening on the virtual keypad and press enter. The actuator will position the valve accordingly. [CAUTION: Do not allow the valve to open or close in faster than 60 seconds.]
3. FWS Supply to the Fish Facility – Local Manual:
    a. Confirm the current Headbox water surface level value and flow control valve (FOS-FWS-FHB01) position on the "HEADBOX LEVEL CONTROL" screen at any HMI. (HMI-1 at the Sorting Facility Service Building is the closest.). If the control system is not functional operators will have to rely on a characteristic curve that should be developed to document flow versus % valve opening at typical reservoir water surface elevations and/or operators will have to visually monitor the Headbox water surface level and adjust the valve position in order to maintain a relatively constant Headbox water level.

b. In the Headbox Valve Vault (VB-FWS-001), place the black Local/Stop/Remote selector switch on the actuator (HBO-003) for the Headbox flow control valve in LOCAL.
    i. Move the black Open/Stop/Close selector knob on the valve actuator housing into the OPEN or CLOSE position as desired to open or close the FCV; the knob will return to the neutral position when released but the actuator will continue to drive the valve.
    ii. Monitor the Headbox water level (LT-007) from the "HEADBOX LEVEL CONTROL" screen or "ANALOG STATUS" screen. Adjust the FCV position using the actuator buttons to maintain the desired water level in the Headbox, typically 569.5 feet EL±0.2 feet.
    iii. Refer to Table 2 in Section **Error! Reference source not found.** for suggested discharge adjustments as a function of Headbox level (LT-007).If the control system is not functional, visually monitor water level at the Headbox itself. Adjust the FCV position to maintain the water level in the Headbox at six inches below the top of the overflow weir.
    iv. CAUTION: Do not fully open or close the flow control valve in faster than 60 seconds.
    v. NOTE: For complete power failure, it is possible to operate the FCV using the actuator handwheel. To engage the handwheel drive on the actuator housing, turn the Hand/Auto lever clockwise while turning the handwheel. The lever can be released and the handwheel will remain engaged until operated electrically when it will automatically disengage and return to motor drive. Turn the handwheel and monitor the local position indicator to achieve desired valve position.

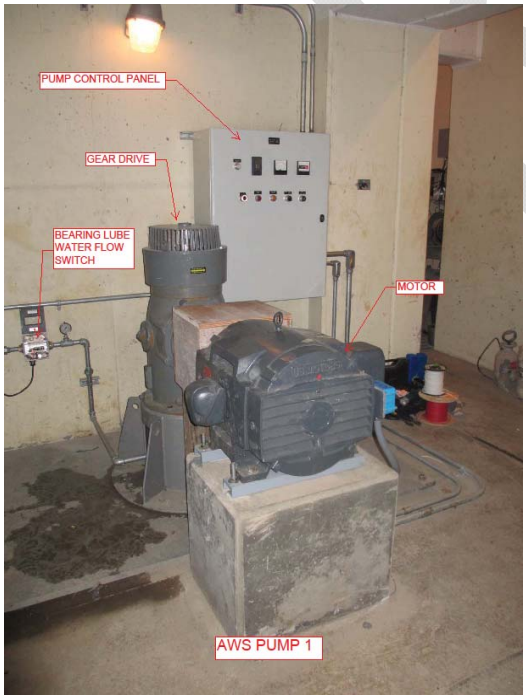
4. FWS Supply to the Fish Facility – Remote Manual:
    a. Confirm the Headbox water surface level value and flow control valve (FOS-FWS-FHB01) position on the "HEADBOX LEVEL CONTROL" screen at any graphic terminal. (HMI-1 at the Sorting Facility Structure is the closest.)
    b. In the Valve Vault confirm that the red Local/Stop/Remote (LSR) selector knob on the actuator housing (HBO-003) is in REMOTE.
    c. On the "HEADBOX LEVEL CONTROL" HMI screen, click on the MANUAL CONTROL button and then the KEY PAD button. Enter the desired percentage opening on the virtual keypad and press enter. The actuator will position the valve accordingly. [CAUTION: Do not allow the valve to open or close in faster than 60 seconds.]
    d. Refer to Table 2 in Section **Error! Reference source not found.** for suggested discharge adjustments as a function of Headbox level (LT-007).

4.1.2.2.2. AWS Pumps

The AWS Pumps can be operated in manual either locally from the pump room or remotely via any graphic terminal. Each AWS pump includes a local control panel, "AWS PUMP NO. # CONTROL PANEL", with reduced-voltage soft-start (RVSS) pump controller, mounted on the wall adjacent to the pump in the pump room. Power is routed through respective circuit breakers mounted in MCC DQ2 in the pump room.

Local Manual:

1. Determine tailrace WSEL (LT-003) either through a graphic terminal "ANALOG SENSORS" status screen or by using the river staff gauge. [NOTE: All new instrumentation and new staff gauges are referenced to the NAVD88 vertical datum.]
2. Start the number of pumps in accordance with the tailrace WSEL (LT-003) and Table 1 in Section **Error! Reference source not found.**. Alternatively, the "AUXILLARY WATER SYSTEM" control screen displays both the number of PUMPS REQUIRED and PUMPS RUNNING in the upper right Status area. [Note that AWS Pump No. 1 should always run as originally designed to be dedicated to the upper supply channel.]
    a. At the respective pump control panel, confirm that the panel is powered as indicated by the white POWER lamp.
    b. Confirm that the Emergency Stop (E-Stop) button is pulled out.
    c. Place the NORM/EMERG BYPASS switch in the NORM (normal) position, which will start the pump with the soft starter.
    d. Place the Hand/Off/Auto (HOA) switch in HAND and the pump will start running as indicated by the red RUN lamp.
    e. Repeat as necessary for the required number of pumps to run.
3. After starting each pump, confirm that the respective pump lubrication water system solenoid valve automatically opens with pump start and that water is flowing to the lineshaft bearings as observable at the flow switch.
4. NOTE: In the event that a soft start controller is not functional or is faulted, each pump can also be started by using the emergency bypass starter; see Emergency Operation section for operational steps.



Remote Manual:

1. Determine tailrace WSEL (LT-003) from a graphic terminal "ANALOG SENSORS" status screen or by using the river staff gauge. [NOTE: All new instrumentation and staff gauges are referenced to the NAVD88 vertical datum.
2. Start the number of pumps in accordance with the tailrace WSEL (LT-003) and Table 1 in Section **Error! Reference source not found.**. Alternatively, the "AUXILARY WATER SYSTEM" control screen displays both the number of PUMPS REQUIRED and PUMPS RUNNING in the upper right Status area. [Note that AWS Pump 1 should always run as originally designed to be dedicated to the upper supply channel.]
    a. At the respective pump control panel, confirm that the panel is powered as indicated by the white POWER lamp.
    b. Confirm that the Emergency Stop (E-Stop) button is pulled out.
    c. Place the NORM/EMERG BYPASS switch in the NORM (normal) position, which will include the soft starter in the motor circuit.
    d. Place the Hand/Off/Auto (HOA) switch in AUTO.
    e. At HMI-3 (or any HMI if all steps above have been completed), click the "AWS PUMPS" button to open the "AUXILARY WATER SYSTEM" control screen.
        i. Click the MANUAL CONTROL button to enable manual pump operation. The "SYSTEM IN MANUAL" indicator will be displayed as red below the button.
        ii. Place each MAN/OFF/AUTO sector switch in the "MAN" position.
        iii. Click the START PUMP button for the desired pump. After starting the "RUNNING" indicator will be displayed as green below the button in the pump's Status area.
    f. At the pump control panel, the running pump will be indicated by the red RUN lamp.
    g. Repeat as necessary for the required number of pumps to run.
5. After starting each pump, confirm that the respective pump lubrication water system solenoid valve automatically opens with pump start and that water is flowing to the line shaft bearings as observable at the flow switch.

4.1.2.2.3. Fish Ladder Gates

The Fish ladder gates (RG-001, RG-002, TG-001) can be operated in manual at the gate actuator (local) or remotely from a graphic terminal as follows.

Local Manual:

1. These procedures assume that a stable water flow (~30 cfs) has already been established down the fish ladder that empty into pool 1.
2. Determine WSELs in pool 1 (LT-002), tailrace (LT-003), transportation channel (LT-004), and stilling basin (LT-005) either through the HMI "ANALOG SENSORS" status screen or by observing the staff gauges in the river and water passages.
3. Raise the main entrance gate to establish a water surface in pool 1 that is 12 inches above the tailrace.
    a. At the gate actuator, place the LOR switch in LOCAL.

b. Push the CLOSE button to raise the gate. Push the STOP button when the water level approaches the correct WSEL in pool 1.
c. Adjust the gate position as necessary using the OPEN/STOP/CLOSE buttons to fine tune the water surface differential.
d. Refer to Table 3 in Section **Error! Reference source not found.** for suggested RG-001 adjustment based on entrance head (LT-002 – LT-003).

4. Position the transportation channel Gate (TG-001) to set the weir invert 2.6 feet below the water surface in pool 1.
   a. At the gate actuator, place the LOR switch in LOCAL.
   b. Push the OPEN button to lower the gate. Push the STOP button when the gate invert approaches the correct elevation.
   c. TG-001 = Tailwater elevation (LT-003) – 2 feet.
5. Raise the side entrance gate (RG-002) to establish a water surface in the transportation channel that is 9 inches above the stilling basin WSEL.
   a. At the gate actuator, place the LOR switch in LOCAL.
   b. Push the CLOSE button to raise the gate. Push the STOP button when the water level approaches the correct WSEL in the transportation channel.
   c. Adjust the side entrance gate and transportation channel gate positions as necessary using the OPEN/STOP/CLOSE buttons to fine tune the water surface differential.
   d. Refer to Table 4 in Section **Error! Reference source not found.** for suggested RG-002 adjustments based on differential between pool 1 and side entrance pool (LT-002 – LT-004).
6. Because each of these gates influences the water flow exiting the fish ladder and the relative position of each of the other gates, repeat these steps for each gate until stable water surface elevations are achieved.

Remote Manual:

1. These procedures assume that a stable water flow (~30 cfs) has already been established down the fish ladder that empties into pool 1.
2. Determine WSELs in pool 1 (LT-002), tailrace (LT-003), transportation channel (LT-004), and stilling basin (LT-005) either through the HMI "ANALOG SENSORS" status screen or by observing the staff gauges in the river and water passages.
3. At any HMI press the "GATE SUMMARY" button to open the fish ladder gates control screen.
4. Adjust the position of the main entrance gate to establish an entrance head (water surface in pool 1 (LT-002 - the tailrace WSEL (LT-003)) that is 1.25 feet ± 0.15 feet above as follows:
   a. From the HMI verify the actuator LOR switch is in REMOTE and the alarm status shows "OKAY". A green "READY" indicator should be visible above the "MANUAL CONTROL" button.
   b. Press the "MANUAL CONTROL" button to place the gate in manual mode. A red "M" should be visible for manual mode.
   c. Press the KEY PAD button and enter the gate % closed value for achieving the desired head differential across the gate (typically 12 inches). Note that all gate actuator positions are in % Closed, not % Open.
   d. On the same control screen under *PROCESS STATUS*, monitor the "Pool 1 - Tailrace" calculated value to confirm proper gate position.
   e. Readjust gate position using the virtual keypad as necessary to fine tune the gate head differential.
   f. Refer to Table 3 in Section **Error! Reference source not found.** for suggested RG-001 adjustment based on entrance head (LT-002 – LT-003).
5. Adjust the position of the transportation channel gate so that the invert is 2.0 feet below the tailrace WSEL (LT-003) as follows:
   a. Repeat previous step 4a for the transportation gate.

b. Repeat previous step 4b for the transportation gate.
c. Press the KEY PAD button and enter the gate % closed value for achieving the desired top of gate elevation, which is typically 2ft below the main tailrace water surface. Note that all gate actuator positions are in % Closed. At 100% closed the gate is fully raised blocking all flow. At 15% closed the channel is 100% open, permitting full flow.
d. On the same control screen under *PROCESS STATUS*, monitor the "Main Tailrace – 2Ft." calculated value to confirm proper gate position.
e. TG-001 = Tailrace (LT-003) – 2 feet.
f. Readjust the gate as necessary to fine tune the top of gate position.

6. Adjust the position of the side entrance gate to establish a differential in water surface so that pool 1 is 0.25 feet ±0.05 feet above the side entrance pool (LT-004) as follows:
   a. Repeat previous step 4a for the side entrance gate.
   b. Repeat previous step 4b for the side entrance gate.
   c. Press the KEY PAD button to move the gate to a % closed position. Note the minimum setting is 10.4% closed (gate lowered allowing full flow). The maximum setting is 85.5% closed (gate raised blocking flow).
   d. On the same control screen under PROCESS STATUS, monitor the "Pool 1 – Side Pool" to confirm proper gate position.
   e. Readjust gate position using the virtual keypad as necessary to fine tune the pool differential.
   f. Refer to Table 4 in Section **Error! Reference source not found.** for suggested RG-002 adjustments based on differential between pool 1 and side entrance pool (LT-002 – LT-004).

4.1.2.2.4. Sorting Operations

Before fish jump over the false weir or are crowded out of the pre-sort pool, the facility operator should decide if any fish will be diverted by a switch gate. If switch gate diversion is a possible course of action, open the appropriate switch gate supply valve preemptively so that water flows down the associated fish pipe prior to diverting fish through a switch gate.

Fish not diverted through a switch gate will go to the anesthetic tank. After fish are anesthetized, the operator may take them out of the tank and either place them in the recovery tank for return to river (note: only resident fish, or juvenile salmon or steelhead are to be placed in the recovery tank and returned to the river, adult salmon or steelhead are not to be returned to the river by this method), or placed them in a fish transport pipe for deposition into a post-sort pool. The fish transport pipes on the west side of the sorting table go to the short term post-sort pools while the fish transport pipes on the east side of the sorting table lead to the long term post-sort holding pools. The operator will ensure the corresponding fish pipe water supply valve (located under the sort table, directly below each fish pipe) is open and water is flowing into the fish transport pipe at the desired rate prior to placing fish in the pipe. Also ensure that the receiving post-sort pool is full of water (water is overflowing the weir boards) and that water is being supplied to the pool at the design flow rate.

4.1.2.2.5. Post-Sort Pool Operations

Once a post-sort pool is full of fish and/or the facility operator chooses to haul a pool of fish to another destination, the following procedures should be followed.

a. Fill the crowding channel with water. If fish are to be crowded to the hopper, open the hopper pit supply valve (FOS-FWDS-STC01) in the long term supply vault. If fish are to be crowded to the fish lock, open the fish lock supply valve (FOS-FWDS-FLK01) using actuator FLS-01. Both valves may be opened to fill the crowding channel quickly. Close the appropriate valve when the water level in the channel reaches full height.

b. Ensure the fish lock drain valve (FOS-FWDS-FLK02) is closed.

c. With the post-sort pool crowder (long term or short term) parked on its trolley, move the trolley to the post-sort pool to be crowded.

d. Drive the crowder off the trolley and over the post-sort pool so that the vertical barrier screen can be raised. It is advised to lower the vertical barrier screen as close to the pool drain screen as possible so that fish do not end up behind the vertical barrier screen once it is lowered.

e. Position crowding channel crowder in appropriate location (see paragraph 4.1.2.2.6 below).

f. Fully raise post-sort pool bulkhead.

g. Fully lower post-sort pool crowder vertical barrier screen.

h. Move the crowder forward and crowd fish out of the post-sort pool.

i. Once fish have exited the post-sort pool and entered the crowding channel, fully close the post - sort pool bulkhead.

j. Fully raise the post-sort pool crowder vertical barrier screen and return crowder to its parked position on the trolley.

4.1.2.2.6. Crowding Channel Operations

The crowding channel is used to crowd fish to the hopper for truck transport, or to the fish lock for return to the anesthetic tank. The crowding channel crowder has two vertical barrier screens for this reason. When crowding fish to the hopper, follow these steps:

a. Fully lower the southern vertical barrier screen (Screen #1 on the pendant).

b. Move the crowder so that the face of the lowered vertical barrier screen is just to the north of the bulkhead opening of the post-sort pool from which fish are to be crowded.

c. Ensure the hopper is positioned in the hopper pit before opening the post-sort pool bulkhead.

d. Once fish have been crowded out of the post-sort pool and into the crowding channel, and the post-sort pool bulkhead lowered, move the crowding channel crowder south towards the hopper.

e. After the crowding channel crowder stops at its southern travel limit by the hopper, raise the hopper and load fish into the fish transport truck.

f. Reverse the crowding channel crowder until clear of the hopper hoist structure, then fully raise the southern vertical barrier screen.

If fish are to be crowded into the fish lock, follow the procedures below.

a. Ensure the fish lock brail is fully lowered and the fish lock bulkhead is fully raised.

b. Fully lower the northern vertical barrier screen (Screen #2 on the pendant) on the crowding channel crowder.

c. Move the crowding channel crowder so that the face of the protruding screen section is just to the south of the bulkhead opening of the post-sort pool from which fish are to be crowded. If needed, steps g. and h. can be interchanged.

d. Once fish have been crowded out of the post-sort pool into the crowding channel, and the post-sort pool bulkhead closed, move the crowding channel crowder towards the fish lock.

e. After the crowding channel crowder stops at its northern travel limit by the fish lock, lower the fish lock bulkhead.

f. Reverse the crowding channel crowder until the vertical barrier screen is clear of the fish lock opening, then fully raise the northern vertical barrier screen.

4.1.2.2.7. Fish Lock Operations

After fish have been crowded into the fish lock and the bulkhead fully lowered, keep the fish lock supply valve open until water fills the fish lock chamber and begins to overflow down the return flume to the anesthetic tank. The fish lock supply valve can be adjusted manually from the fish lock control panel so that the fish lock chamber fills and then overflows at the Operator's desired rates. Once the fish lock is full of water, raise the fish lock brail in order to raise the fish and meter them out into the return flume. Once all the fish have been brailed out of the fish lock, fully lower the fish lock brail. Open the fish lock drain valve in order to drain water from the fish lock. IMPORTANT: do not attempt to raise the fish lock bulkhead when there is a head differential across it. The water level in the crowding channel and the water level in the fish lock must be approximately equal before opening the fish lock bulkhead. Failure to comply will break the bulkhead hoisting cables.

4.1.2.3. Automatic Operation

To operate the Foster Adult Fish Facility in Automatic mode, follow the procedures below. For the facility to operate satisfactorily, the normal operating criteria in section 4.2.1 must be met. These instructions assume that the Pre-Activation Checklist items have been completed, water systems are watered up, and properly started up. START-UP ORDER NEEDS TO BE INCLUDED, OTHERWISE LADDER FLOW MAY OVERTOP ENTRANCE GATES?.

4.1.2.3.1. Gravity Forebay Water Supply System

The FWS System is designed to function automatically by implementing the following steps:

1. FWS attraction water supply to side entrance:
    a. Place the side entrance FCV actuator (PHS-001) red LSR selector switch in REMOTE.

b. At any graphic terminal navigate to the "*SIDE ENTRANCE VALVE*" screen. Verify the green "*READY*" symbol is visible above the "*AUTO CONTROL*" button.
c. After pressing the "*AUTO CONTROL*" button a green circle with "A" should appear.
d. The Side entrance FCV (FOS-FWS-PHS01) should modulate automatically to maintain the flow rate setpoint for supplying attraction water to the side entrance.

2. FWS supply to Fish Facility:
   a. Place the Headbox FCV actuator (HBO-003) red LSR selector switch in REMOTE.
   b. At any graphic terminal navigate to the "HEADBOX V*ALVE*" screen. Verify the green "*READY*" symbol is visible above the "*AUTO CONTROL*" button.
   c. After pressing the "*AUTO CONTROL*" button a green circle with "A" should appear.
   d. The Headbox FCV (FOS-FWS-FHB01) should modulate automatically to maintain the Headbox level setpoint for supplying FWS water to meet Fish Facility demands.
   e. Manually adjust the ten manual 14-inch butterfly valves at the Headbox as necessary to equalize FWS flow to the ten packed columns.

4.1.2.3.2. AWS Pumps

In normal operation the AWS Pumps are designed to function automatically in response to river level by performing the following:

1. Place the Pump HOA selector switch in AUTO at each pump control panel.
2. At any graphic terminal navigate to the "AWS PUMP" screen and verify that all pump selector switches are in the AUTO position.
3. Verify the "*READY for AUTO*" light is visible below the "*AUTO CONTROL*" button.
4. After pressing the "*AUTO CONTROL*" button the "*SYSTEM in AUTO*" light should illuminate.
5. Check that the pump control setpoints established through the control screen are in accordance with the recommended operating procedures in Table 1 in Section **Error! Reference source not found.**.

4.1.2.3.3. Fish Ladder Gates

In normal operation the Fish Ladder Gates are designed to function automatically in response to river level and attraction water flows by performing the following steps:

1. Place the three roller gate actuators in REMOTE using the LOR selector switch on each unit.
2. At any graphic terminal navigate to the "GATE SUMMARY" screen. Alternatively each individual gate control screen may be used.
3. At the HMI verify each actuator LOR switch shows "REMOTE" and the alarm status shows "OKAY". A green "READY" indicator should be visible above each "AUTO CONTROL" button.
4. Place the two Fish Ladder Entrance Gates (RG-001 and RG-002) and the transportation channel gate (TG-001) in AUTO.
5. After pressing the "AUTO CONTROL" button a letter "A" within a green circle should appear, indicating automatic mode.

4.1.2.3.4. Pre-Sort Pool Operations

4.1.3. Normal Facility Shutdown

To shut down the Foster Adult Fish Facility AWS system, follow the procedures in section 4.1.3.1 AWS System Shutdown. To shut down the entire Foster Adult Fish Facility, follow the procedures in sections 4.1.3.2 (Facility Shutdown) and 4.1.3.3 (Dewatering Procedure).

4.1.3.1. Attraction Water Systems Shutdown

When fish trapping is to be curtailed, the attraction water systems, side entrance FWS water and AWS Pumps, are no longer needed. To shut down the Foster Adult Fish Facility attraction water systems, follow the procedures below.

Prior to beginning these shutdown procedures, lower the picket gates at both the main entrance and side entrance to exclude fish from entering the ladder system. Facility shutdown cannot be implemented until all fish have traveled up the ladder and/or been processed or removed from all fish facilities.

4.1.3.1.1. Side Entrance Attraction Water Shutdown

1. Place the side entrance FCV actuator (PHS-001) LOR switch in LOCAL.
2. Slowly close the FCV by pushing the CLOSE pushbutton. CAUTION: Do not close the valve in faster than 60 seconds. Cycle the actuator between STOP and CLOSE as necessary to regulate closing time.

Alternatively (Remote Manual):

1. At any HMI navigate to the “SIDE ENTRANCE VALVE” control screen, and verify the side entrance FCV actuator (PHS-001) LOR switch is in REMOTE and the status is “OKAY”.
2. From the same HMI screen, verify the green “READY” indicator is visible above the “MANUAL CONTROL” button.
3. After placing the side entrance FCV (FOS-FWS-PHS01) in manual, a letter “M” within a red circle should be visible.
4. Close the FCV by entering 0.0% open using the virtual keypad.

4.1.3.1.2. AWS Pumps Shutdown

1. At each AWS Pump control panel, place the HOA switch for each Pump (FOS-AWS-PMP01 thru – PMP04) in OFF.
2. Confirm that the bearing lube water supply solenoid valve closes.

Alternatively (Remote Manual):

1. At any HMI navigate to the “AWS PUMP” screen. Verify the HOA switch for each Pump (FOS-AWS-PMP01 through PMP04) is in AUTO.
2. Press the red “STOP” button for each pump to be stopped.

4.1.3.2. Facility Shutdown

To shut down the Foster Adult Fish Facility, follow the procedures below, and in section 4.1.3.3 (Dewatering Procedure). To shut down only the attraction water systems, follow the procedures in section 4.1.3.1. AWS System Shutdown.

4.1.3.2.1. Side Entrance Attraction Water Shutdown

1. Place the side entrance FCV actuator (PHS-001) LOR switch in LOCAL.
2. Slowly close the FCV by pushing the CLOSE pushbutton. CAUTION: Do not close the valve in faster than 60 seconds. Cycle the actuator between STOP and CLOSE as necessary to regulate closing time.
3. In the pump room, place the LSR knob in the STOP position at actuator PHS-001.

Alternatively (Remote Manual):

1. At any HMI navigate to the "SIDE ENTRANCE VALVE" control screen, and verify the side entrance FCV actuator (PHS-001) LOR switch is in REMOTE and the status is "OKAY".
2. From the same HMI screen, verify the green "READY" indicator is visible above the "MANUAL CONTROL" button.
3. After placing the side entrance FCV (FOS-FWS-PHS01) in manual, a letter "M" within a red circle should be visible.
4. Close the FCV by entering 0.0% open using the virtual keypad.
5. In the pump room, place the red LSR knob in the STOP position at actuator PHS-001.

4.1.3.2.2. AWS Pumps Shutdown

1. At each AWS Pump control panel, place the HOA switch for each Pump (FOS-AWS-PMP01 thru – PMP04) in OFF.
2. Confirm that the bearing lube water supply solenoid valve closes.

Alternatively (Remote Manual):

1. At any HMI navigate to the "AWS PUMP" screen. Verify the HOA switch for each Pump (FOS-AWS-PMP01 through PMP04) is in AUTO.
2. Press the red "STOP" button for each pump to be stopped.
3. For extended shutdowns, turn off the bearing lubrication water system by shutting the supply valve on the 24-FWS pipe and opening the solenoid valve bypass valve for each pump to allow the piping to drain.

4.1.3.2.3. Fish Facility

1. Dewater the pre-sort pool:
    a. Shut the two pre-sort pool supply valves (FOS-FWDS-PSS01 and FOS-FWDS-PSS02). These are 20" butterfly valves with electric actuators. They can be actuated remotely via the HMI or locally at each actuator. This will stop water from flowing into the pre-sort pool. The water in the pool will drain down the fish ladder until the water reaches the crest of the finger weir (approximate 5 foot water depth in pool).
    b. Open the pre-sort pool drain valve (FOS-FWDS-PRE01) located in the East pre-sort pool supply vault. This is an 8" butterfly valve that is manually actuated. This will drain the remaining water from the pre-sort pool and floor diffuser pits to the river via the storm sewer system.
    c. Open the pre-sort pool Brail pit drain valve (FOS-FWDS-PRE05). This is a 2", manually actuated ball valve.

2. FWS supply to Headbox:
    a. At any HMI, navigate to the "HEADBOX VALVE" control screen and verify the Headbox FCV (FOS-FWS-FHB01) LOR switch is in REMOTE and the status is "OKAY".

b. From the same HMI screen, verify the green "READY" indicator is visible above the "MANUAL CONTROL" button.
c. After placing the valve in manual control mode, the letter "M" within a red circle should be visible.
d. Close the FCV by entering 0.0% open using the virtual keypad.

3. Dewater the Headbox and FWDS.

The Facility Water Distribution System is interconnected. Individual points of use have isolation valves and can be shut down separately from the system. As part of the follow on contract, two stainless steel slide gates were installed inside the headbox that allow facility operators to shut off flow to each branch of the FWDS independently. Therefore, the post sort pool area can be dewatered while maintaining operations at the presort pool, sorting area, and fish ladder. Alternately, the presort pool, fish ladder, and sorting area could be dewatered while continuing to hold fish in the post sort pools. The steps below outline procedures to dewater each branch of the FWDS as well as the entire facility.

a. To dewater the post sort pools while maintaining fish ladder flow, perform the following:
    1) Close all post sort pool supply valves, hopper pit supply valve, and fish lock supply valve so that the slide gate can be closed under a no flow condition.
    2) Close the slide gate valve on the post sort pool branch of the FWDS. This slide gate is on the South side of the headbox.
    3) Assuming multiple post sort pools and the crowding channel are watered up, open the post sort pool bulkheads so that the post sort pools and crowding channel are hydraulically connected.
    4) Under a balanced head, open the fish lock bulkhead.
    5) Open all three switchgate supply valves, FOS-FWDS-PSF01, FOS-FWDS-PSF02, and FOS-FWDS-PSFPSF03. These are the high points in this branch and will allow air to enter the pipes while draining.
    6) Open the fish lock supply valve, FOS-FWDS-FLK01. This is the low point in the system and will drain the majority of the water in the piping.
    7) Open the fish lock drain valve, FOS-FWDS-FLK02. This will drain all water in the piping and post sort pools to the outfall structure at the river.
    8) If the post sort pool supply pipes under each post sort pool need to be drained, use the recirculation pumps in drainage mode.

b. To dewater the presort pool and fish ladder while maintaining operations in the post sort pools, perform the following:
    1) Notify ODFW and prepare to perform fish salvage operations in the presort pool and fish ladder.
    2) Close the presort pool supply valves, FOS-FWDS-PSS01 and FOS-FWDS-PSS02, in accordance with fish ladder dewatering and fish salvage procedures.
    3) Close all other supply valves in the sorting area. This will allow the slide gate to close under a no flow condition.
    4) Close the slide gate on the presort pool/sorting area branch of the FWDS. This in on the West side of the headbox.
    5) Open the flume supply valve, FOS-FWDS-PRE03. This is the high spot on this branch and will allow air to enter the system while draining.
    6) Open the presort pool drain valve, FOS-FWDS-PRE01, and the brail pit drain valve, FOS-FWDS-PRE05. This will drain the piping to the pre-sort pool floor and brail pit elevation.
c. To dewater the entire FWDS to include the headbox, perform the following:

1) Ensure all post-sort pools and the Central Crowding Channel are at the same water depth (full) by opening the associated water supply valve. Then open all post-sort pool bulkheads. This hydraulically connects the entire post-sort area. Alternately, each post-sort pool could be drained separately by lifting out the weirboards at the end of each pool.
2) Open the flume supply valve, fish pipe supply valves at the sorting table, and switch gate valves. In addition to drawing water from the Headbox and draining it more quickly, these valves are the high points in the system. In addition the combination air/vacuum release valves located in the short term post-sort pool supply vault and the West pre-sort pool supply vault these high point valves will allow air to enter the system while draining the pipelines.
3) Open the fish lock drain valve and the fish lock supply valve. The fish lock is the low point in the system. All water in the FDWS pipes will ultimately drain through the fish lock supply line and out the fish lock drain to the river via the storm sewer system.

4.1.3.3. Dewatering Procedure

After completing the Facility Shutdown procedures (section 4.1.3.2) follow the procedures below to dewater the Foster Adult Fish Facility.

1. Dewater FWS Pipelines:
    a. Close FWS isolation valves FOS-FWS-VRM01, -VRM02, and –VRM03 in the valve room.
    b. At any HMI open FOS-FWS-PHS01 to the 25% open position to drain the 24-FWS through the lower dissipator and side entrance. The air vacuum release valve in the valve room will allow air to enter to prevent vacuum conditions in the pipe.
    c. In the Valve Vault, open the two globe drain valves to slowly drain the 36-FWS through the storm drain system to the river. The air vacuum release valve in the valve room will allow air to enter to prevent vacuum conditions in the pipe.
    d. At the Headbox, confirm that all ten butterfly valves are fully open on the 14-FWS supply pipes.
2. Dewater pumphouse:
    a. At main entrance, remove the pump intake trash rack.
    b. Install the pump intake bulkhead.
    c. Prepare the drainage system in the Powerhouse.
    d. Open the drain valve in the main entrance sump, which will allow the remaining water in the pumphouse to drain to the Powerhouse.

4.1.4. Emergency Operations

4.1.4.1. Power Outage

Given that fish collection is a non-critical operation at Foster Dam and the capacity limitations of the existing emergency generator, there is limited fish facility equipment provided with emergency backup power at the site. Since the FWS system conveys water by gravity, the water supply to the fish facility, including the fish holding pools, and attraction water to the side entrance can be maintained during a power outage. The FWS flow control valves will fail in the last position so flow will automatically continue with no action taken. The following procedures address the operational steps for addressing power outage operations.

1. 24-FWS to side entrance:

a. The flow control valve will fail in last position and it may not be necessary to take any action. To provide some safeguard that excessive velocities are not generated in the pipe, the FCV could be closed slightly using the manual handwheel (See Manual Normal procedures for more details).

2. 36-FWS Supply to Fish Facility:
   a. The Headbox flow control valve will fail in last position and it may not be necessary to take any action. To assure that all water demands are met at the Fish Facility, the valve could be adjusted manually to produce enough flow to slightly overtop the Headbox overflow weir (See Manual Normal procedures for more details). Otherwise, the level in the Headbox can be visually monitored and the valve manually adjusted to maintain adequate water level. This will assure that water continues to flow down the fish ladder and not strand any fish in transit up the ladder.
   b. [other procedures at Fish Facility; need input from USACE]
3. AWS Pumps: The AWS Pumps are strictly for attraction water and will not operate during a power outage.

4.2. Equipment Operations

4.2.1. Fish Ladder

[All equipment procedures are covered in the facility operations (see Section 4.1 for details).

4.2.2. Headbox

[All equipment procedures are covered in the facility operations (see Section 4.1 for details).

4.2.3. Pre-Sort Pool

4.2.3.1. Finger Weir

The finger weir can be raised and lowered manually by a hand winch on the NE end of the pre-sort pool. The level should be set in accordance with the fish biologist's recommendations. The crest of the finger weir shouldn't be so far out of the water as to impede fish from entering the pool. Nor should it be so low that fish are able to easily fall back out of the pre-sort pool into the fish ladder.

4.2.3.2. Crowder

The pre-sort crowder can be operated at the either the Presort Control Console or the Pre-sort Crowder Control Cabinet, shown in Figure 12. A description of each button function is provided below:

SPEED: Select between two crowder speeds, 'Lo' and 'Hi'.

RAISE: Raises crowder screen.

LOWER: Lowers crowder screen.

CROWD (FWD): Moves crowder forward toward false weir (east).

PARK (REV): Reverses crowder away from false weir (west).

STOP: Stops all crowder operation.

ENABLE: This button must be pressed in the event and E-STOP button is actuated.

Crowder Control Cabinet

Operator Station at False Weir Platform

4.2.3.3. False Weir

The false weir attraction flow is supplied by pump. Operate the false weir at the Pre-sort Control Console. The false weir controls are shown in more detail in Figure 13. To turn the false weir on, push the 'START VFD' button. Flow can be regulated using the turn dial, set dial to 0% for minimum flow and 100% for maximum flow. To turn the false weir off and stop flow, push the 'STOP VFD' button.

4.2.3.4. Closure Gate

The Closure Gate prevents the fish from entering the false weir and flume when processing is temporarily suspended. The closure gate is operated by a winch with an automatic brake. The winch is located adjacent to the gate and is operated manually to open and close the gate.

4.2.3.5. Pre-Sort Brail

The pre-sort brail is intended to be used in the last step of crowding if the adult fish do not move volitionally by way of the false weir. The brail only activates when the crowder has reached its full crowder position. By depressing the 'raise' button the brail will move up in the water column until the operator presses the stop button. The brail may be moved down or up from an intermediate position if the brail is stopped prior to reaching its lower or upper limit.

For maintenance purposes limits can be overridden and the brail can be operated with the crowder in the parked position.

4.2.3.6. Pre-Sort Pool Piping

The primary portions of this pipe are buried or embedded. The pipe material is schedule 40/80 PVC and the pipe embedded in concrete is stainless steel. System pressure varies based on head box water surface elevation and can never exceed 20 PSI.

4.2.3.7. False Weir Water Supply and Drain

These are 6"actuated valves that regulates the water traveling down the Transport flume. Up to 1.25 CFS can be supplied for passage operations sourced from the FWS.

4.2.3.8. Valves

Process valves in the Pre-sort area are butterfly valves operated by lever or electric actuator.

4.2.3.9. Diffusers

There are two Pre-sort diffusers each one is supplied by 16" diameter pipe as part of the FWS piping system. Diffusers should be inspected annually for sediment and debris accumulation. The screen for each pool should be removed and pressure washed to remove debris. Remove the porosity plates located below the diffuser grating and pressure wash them to remove debris. Sediment and debris should also be removed from the pit area below the porosity plate. It is recommended that the majority of the debris is removed and disposed of in accordance with local laws and regulations.

4.2.4. Sort Facility

4.2.4.1. Switch Gates

Switch gates are used to direct incoming fish to desired locations. The label above each button indicates the location where each fish will be deposited. Momentarily press the desired pushbutton to open the switch gate. Switch gate will close upon release of the pushbutton. The "Return-to-River" switch gate can be held open indefinitely by switching the "SWITCHGATE CONTROLS" selector switch (on the Pre-sort Control Console) to "WINTER RETURN". This selector switch should normally be in the "NORMAL" position. The switch gate speed can be adjusted by needle valve. Switch gate operation should only be set to a minimum actuation speed as faster speeds increase wear and tear on the switch gates.

CAUTION: Ensure water supply valves at operator control station have been opened prior to operating switch gates. (See operator station at false weir)

Switch gate Control at Operator Station at False Weir Platform

4.2.4.2. Anesthetic Tank

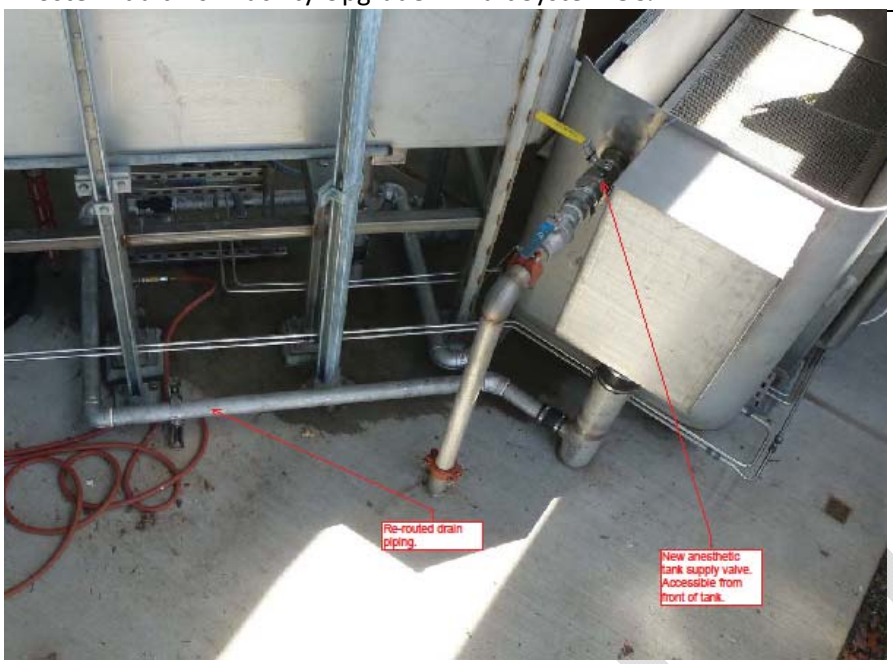
The anesthetic tank has a pneumatically operated brail. Press the 'RAISE' button to raise the brail and 'LOWER' button to lower it.

CAUTION: Personnel should not enter the anesthetic tank. The brail is not designed for floor loads and will not support the weight of an operator safely.

The anesthetic tank is filled by opening a manually actuated ball valve. Water is sourced from the FWS.

The anesthetic tank is drained by opening a ball valve. It drains to the raingarden near the fish lock.

Some fish lock control is allowed at the anesthetic tank. The brail hoist may be operated from the anesthetic tank. The left side controls move the tank brail up and down; the right side controls move the fish lock brail up and down.



Behind Sorting Table

Operator Station at Anesthetic tank

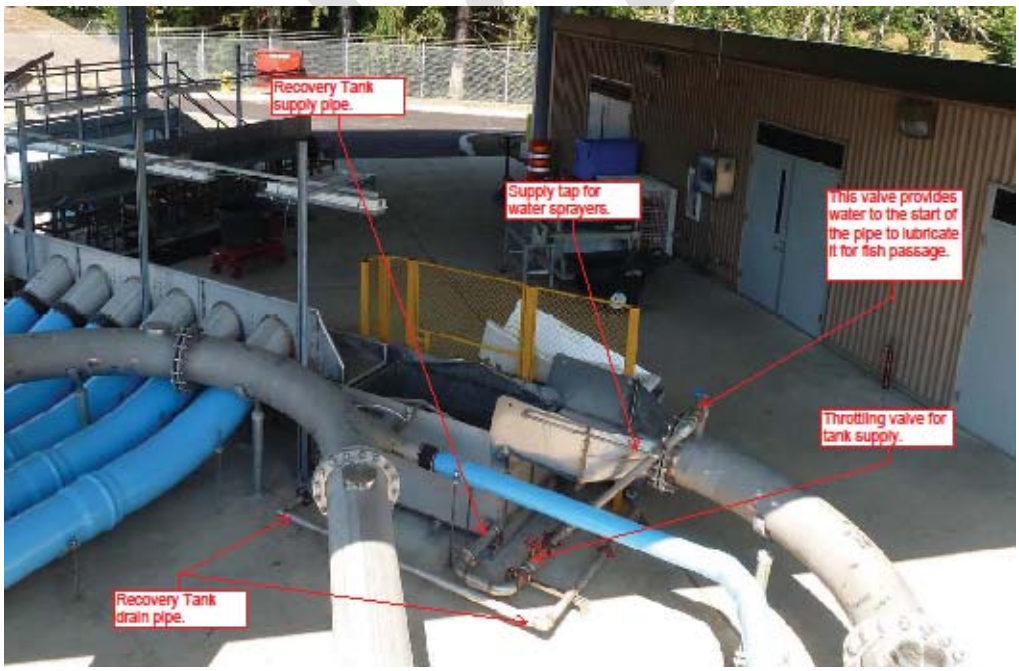
4.2.4.3. Sort Table

The sort table is connected to a network of fish pipes. Control of the fish pipe water supply is performed here at manually controlled valves beneath the table at each fish pipe entry. The quantity of water should be adjusted to ensure excess water is not added to the sorting ponds. Flushing water is provided and should also be adjusted as required to allow non-injurious movement of adult fish.

4.2.4.4. Recovery Tank

The recovery tank allows anesthetized fish to regain consciousness. A pneumatically operated brail can be used to move fish into the return to river pipe. For safety an interlock is used to control the brail; to operate the interlock button must be depressed while simultaneously depressing the 'up' or 'down' button.

Prior to operating recovery tank ensure flushing water valve is on (located on top of return to river pipe) and attraction water, by way of flexible nozzle is operating.



Recovery Tank

4.2.4.5. Return to River Pipe

The return to river pipe takes fish from the transport flume and the recovery tank and deposits them downstream from the dam tailwater. Flushing water is provided by the transport flume and the recovery tank.

4.2.4.1. Mechanical Room

4.2.4.1.1. Compressed Air

The compressed air system is self-activating in that a relay will control air pressure for each air access point. Pressure should be maintained at approximately 110 PSI.

4.2.4.1.1. Wash down water pump and tank

The washdown pump is self-activating in that a pressure switch will control water pressure in the tank. Pressure will vary from 30 to 50 PSI.

4.2.4.2. HVAC

4.2.4.2.1. Exhaust fans

When the room temperature reaches 80 degrees Fahrenheit, the fans will start.

4.2.4.2.2. Unit Heaters

Unit heaters will cycle to maintain the space at 55 ° F (Adjustable).

4.2.5. Post-Sort Pools, Crowding Channel, and Hopper Pit

4.2.5.1. Post-Sort Pool Trolley

There are two crowder trolleys; one for the short term side and one for the long term side. The crowder trolley is used to move the crowder to the pool that requires crowding. Each crowder trolley has identical controls.

LEVER: Moves trolley north or south along rails. The lever functions as a two speed switch and while in low speed the low speed light is lit.

E-STOP: For safety button is pressed at any point to stop the trolley.

ALIGNMENT BYPASS: Used to adjust the trolley to ensure the crowder rails are aligned in the event that the limit switches fail to automatically align the crowder to the crowder rails.

CROWDER DOCKED: Indicates, when lit, that the crowder is correctly on the trolley and ready for travel to the next pond.

RAILS ALIGNED: Indicates, when lit, that the trolley is correctly aligned with the crowder rails. At this point the crowder can be moved off the trolley.

CAUTION: Operator should verify that the trolley crowder rails are aligned with the pool crowder rails prior to moving the crowder off the trolley.

4.2.5.2. Post-Sort Pool Crowder

There are two crowders; one for the short term side and one for the long term side. The crowder is used to move fish from a pond to the sorting channel. Each crowder has identical controls.

LEVER: Moves crowder forward or backward along rails. Lights indicate the direction of travel. The lever functions as a two speed switch and while in low speed the low speed light is lit.

E-STOP: For safety button is pressed at any point to stop the crowder.

REVERSE LIMIT BYPASS: Follow on work complete

ENABLE: Follow on work complete

RAISE: Press to raise crowding screen.

LOWER: Press to lower crowding screen.

STOP: Stops crowder screen at any point of travel.

4.2.5.3. Crowding Channel Crowder

The sorting channel crowder functions to move fish to the hopper or the fish lock. There is a separate operating crowding screen for each direction of travel. See picture below.

4.2.5.4. FWS Piping (Headbox to Post-Sort Pools)

4.2.5.5. Recirculation Water System

The recirculation water system controls pond drains, surface sprayers, and chemical delivery. Each action is outlined by placard at the operator station.

4.2.5.6. Fish Screens and Weir boards

The fish screens have a hinged panel located at the bottom of the screen for maintenance. This panel can be opened so debris can be moved to pond drains. It may be necessary to periodically clean debris using a rake or squeegee.

Behind the screens are weir boards. The weir boards control the water surface elevation of each pond. A lifting beam is supplied so an operator can remove weir boards while standing on the deck grating.

LIFTING BEAM OPERATION:

- Water level should be reduced to the desired water elevation. The weir boards that need to be removed should be completely out of the water.
- Lower lifting beam down to cap weir board allowing it to engage both hooks; remove weir board
- Repeat with the desired number of weir boards that need to be removed. *Note: each board is 8" in height*
- Attach cap weir board to the lifting beam and lower down slot
- Allow main line to go slack (this should allow hooks to disengage) pull secondary line to keep hooks from reengaging weir board and then pull lifting beam up and out of slot with main line.

4.2.5.7. Post-Sort Pool Bulkheads and Hoists

The post-sort pool bulkheads should normally be kept in the closed (down) position. The bulkheads are designed to seal in both directions so that the Crowding Channel may be watered up and the post-sort pool dry, or vice versa. The post-sort pool bulkheads are not designed to be opened under differential. Water levels in the Crowding Channel and post-sort pools must be equal before raising the bulkheads.

The bulkheads are operated by an electric wire rope hoist. Each hoist is controlled by a handheld pendant.

4.2.5.8. Fish lock Bulkhead and Hoist

In order to use the fish lock a column of water must be supported to an elevation sufficient to allow fish to move into the anesthetic tank. Using the sorting crowder fish are moved into the base of the fish ladder. The fish lock bulk head is lowered and the column is then filled with water.

HOIST

RAISE: When pressed raises the brail.

LOWER: When pressed lowers brail.

VFD-BYPASS: Follow on work complete

STOP: Stops brail at any point of travel.

HOIST RUNNING: When lit, Brail is moving

SPEED: Low/high speed selection

BULKHEAD

EXTREME CAUTION: Bulkhead operator must verify that the water level in the column is level with the sorting channel prior to raising the bulkhead.

RAISE: When pressed raises the bulkhead.

LOWER: When pressed lowers bulkhead.

VFD-BYPASS: Follow on work complete

STOP: Stops bulkhead at any point of travel.

HOIST RUNNING: When lit, Bulkhead is moving

SPEED: Low/high speed selection

Once the bulkhead is lowered the supply valve is opened filling the column. Valve position can be changed to allow a small amount of overflow water to enter the fish lock flume. After the fish have been processed the brail should be lowered and the fish lock should be emptied using the drain valve.

4.2.5.9. Sort Channel Drain System

Need a picture?

4.2.6. Fish Transfer and Loading Equipment

4.2.6.1. Hopper Crane

The hopper crane will typically remain hooked to the fish hopper, which will be positioned either in the hopper pit or the above-ground hopper storage box under the crane structure. During fish transfer periods, fish will be crowded directly into the fish hopper in the pit. When ready to transfer fish to the fish truck perform the following steps:

1. Push the START button to activate the hoist and trolley controls.
2. Confirm that the Crowding Channel Crowder is parked against the hopper and has fully engaged the limit switch; otherwise, the hopper cannot be moved with the usual pendant pushbuttons. [If desired, the CROWDER BYPASS button can be used to defeat the limit switch permissive.]
3. Slowly raise the hopper by depressing the HOIST UP button (two step button for two-speed control) to allow water to slowly drain out the perforations while retaining all fish.
4. Raise the hopper to clear all obstacles and high enough to clear the fish truck mating flange.
5. Push the TROLLEY RIGHT button to move the hopper over the fish truck (previously filled with water). Fully depress the RIGHT button for faster travel.
6. Manipulate the TROLLEY and HOIST buttons to align the hopper flange with the mating flange on the truck. Fully lower the hopper onto the truck flange.
7. Open the butterfly valve to allow hopper water to fill the void between the hopper and truck.
8. Pull the hopper door handle down to raise the door inside the hopper and complete the water-to-water connection.
9. Open the drain valve at the back of the fish truck to release water to the area drain and lower the water level from the hopper into the truck tank effectively transferring all fish into the truck.
10. Confirm water level in the truck tank and close the truck drain valve when at the proper level.
11. Close the water transfer valve, close the door, and raise the hopper off the truck. Reposition the hopper into the hopper pit or storage box.

4.2.6.2. Fish Hopper

The fish hopper is generally a welded-aluminum construction "box" used for transferring fish from the post-sort pools to fish trucks for out-planting fish upstream of Foster Dam. The hopper has a limited number of moving components and is generally maneuvered using the hopper crane (see above). The hopper will typically be positioned in the hopper pit at the end of the Crowding Channel. The three-sided box allows fish to be crowded into the hopper through the open side with the crowder screen serving as the fourth side of the enclosure to retain fish inside. Brush strips are included where needed on edges to preclude fish from areas where they could be harmed or elude transfer. When the crowding channel crowder has mated up with the fish hopper, a limit switch completes a contact, which is a permissive for using the hopper crane to raise the hopper. The limit switch assures that the crowder screen is fully against the hopper so fish cannot escape.

The hopper includes a manually operated water transfer ("drain") valve that is used to complete the water-to-water connection between the hopper and the fish truck. After the hopper has been positioned on the fish truck's tank flange, the butterfly valve is opened to transfer hopper water into the void below the hopper door and equalize pressure. Otherwise, the weight of water in the hopper is too great to open the door. The circular plunger-style hopper door is opened by pulling down on the door handle on the exterior of the hopper once the water-to-water connection is complete. The door rises to effectively interconnect the hopper water with the truck tank water and allow fish to pass. When the tank is drained down enough, all the water and the fish end up in the truck's tank. When fish transfer is complete, the hopper door and water transfer valve are both closed and the hopper repositioned with the hopper crane back into the hopper pit for the next batch of fish.

4.2.6.3. Fish Truck

4.2.6.4. Truck Fill Station

The truck fill station is used to fill fish trucks with water prior to transferring fish from the hopper. The truck fill pump provides a pressurized water supply (FWS water) to lift the water up into the truck and accelerate the filling process. The fill pump is activated through the local control panel mounted next to the pump.

1. Confirm that pump and control panel are powered up; green STANDBY lamp should be lit.
2. Confirm that discharge isolation valve is open (should always remain open).
3. Confirm that FWS supply valve (post-mounted handwheel operator) is fully open and that buried drain valve (tee-handle operator) is closed (should only be closed/opened, respectively, during freezing periods).
4. Move the RUN/STOP switch to the RUN position to start the pump.
5. Visually monitor the fish truck tank level.
6. Stop the pump when tank is full to the brim by moving the switch to the STOP position.

4.2.7. Fire Protection Water System

4.2.7.1. Piping

4.2.7.2. Fire Hydrant

4.2.7.3. Hose Box

4.2.8. Maintenance Building Office/Maintenance Building

4.2.8.1. Reduced Pressure Backflow Preventer

Refer to the Contractor's approved Operation and Maintenance manual, Volume 8 Part 1, for operation procedures for Reduced Pressure Backflow Preventer.

4.2.8.2. Electric Water Heater

Refer to the Contractor's approved Operation and Maintenance manual, Volume 8 Part 1, for operation procedures for operation procedures for Electric Water Heater.

4.2.8.3. Electric Trap Primer

Refer to the Contractor's approved Operation and Maintenance manual, Volume 8 Part 1, for operation procedures for Electric Trap Primers.

4.2.8.4. Plumbing Fixtures

Refer to the Contractor's approved Operation and Maintenance manual, Volume 8 Part 1, for operation procedures for plumbing fixtures.

4.2.8.5. Sanitary Sewer

Deploy trap and drain auger at blockage location. If efforts fail a third party vendor may be required that specializes in blockage removal. In all cases, ensure protective gear is worn per EM-385 guidelines.

4.2.8.6. Unit Heaters

Unit heaters will cycle to maintain the space at 55 °F (Adjustable). Refer to the Contractor's approved Operation and Maintenance manual, Volume 8 Part 1, for more on unit heater operation.

4.2.8.7. Make-up Air Handling Unit

The space will be ventilated continuously while the following conditions are met: The space is occupied, carbon monoxide levels are at or above 9PPM, and when space temperature is below 45 ° F. Occupancy will be determined with an occupancy sensor, temperature will be determined by a temperature sensor and CO will be measured with a VOC sensor. All sensors are located in the Maintenance Room. Refer to the Contractor's approved Operation and Maintenance manual, Volume 8 Part 1, for more on the Make-up Air Handling Unit operation.

4.2.8.8. Split System Heat Pumps

Units will cycle as required to hold a temperature of 72 °F (adjustable) in the spaces being served. Refer to the Contractor's approved Operation and Maintenance manual, Volume 8 Part 1, for more on Split System Heat Pump operations.

4.2.8.9. Chemical Storage Building

Refer to the Contractor's approved Operation and Maintenance manual.

4.2.9. Power

5. Chapter 5: Preventative Maintenance

5.1. System Maintenance

5.1.1. General Maintenance Policies

This section describes the equipment and routine operation and maintenance procedures for the Foster Adult Fish Facility. Additional reference data and revised procedures and parameters should be inserted into the manual as dictated by changing conditions and operator experience with this particular facility.

5.1.1.1. Contractor Supplied O&M Manual

All employees should become familiar with the equipment and the respective manufacturer's operation and maintenance (O&M) literature before performing the procedures described in this section. All equipment should be maintained in accordance with the manufacturer's recommendations. Detailed information is provided in the manufacturer-supplied O&M manual, such as operation, maintenance, adjustment, troubleshooting, lubrication, startup, shutdown, assembly, spare parts, and storage. The manufacturer-supplied O&M manual should be kept current by inserting or replacing information as equipment items are added or replaced.

5.1.1.2. Routine Maintenance Policies

All equipment should be operated and maintained in accordance with the manufacturer's instructions. This section describes general policies applicable to all areas. Efficient operation and maintenance of the facility requires that all areas be kept neat, clean, and organized. Operators should perform the required housekeeping in their assigned areas. Typical housekeeping tasks are listed below:

- Clean debris from fish screens and porosity plates.
- Keep the cooling surfaces of electric motors clean.
- Replace burned-out light bulbs.
- Keep general area clean and free of obstacles.
- Clean and touch up paint.
- Keep all grating, access covers, and safety shields in place.
- Keep all water hoses and power cords rolled up and properly stored.

5.1.1.3. Pre-startup Procedure

The following basic procedures are recommended before starting and operating all processes and equipment:

- Be sure that the appropriate HAND/OFF/AUTO switches, ON/OFF switches, etc. are turned OFF prior to energizing equipment electrical supply.

- Be sure all grating, equipment safety shields, and floor hatches are in place. Always keep grating, equipment shields, and floor hatches in place, except during maintenance procedures; then replace immediately upon completion of task.
- Check that all clothing, tools, etc. are removed from control panels and equipment.
- Check that all electrical junction boxes and control panels are properly closed.
- Valves and gates should work smoothly and seat properly.
- Valves and gates should be set in the correct position prior to start-up. Verify that all lock-out/tag-out procedures are completed.
- Make any needed repairs or adjustments prior to startup.
- Check that all equipment is properly lubricated and ready to operate. (Follow manufacturer's instructions.)
- Check that all foreign objects have been removed from equipment and piping.
- Check all equipment frequently during the first day of operation, after repair, replacement, or seasonal startup. If a malfunction occurs, do not continue to operate. Minor problems can often cause serious damage if not corrected.

5.1.2. Basic Maintenance Procedures

The operation and maintenance of equipment and structures is important for effective performance. The result of good maintenance is lower operating costs, better morale for staff, and better visitor image. To assist in achieving these objectives, the recommendations in this chapter should be followed. This chapter contains maintenance procedures common to many of the Foster Adult Fish Facility elements. For specific procedures for the various elements, see equipment Maintenance and Contractor supplied O&M manuals. An overall inspection should be made twice a year for determination of maintenance work required for each element. Inspections and maintenance of specific elements should be made on the schedule noted herein, or as noted in the manufacturer's instructions. The best policy is to complete maintenance work as it is required. Delaying maintenance work will only increase the cost and amount of work required, and decrease the life of the equipment. This policy should not preclude more frequent inspections and resulting maintenance. The material used for maintenance repairs shall conform or be equal to the original construction contract specification requirements.

5.1.3. Preventative Maintenance Management

5.1.3.1. General

Periodic maintenance and inspection is required for all mechanical equipment. Proper and efficient maintenance of equipment and structures will extend the useful life. The use of a maintenance management program will help to ensure that all equipment is maintained at the required intervals.

5.1.3.2. Equipment Inspection and Maintenance

Visual and physical observations of the machinery and equipment should be performed by the operators on a regular basis. All unusual conditions are to be reported immediately to the facility manager. If the operator feels that damage to the piece of equipment and/or a safety hazard is created by this condition, the piece of equipment should be taken out of service immediately and the facility manager notified.

5.2. Equipment and Structure Maintenance

5.2.1. Fish Ladder

The fish ladder should be visually inspected annually to see that no objects and debris are present anywhere within the fish ladder. Visual inspection should also include the condition of concrete surfaces and the various steel items such as fish screens, diffusers, lifting frame, personnel guardrails and walkways located near the entrance. Connector machine bolts and concrete anchors should be visually inspected for corrosion and replaced in kind as needed.

5.2.1.1. Fish Ladder Entrance

5.2.1.1.1. Fish Entrance Gates

Each gate and actuator should be visually inspected for damage and corrosion. Ensure hoisting mechanism is lubricated per manufacturer's recommendations. Exercise each hoist (open completely and close completely) every month.

5.2.1.1.2. Fish Barrier Screen and Support Structure

A visual inspection should include the condition of various steel items such as fasteners, wire rope, and connection points on the screen. The lifting frame should not show significant corrosion clean the screen as needed to remove corrosion. Bolted connections and concrete anchors should be visually inspected for corrosion and replaced in kind as needed. Exercise the gate hoist from the full up position to 6 inches above the water surface, three times every month.

5.2.1.2. AWS Pump Structure

A visual inspection of the structure should be performed during the annual ladder outage if full dewatering will be performed. Report any large concrete cracks or unusual surface erosion.

5.2.2. Pre-Sort Pool

Visually inspect the concrete surface for surface damage annually. All steel features such as work platforms, walkways, personnel guard rails, Crowder rails, metal doors and the steel stairs should be inspected for corrosion. All connection fasteners for the work platforms and walkway system should be inspected and any corroded bolts replaced in kind as needed. Repaint or repair galvanizing as needed.

The cover structure should be visually inspected for corrosion spots or peeling paint in the metal roof and support columns and beams. Corrosion on metal items should be cleaned and metal surfaces recoated with materials as needed to match the initial coating. All fasteners shall be checked for corrosion and replaced in kind as needed.

5.2.2.1. Finger Weir

Visually inspect the aluminum frame work for cracks and damage. All bolted connections, wire ropes, and sheaves should be inspected monthly and any deficiencies should be reported immediately. Operate the finger weir monthly through its full range of motion and ensure winch brake holds the weir at various elevations. The winch is sealed and does not require periodic lubrication however, it should be inspected for corrosion and damage; replace if inoperable or if operating is unsafe.

See Contractor provided Operation and maintenance manual Volume 03.

5.2.2.2. Crowder

Visually inspect the chassis for corrosion, cracks, and damage every two weeks. Items that are heavily corroded or damaged should be reported and replaced as needed. After the visual inspection, if the crowder has not been operated in the previous two weeks, the crowder should be exercised. Three cycles of screen Travel should be performed, observe the operation and report any problems. Three traversing cycles should be performed with the screen in the up position.

See Contractor provided Operation and maintenance manual Volume 06, Part 04.

5.2.2.3. False Weir

Visually inspect for corrosion, cracks, leaks, and damage on a monthly basis. Items that are damaged should be reported and replaced as needed. Monitor leaks and report if deemed excessive or a threat to equipment or operator safety. The false weir pump should be exercised every two weeks if left idle for an extended period. This operation should be performed with the closure gate in the down position to avoid attracting fish into the flume. Unusual performance or noise should be reported immediately.

See Contractor provided Operation and maintenance manual Volume 03.

5.2.2.4. Closure Gate

Visually inspect the frame for cracks and damage. All bolted connections, wire ropes, and sheaves should be inspected monthly and any deficiencies should be reported immediately. Operate the closure gate monthly through its full range of motion and ensure winch brake holds the gate at various elevations. The winch is sealed and does not require periodic lubrication however, it should be inspected for corrosion and damage; replace if inoperable or if operating is unsafe.

See Contractor provided Operation and maintenance manual Volume 03.

5.2.2.5. Pre-sort Pool Piping

Exposed pre-sort piping should be visually inspected for leaks on a month to month basis. Leaks should be reported and monitored. Areas that experience erosion should be reported as this could indicate a buried pipe is leaking.

5.2.2.6. False Weir Drain

Visually inspect the false weir drain annually for leaks and damage. The valve should be exercised on a month to month basis.

See Contractor provided Operation and maintenance manual Volume 07, section 01.

5.2.2.7. Valves

The valves in pre-sort piping area should be visually inspected for leaks and corrosion on a month to month basis. Leaks and significant corrosion should be reported and monitored. Valves should be exercised, full open to full closed, on a month to month basis. Unusual difficultly opening or closing the valve should be reported.

See Contractor provided Operation and maintenance manual Volume 07, Part 01.

5.2.2.8. Diffusers

Diffuser maintenance is only performed during the annual facility shutdown period. The diffuser grating should be removed and cleaned annually. The diffuser pit should be inspected for debris accumulation and the low point drain should drain freely.

5.2.3. Sort Facility

The cover structure should be visually inspected for corrosion spots or peeling paint in the metal roof and support columns and beams. Corrosion on metal items should be cleaned and metal surfaces recoated with materials as needed to match the initial coating. All fasteners shall be checked for corrosion and replaced in kind as needed.

5.2.3.1. Mechanical/Electrical

5.2.3.1.1. Compressed Air

The air compressor and any exposed compressed air pipe should be visually inspected monthly. The Operator should note any unusually significant increase in compressor operation and report it to the appropriate personnel.

5.2.3.2. Plumbing

The mechanical room piping should be visually inspected for leaks and damage every six months. Report or perform authorized repairs for any significant leak.

5.2.3.3. HVAC

The heater units should be inspected and cleaned per manufacturer's recommended interval.

The office heat pump should be inspected for debris infiltration and insect infestation every three months. Perform maintenance per manufacturer's recommendations.

See Contractor provided Operation and maintenance manual Volume 08, part 1.

5.2.4. Post-Sort Pools, Sorting Channel, and Hopper Pit

Visually inspect the concrete surface for surface damage annually. All steel features such as work platforms, walkways, personnel guard rails, Crowder rails, metal doors and the steel stairs should be inspected for corrosion. All connection fasteners for the work platforms and walkway system should be inspected and any corroded bolts replaced in kind as needed. Repaint or repair galvanizing as needed.

5.2.4.1. Post-sort Pool Crowders

Visually inspect the chassis for corrosion, cracks, and damage every two weeks. Items that are heavily corroded or damaged should be reported and replaced as needed. After the visual inspection the crowder should be exercised. Three cycles of screen Travel should be performed, observe the operation and report any problems. Three traversing cycles should be performed with the screen in the up position. If long term inactivity is expected park the crowder under the post sort pool shade structure.

See Contractor provided Operation and maintenance manual Volume 06, Part 01.

5.2.4.2. Sorting Channel Crowder

Visually inspect the chassis for corrosion, cracks, and damage every two weeks. Items that are heavily corroded or damaged should be reported and replaced as needed. After the visual inspection the crowder

should be exercised. Three cycles of screen Travel should be performed, observe the operation and report any problems. Three traversing cycles should be performed with the screen in the up position.

See Contractor provided Operation and maintenance manual Volume 06, Part 03.

5.2.4.3. FWS Piping

Visually inspect exposed piping for leaks and damage once every 6 months. Report leaks and damage to the appropriate authorities.

5.2.4.4. Diffusers

Diffuser maintenance is only performed during the annual facility shutdown period. The diffuser grating should be removed and cleaned annually. The diffuser pit should be inspected for debris accumulation; clean debris as necessary. Pit drains should drain freely.

5.2.4.5. Removable Fish Screens and Overflow Stoplogs

The removable fish screens should be cleaned weekly; the change in water height across the screen should not exceed 6 inches between cleanings.

5.2.4.6. Sort Channel Drain System

The pipe should be flushed prior to use. Annual inspections should be performed to ensure the interior of the pipe is not damaged.

5.2.4.7. FWS Piping

The FWS pipe in the IPS should be visually inspected for damage, leaks, and corrosion. It is normal for the pipe to have condensed water dripping from the bottom of the pipe; the leak should be actively dripping water. If a leak is found report it to the appropriate authorities.

5.2.4.8. FWS Flowmeter

The flow meter should not require regular maintenance. Function is purely electronic in nature.

See Contractor provided Operation and maintenance manual Volume 01.

5.2.4.9. AWS Valve and Sump Pump System

See Contractor provided Operation and maintenance manual Volume 02.

5.2.4.10. Washdown Pipe System

Visually inspect for corrosion, leaks, and damage on a bi-annual basis. Items that are damaged should be reported and replaced by authorized personnel. Monitor leaks and report if deemed excessive or a threat to equipment or operator safety. Each hose bib should be used at least once every three months. washdown pump function should be verified while running the hose bibs.

See Contractor provided Operation and maintenance manual Volume 07, part 1 and 2.

5.2.4.11. Intake Screen

Clean using the trash rake?

5.2.5. Fish Sorting Equipment

5.2.5.1. Fish Transport Flume

Visually inspect for corrosion, cracks, leaks, and damage on a monthly basis. Items that are damaged should be reported and replaced as needed. Monitor leaks and report if deemed excessive or a threat to equipment or operator safety.

5.2.5.2. Switch Gates

Visually inspect for corrosion, cracks, leaks, and damage on a monthly basis. Items that are damaged should be reported and replaced as needed. Monitor water leaks and report if deemed excessive or a threat to equipment or operator safety. Report compressed air leaks for immediate repair. Cycle each switch gate three times every month.

See Contractor provided Operation and maintenance manual Volume 04.

5.2.5.3. Anesthetic Tank

Visually inspect for corrosion, cracks, leaks, and damage on a monthly basis. Items that are damaged should be reported and replaced as needed. Water leaks should be repaired immediately as it could lead to accelerated anesthetic dilution or fish un-watering and low dissolved oxygen levels. Report compressed air leaks for immediate repair. If freezing temperatures are expected crack the tank fill valve to keep pipe from freezing. Cycle the anesthetic tank brail three times every two weeks with water in the tank. Empty the tank using the drain pump this will serve to exercise the pump.

See Contractor provided Operation and maintenance manual Volume 04.

5.2.5.4. Sort Table

Visually inspect for corrosion, cracks, leaks, and damage on a monthly basis. Items that are damaged should be reported and replaced as needed. If freezing temperatures are expected crack each flume supply valve to keep the pipes from freezing.

See Contractor provided Operation and maintenance manual Volume 04

5.2.5.5. Recovery Tank

Visually inspect for corrosion, cracks, leaks, and damage on a monthly basis. Items that are damaged should be reported and replaced as needed. If freezing temperatures are expected crack the tank fill valve to keep the pipes from freezing. Cycle the recovery tank brail three times every two weeks.

See Contractor provided Operation and maintenance manual Volume 04.

5.2.6. Fish Transfer and Loading Equipment

5.2.6.1. Hopper Hoist

Visually inspect for corrosion, cracks, and damage on a monthly basis. Items that are damaged should be reported and replaced by authorized personnel. The hopper hoist maintenance is performed per manufacturer's recommendations. Reference EM 385-1-1 for additional requirements related to safe operation of a monorail crane.

See Contractor provided Operation and maintenance manual Volume 05, Part 02.

5.2.6.2. Hopper Loading Structure

Visually inspect for corrosion, cracks, and damage on a monthly basis. Items that are damaged should be reported; items are replaced by authorized personnel only.

5.2.6.3. Hopper

Visually inspect for corrosion, cracks, leaks, and damage on a monthly basis. Items that are damaged should be reported and replaced as needed. Monitor leaks and report if deemed excessive or a threat to equipment or operator safety.

See Contractor provided Operation and maintenance manual Volume 05, Part 02.

5.2.6.4. Fish Truck

5.2.6.4.1. Diesel Generator

Visually inspect generator for leaks. Check fluid levels and run generator periodically per manufacturer's recommendations.

See Contractor provided Operation and maintenance manual Volume 08.

5.2.6.4.2. Automatic Transfer Switch

See Contractor provided Operation and maintenance manual Volume 08.

5.2.6.5. Maintenance Building

The structure should be visually inspected for corrosion spots or peeling paint in the metal roof and support columns and beams. Corrosion on metal items should be cleaned and metal surfaces recoated with materials as needed to match the initial coating. All fasteners shall be checked for corrosion and replaced in kind as needed.

See Contractor provided Operation and maintenance manual Volume 08.

5.2.6.6. Site Host Structure

The cover structure should be visually inspected for corrosion spots or peeling paint in the metal roof and support columns and beams. Corrosion on metal items should be cleaned and metal surfaces recoated with materials as needed to match the initial coating. All fasteners shall be checked for corrosion and replaced in kind as needed.

See Contractor provided Operation and maintenance manual Volume XX, section XX.

5.2.6.6.1. Power Pedestal

This pedestal should be visually inspected on an annual basis. Report any unusual damage or functionality.

See Contractor provided Operation and maintenance manual Volume XX, section XX.

5.2.6.6.2. Potable Water

The hose bib should be visually inspected on an annual basis. Report any damage or loss of functionality.

5.2.6.6.3. Sanitary Sewer

The sanitary sewer dump connection should be visually inspected on an annual basis. Report any damage or loss of functionality.

5.2.7. Storm Water Facilities

The storm drainage system should be inspected annually and after every significant storm event and cleared of trash and debris.

The O&M manuals for the rain gardens, swales, planters, catch basins, and water quality catch basins are located in Appendix J.

5.2.8. Sanitary Sewer System

The sanitary sewer system should be inspected annually and cleared of excessive trash and debris.

5.2.9. Facility Vehicle Entrance Gates

A visual inspection of the fencing and rollers should be performed monthly. Gates should be operated monthly to ensure moving components receive lubrication. Rollers may require lubrication based on use refer to the Manufacturer's O&M manual.

See Contractor provided Operation and maintenance manual Volume XX, section XX.

5.2.10. Power

5.2.10.1. Primary Metering Cabinet

5.2.10.2. Transformer FTQ1

5.2.10.3. Backup Power System

5.2.10.4. Metering, Protection, and Grounding

5.2.11. Industrial Control System (ICS)

Reference the operations and maintenance manual for specific preventative maintenance requirements.

5.2.12. Intrusion Detection

6. Chapter 6: Industrial Control System

6.1. General

The industrial control system (ICS) and graphic terminals (HMI) allow monitoring and control of various fish collection facility sensors, gates, power meters, valves, and automated processes. All graphic terminals are touch screens except for the desktop workstation in the control room.

LOCATION AND IDENTIFICATION

- Control Room – (PC)
- Fish Hatchery – (HMI 4)
- Maintenance Building – (HMI 2)
- Pump Room – (HMI 3)
- Sorting Area – (HMI 1)

REFERENCE

- Sheet EI601 – Control Network Diagram
- Sheet EI603 – Sort Facility HMI Cabinet
- Sheet EI606 – Hatchery Remote I/O Cabinet
- Sheet EI608 – Pump Room Remote I/O Cabinet
- Sheet EI611 – Maintenance Building Remote I/O Cabinet

6.2. MAIN OVERVIEW SCREEN

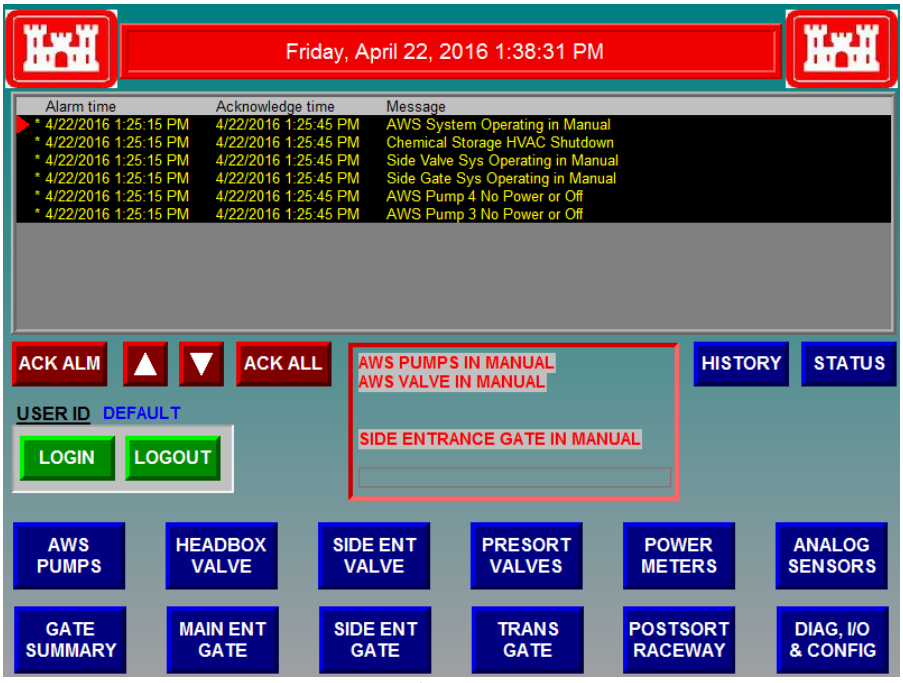


Figure 1

The main display is used for accessing all other screens and is shown in figure 1. Each blue pushbutton opens a Fish Collection Facility screen as labeled. Any control-type screen first requires the user to login

using the green pushbutton. Data monitoring type screens without control capability do not typically require the user to login.

The alarm object provides a brief listing of recent alarms. For additional alarm information go to the alarm “HISTORY” and/or alarm “STATUS” screens by pressing the correct blue pushbutton.

The “ACK ALM” pushbutton can be used to acknowledge individual alarms, as selected by the up/down arrows. The “ACK ALL” button acknowledges all current alarms. Acknowledging an alarm does not clear an alarm, even if it is no longer active. Alarm clearing is performed from the alarm “HISTORY” screen.

The date and time for each graphic terminal is synchronized with the Fish Collection Facility PLC every day around 3:01AM. Time shifts related to Daylight Saving Time (DST) should be updated automatically.

6.3. AUXILLARY WATER PUMPS

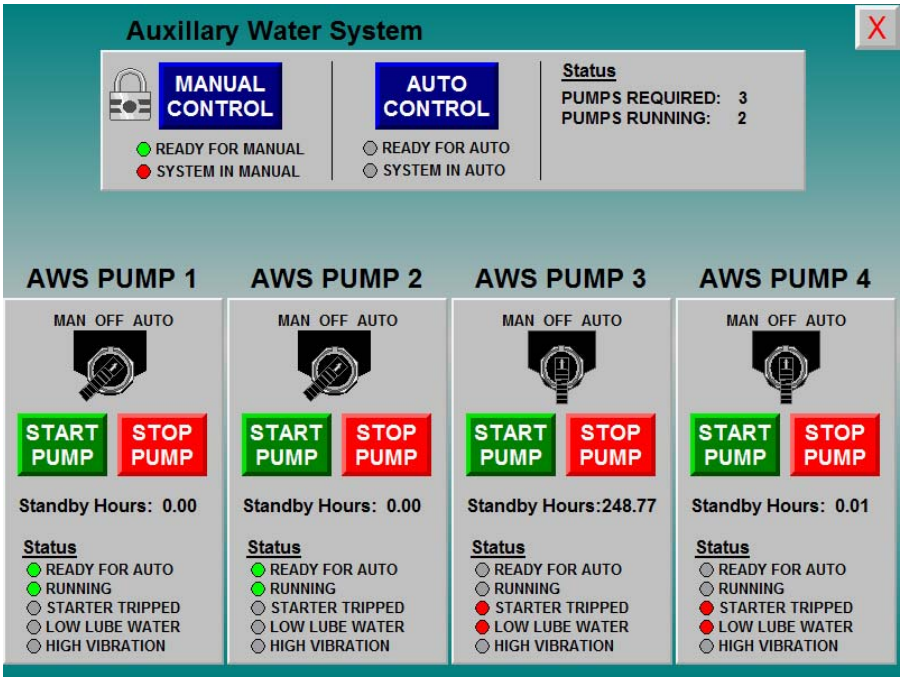


Figure 2

The AWS PUMP screen shown in figure 2 permits both control and monitoring of the auxiliary water system pumps. In automatic control mode the number of pumps required are automatically determined and operated based on the tailrace (LT.003) water elevation. In manual mode each pump is controlled by the START PUMP and STOP PUMP buttons.

The “MANUAL CONTROL” pushbutton sets the control mode for the AWS Pump process. When pressed a lock will appear, indicating the mode will not change from manual unless the “AUTO CONTROL” pushbutton is pressed. In manual mode each pump must be individually started and stopped as described below. The “READY FOR MANUAL” light is green if at least one pump is ready for manual control.

The “AUTO CONTROL” pushbutton will not function unless the “READY FOR AUTO” light is green. Automatic control requires the following prerequisites listed below. Without all prerequisites satisfied the system will remain in manual or revert to manual until the prerequisites have been established and/or reestablished.

- All four pumps indicate “READY FOR AUTO”.
- Tailrace Level Transmitter (LT.003) is functional.
- No pumps are running in manual/hand.
- The AWS pump process alarm is not disabled.

PUMP STATUS: An individual pump is “READY FOR AUTO” based on the following prerequisites:

- The cabinet selector switch is in auto position.
- The soft-starter is not tripped
- The high vibration alarm switch is not active. Note there is a second high vibration switch that is hardwired to stop the pump. The second switch is not connected to nor monitored by the controller and graphic terminals.
- The low lubrication water flow alarm is not active during pump operation. Note the “LOW LUBE WATER” status is normally red when the pump is off. The low lube alarm may only occur while the pump is running.
- The PLC input module for the pumps has not faulted.

The green “START PUMP” pushbutton runs the corresponding AWS pump. Since there is no confirmation after pressing the button, the pump should run immediately. If adequate flow is not achieved five seconds after the pump starts an alarm will be generated and the pump will stop. If the “START PUMP” button appears yellow there is a communications error between the graphic terminal and controller.

The red “STOP PUMP” button halts the corresponding AWS pump. There is no confirmation after pressing the button. After the pump stops the “LOW LUBE WATER” light should turn red. If the “STOP PUMP” button appears yellow there is a communications error between the graphic terminal and controller.

Pump standby hours are incremented only when the unit is not running but “READY FOR AUTO”. A pump is not in standby mode when off or otherwise unavailable to run. In automatic mode all pumps in standby mode will be automatically exercised every 30 days or sooner. Standby hours are immediately reset when the unit runs.

6.4. FACILITY WATER SYSTEM

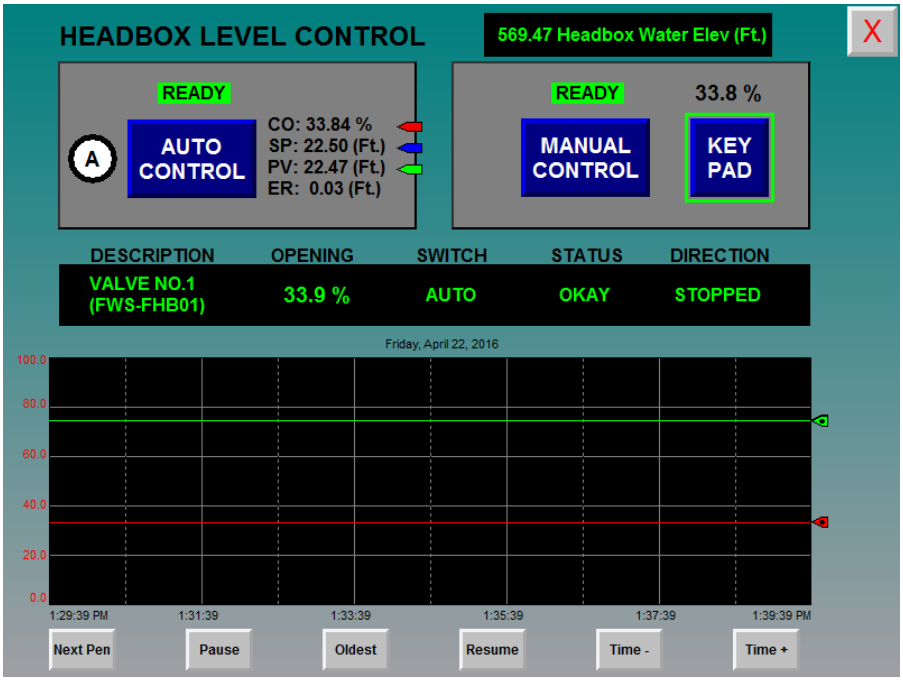


Figure 3

The hydraulic headbox level control screen for the facility water system (FWS) is shown in Figure 3. This screen permits automatic control of the headbox water level and manual positioning of the valve actuator. The valve's actual position, switch status, alarm status, and current movement is included on the display.

The "MANUAL CONTROL" pushbutton permits manual positioning of the headbox valve actuator through a virtual on-screen KEYPAD. The minimum setting is 0% open (fully closed). The maximum setting is 70% open. A lock symbol is visible after MANUAL CONTROL is selected, indicating the controller will not attempt to return the mode to automatic control. A green "Ready" symbol above the blue "MANUAL CONTROL" pushbutton indicates all required prerequisites listed below are present.

- The Actuator selector switch is in remote
- The actuator has not tripped on thermal overload.
- The actuator has not jammed
- No actuator internal alarms
- No actuator network alarm

The "AUTO CONTROL" pushbutton permits automatic headbox water level control. In automatic mode the controller should maintain the reservoir's water level at the setpoint +/- the deadband by modulating the valve actuator. If the green "Ready" symbol above the blue pushbutton is not visible then the system cannot be placed in "Auto". A red "NOT READY" symbol indicates one or more of the following prerequisites is missing.

- The actuator is ready for manual control. (See above.)
- Headbox Level Transmitter LT.007 is functional.
- The headbox process alarm is not disabled.

The graph displays the CO, PV, and SP over the last 10 minutes. Only the graphic terminals at the Control Room and Sorting Facility log historical data so that it's available anytime the screen is displayed. All other terminals populate graphs only when the screen is open for viewing.

- CO represents Controller Output, and should normally match the gate opening shown.
- SP is the desired water depth of the headbox & is fixed at 22.5 Ft deep with a 0.25 Ft deadband
- PV represents Process Variable and is the actual measured water level in the headbox.
- ER is the error or the difference between SP and PV and is normally within +/- 0.25 Ft.

6.5. SIDE ENTRANCE WATER SUPPLY

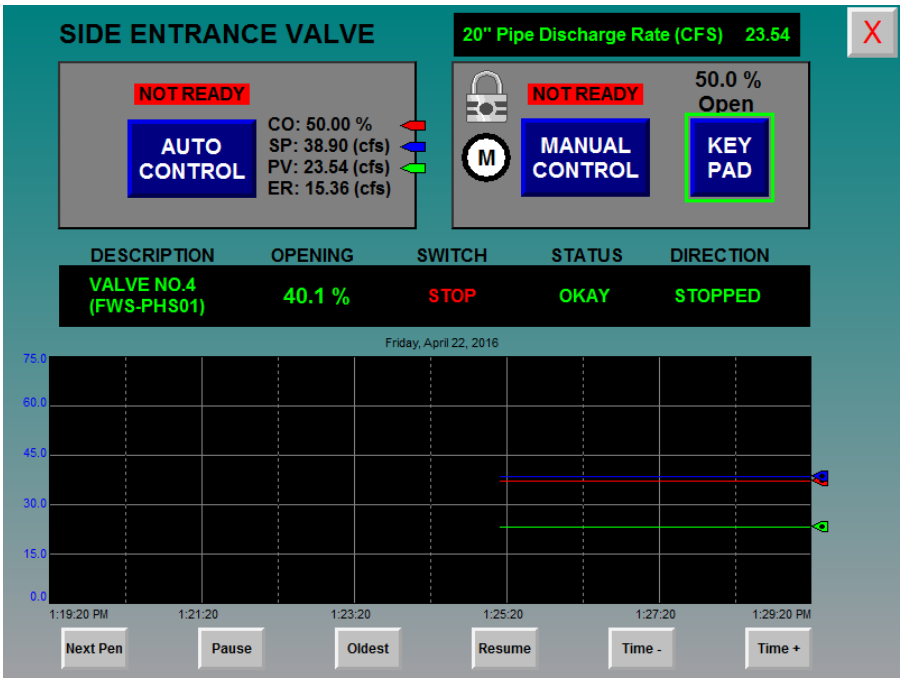


Figure 4

The side entrance water supply control screen is shown in figure 4. This screen permits manual and automatic control of the attraction water for the spillgate-side fish ladder entrance. The display includes the actuator description, valve position (% open), selector switch status, alarm status, current movement, and trending graph.

The "*MANUAL CONTROL*" pushbutton permits manual positioning of the valve actuator through a virtual on-screen KEYPAD. The minimum setting is 0% open (fully closed) and the maximum setting is 100% open. A lock symbol is visible after *MANUAL CONTROL* is selected, indicating the controller will not attempt to return the process to automatic mode. A green "*READY*" symbol above the blue pushbutton indicates all required prerequisites listed below are present. A red "*NOT READY*" symbol indicates at least one permissive is missing.

- The Actuator selector switch is in remote
- The actuator has not tripped on thermal overload
- The actuator has not jammed

- No actuator internal alarms
- No actuator network alarm

The "*AUTO CONTROL*" pushbutton permits automatic water flow control for the side entrance to the fish ladder. In automatic mode the controller should maintain the side entrance water flow at the setpoint +/- the deadband by modulating the valve actuator. If the green "Ready" symbol above the *AUTO CONTROL* button is not visible then the system cannot be placed in "Auto". A red "NOT READY" symbol indicates one or more of the following prerequisites is missing.

- The actuator is ready for manual control. (See above.)
- Pool 1 Water Level Transmitter LT.002 is functional.
- Transportation Water Level Transmitter Lt.004 is functional.
- The Side Valve Process alarm is not disabled.

The graph displays the SP, CO, and PV over the last 10 minutes. Only the Control Room and Sorting Facility graphic terminals log historical data, enabling graph data to be available anytime the display is selected. All other terminals populate graphs only when the screen is open for viewing.

- CO represents Controller Output, and should normally match the gate opening shown.
- SP is desired water flow in CFS and varies based on the number of AWS pumps running. There is a 5.0 CFS deadband.
- PV represents Process Variable and is the actual measured water flow at the side entrance.
- ER is the error or the difference between SP and PV in CFS.

6.6. PRESORT POOL WATER SUPLY

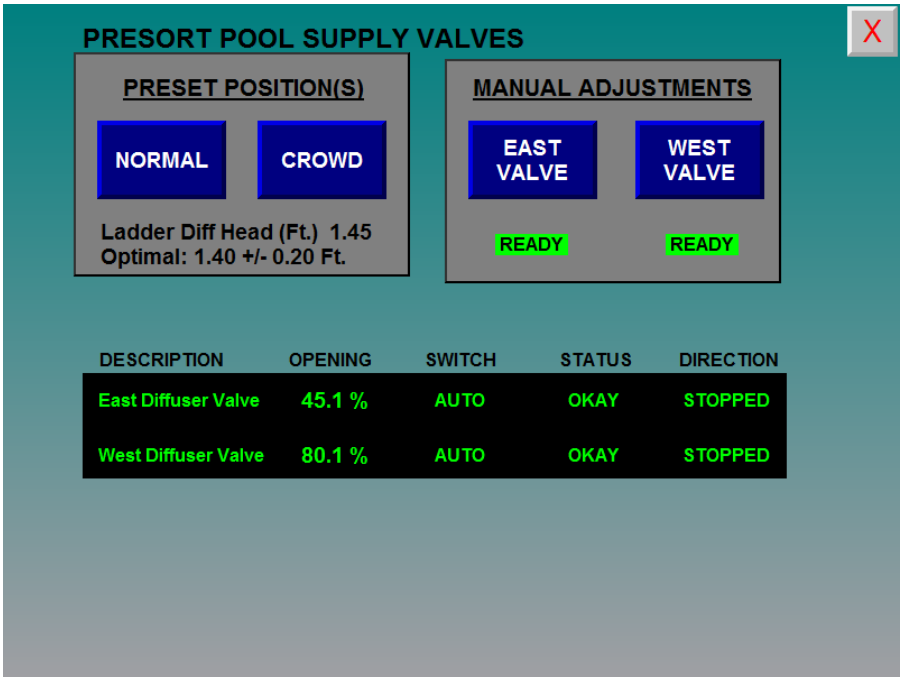


Figure 5

The presort pool water supply screen is shown in figure 5. The display permits manual positioning of the valves or the use of presets for normal operation and fish crowding. The display includes the actuator description, valve position (% open), selector switch status, alarm status, and current movement.

Manual adjustments for the "*EAST VALVE*" and "*WEST VALVE*" are achieved through a virtual touch screen keyboard that is activated by the corresponding blue pushbutton. A green "*READY*" symbol below the blue pushbutton indicates all required prerequisites are present. A red "*NOT READY*" symbol indicates at least one permissive listed below is missing.

- The Actuator selector switch is in remote
- The actuator has not tripped on thermal overload
- The actuator has not jammed
- No actuator internal alarms
- No actuator network alarm

Preset valve adjustments are executed by pressing the "*NORMAL*" or "*CROWD*" pushbuttons. The "*NORMAL*" preset moves the east valve to approximately 45% open and the west valve to approximately 80% open. The "*CROWD*" preset moves both valves to 100% open.

When the "*CROWD*" preset is selected the time delay for the Pre-Sort pool Water Level High or Low alarm is changed from 5 minutes to 6 hours to help reduce unwanted alarms while crowding fish.

6.7. DIGITAL POWER METERS

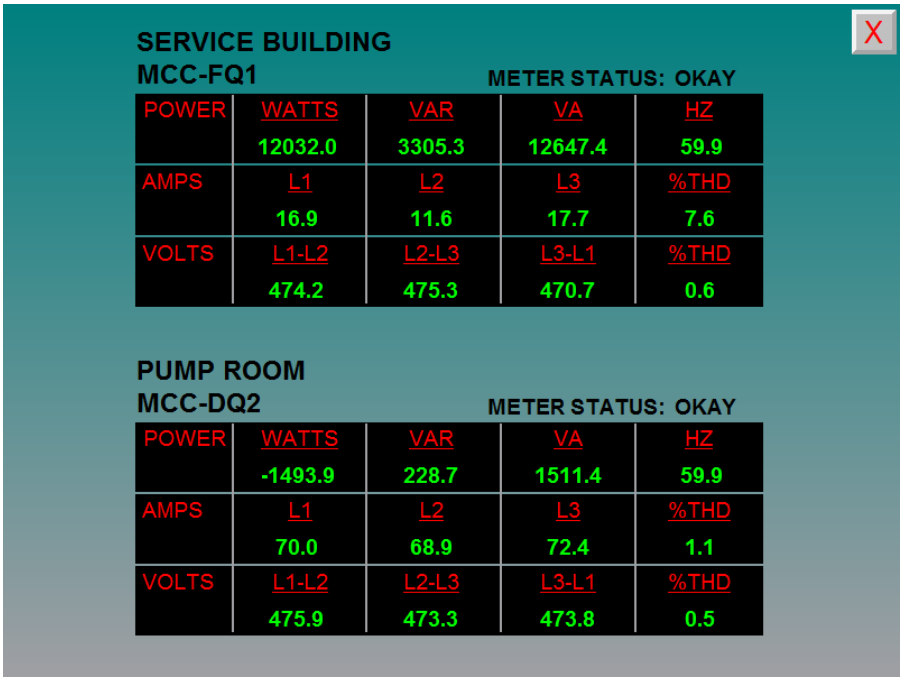
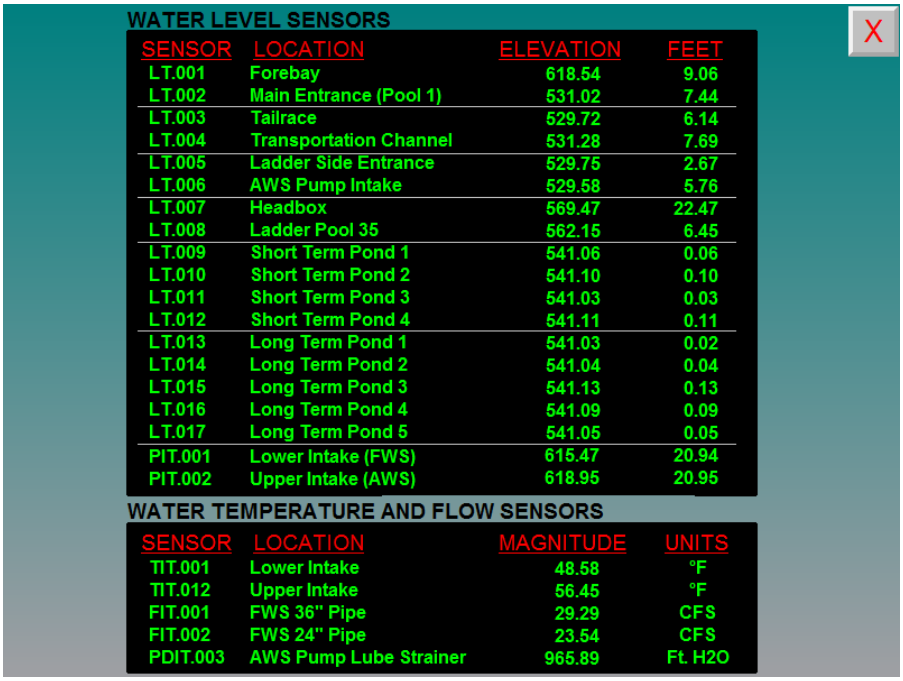


Figure 6

The power meters screen is shown in figure 6. Real time power consumption as measured from the Service Building Panelboard and Pump Room Motor Control Center is displayed. Any cell displaying -99.9 indicates meter trouble or loss of communications. Meter status is either "okay" or "alarm".

6.8. INSTRUMENTATION



WATER LEVEL SENSORS

SENSOR	LOCATION	ELEVATION	FEET
LT.001	Forebay	618.54	9.06
LT.002	Main Entrance (Pool 1)	531.02	7.44
LT.003	Tailrace	529.72	6.14
LT.004	Transportation Channel	531.28	7.69
LT.005	Ladder Side Entrance	529.75	2.67
LT.006	AWS Pump Intake	529.58	5.76
LT.007	Headbox	569.47	22.47
LT.008	Ladder Pool 35	562.15	6.45
LT.009	Short Term Pond 1	541.06	0.06
LT.010	Short Term Pond 2	541.10	0.10
LT.011	Short Term Pond 3	541.03	0.03
LT.012	Short Term Pond 4	541.11	0.11
LT.013	Long Term Pond 1	541.03	0.02
LT.014	Long Term Pond 2	541.04	0.04
LT.015	Long Term Pond 3	541.13	0.13
LT.016	Long Term Pond 4	541.09	0.09
LT.017	Long Term Pond 5	541.05	0.05
PIT.001	Lower Intake (FWS)	615.47	20.94
PIT.002	Upper Intake (AWS)	618.95	20.95

WATER TEMPERATURE AND FLOW SENSORS

SENSOR	LOCATION	MAGNITUDE	UNITS
TIT.001	Lower Intake	48.58	°F
TIT.012	Upper Intake	56.45	°F
FIT.001	FWS 36" Pipe	29.29	CFS
FIT.002	FWS 24" Pipe	23.54	CFS
PDIT.003	AWS Pump Lube Strainer	965.89	Ft. H2O

Figure 7

Analog instrumentation for water flow, level, and temperature sensing is summarized in figure 7. A value of -99.9 indicates sensor trouble and the actual value is unknown.

ABREVIATIONS

- FIT Flow Transmitter with integral display
- LT Level Transmitter – submersible type with no display.
- PIT Pressure Transmitter with integral display
- TIT Temperature Transmitter with integral display

SENSOR DETAILS and LOCATIONS

- Sheet EI-617 Sensor schedules and details.
- Sheet EB403 Location of LT.001.
- Sheet EC501 Location of LT.002 through LT.004.
- Sheet EC404 Location of LT.005.
- Sheet EC403 Location of LT.006.
- Sheet EF401 Location of LT.007.
- Sheet EJ401 Location of LT.008.
- Sheet EM401 Location of LT.009 through LT.017.
- Sheet EB402 Location of PIT.001 and PIT.002.
- Sheet EB402 Location of TIT.001 and TIT.002
- Sheet EB401 Location of FIT.001 and FIT.002
- Sheet EC403 Location of PIT.003.

6.9. MAIN FISH ENTRANCE GATE

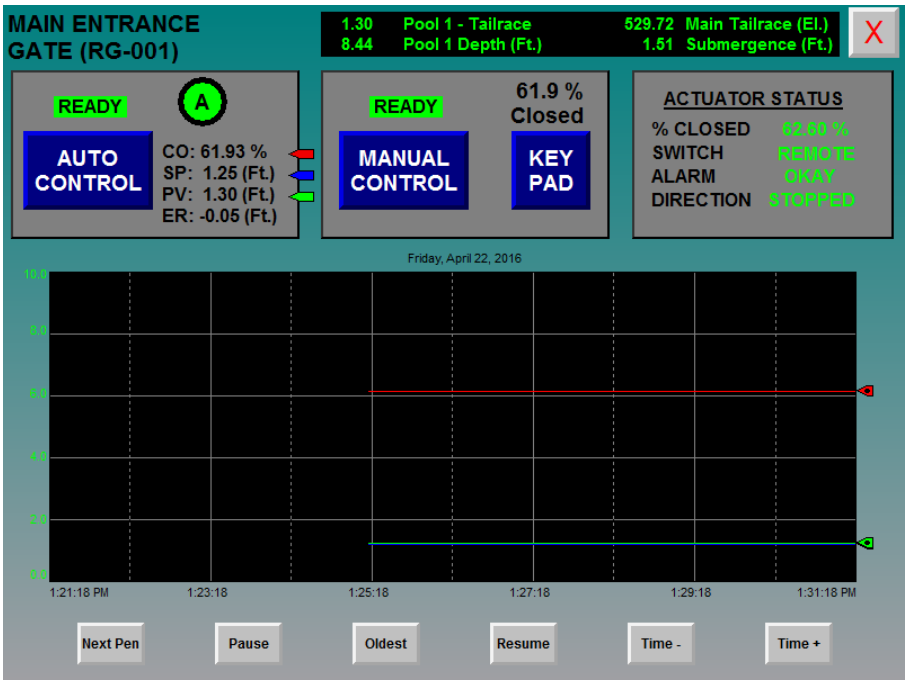


Figure 8

The main entrance gate control screen is shown in figure 8. This screen is for manual and automatic control of the main entrance gate to the fish ladder. The display includes the actuator description, gate position (% closed), selector switch status, alarm status, current movement, and historical graph.

The "*MANUAL CONTROL*" pushbutton enables manual positioning of the gate actuator through a virtual on-screen KEYPAD. The minimum setting is 10.4% closed (gate lowered allowing full flow). The maximum setting is 85.5% closed (gate raised blocking flow). A visible lock symbol will appear after selecting *MANUAL CONTROL*, indicating the controller will not attempt to return the process to automatic control mode. A green "*READY*" symbol above the blue pushbutton indicates all required prerequisites listed below are present. A red "*NOT READY*" symbol indicates at least one permissive is missing.

- The actuator's selector switch is in remote
- No actuator internal warnings
- No actuator internal faults
- No actuator internal not-ready indication. (Various collective internal signals from actuator.)
- No actuator loss of phase
- No actuator network alarm

The "*AUTO CONTROL*" pushbutton permits automatic positioning of the main entrance gate by the controller to maintain the pool 1 water level at the desired set-point +/- the deadband. If the green "*READY*" symbol above the blue button is not visible then the system cannot be placed in "Auto". A red "*NOT READY*" symbol indicates one or more of the following prerequisites is missing.

- The actuator is ready for manual control. (See above.)

- Pool 1 water Level Transmitter LT.002 is functional.
- Tailrace water Level Transmitter LT.003 is functional.
- The Main Entrance Gate Process alarm is not disabled.

The graph displays the SP, CO, and PV over the last 10 minutes. Only the graphic terminals at the Control Room and Sorting Facility log historical data, enabling graph data to be available anytime the display is selected. All other terminals populate graphs only when the screen is open for viewing.

- CO represents Controller Output, which is the desired gate position sent to the actuator.
- The SP is normally 1.25 Ft, which is the pool 1 water height above the river (tailrace). The setpoint may automatically increase if the pool 1 water depth is not at least 6.0 ft. The SP has a 0.15 Ft dead-band.
- PV represents Process Variable and is the measured water level difference between Pool 1 and the Tailrace.
- ER (error) is the difference between the actual SP and the measured PV.

6.10. SIDE FISH ENTRANCE GATE

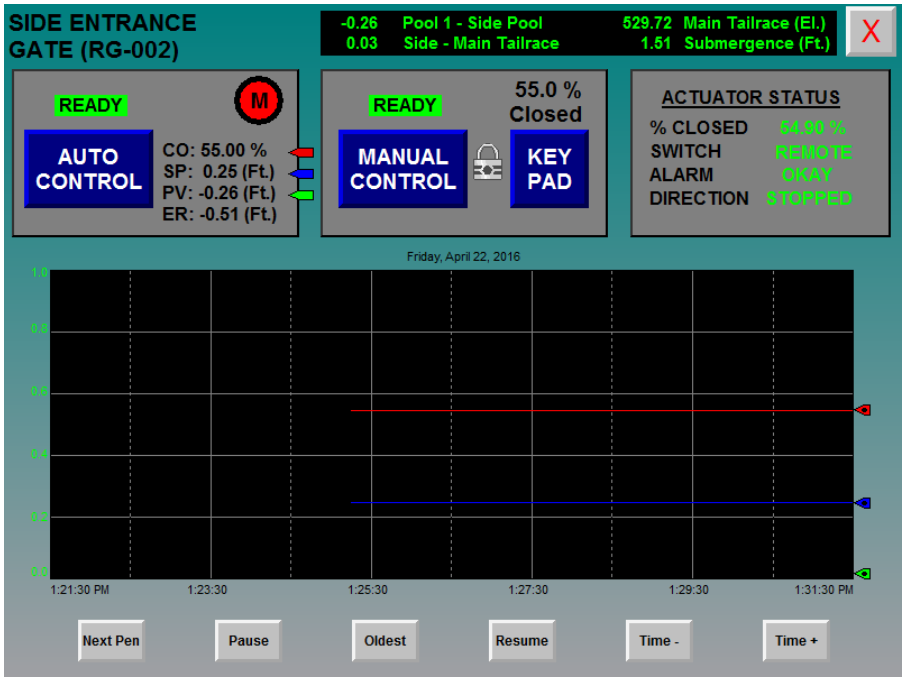


Figure 9

The side entrance gate control display is shown in Figure 9. The screen enables manual and automatic control of the side entrance gate to the fish ladder. The display includes the actuator description, gate position (% closed), selector switch status, alarm status, current movement, and historical graph.

The "*MANUAL CONTROL*" pushbutton permits manual positioning of the gate actuator through a virtual on-screen KEYPAD. The minimum setting is 10.4% closed (gate lowered allowing full flow). The maximum setting is 85.5% closed (gate raised blocking flow). A visible lock symbol will appear after selecting *MANUAL CONTROL*, indicating the controller will not attempt to return the process to automatic mode. A green

"*READY*" symbol above the "*MANUAL CONTROL"* pushbutton indicates all required prerequisites listed below are present. A red "*NOT READY*" symbol indicates at least one permissive is missing.

- The actuator's selector switch is in remote
- No actuator internal warnings
- No actuator internal faults
- No actuator internal not-ready indication. (Various collective internal signals from actuator.)
- No actuator loss of phase
- No actuator network alarm

The "*AUTO CONTROL*" pushbutton permits automatic positioning of the side entrance gate by the controller to maintain the water differential across pool 1 and the transportation channel at the desired set-point +/- the deadband. If the green "*READY*" symbol above the "*AUTO CONTROL*" pushbutton is not visible then the process cannot be placed in automatic mode. A red "NOT READY" symbol indicates one or more of the following prerequisites is missing.

- The actuator is ready for manual control. (See above.)
- Pool 1 water Level Transmitter LT.002 is functional.
- Transportation channel water Level Transmitter Lt.004 is functional. (Note the transportation channel water level is equivalent to the side entrance pool level.)
- The Side Entrance Gate process alarm is not disabled.

The graph displays the SP, CO, and PV over the last 10 minutes. Only the Control Room and Sorting Facility graphic terminals log historical data, enabling graph data to be available anytime the display is selected. All other terminals capture graph data only while the display is open for viewing.

- CO represents Controller Output, which is the desired gate position sent to the actuator.
- The SP (setpoint) is 0.25 Ft, which is the desired pool 1 water height above the transportation channel (side entrance pool). The controller deadband is 0.10 Ft.
- PV represents Process Variable and is the measured water level difference between pool 1 and the transportation channel (side entrance pool).
- ER (error) is the difference between the actual SP and the measured PV.

6.11. TRANSPORTATION CHANNEL GATE

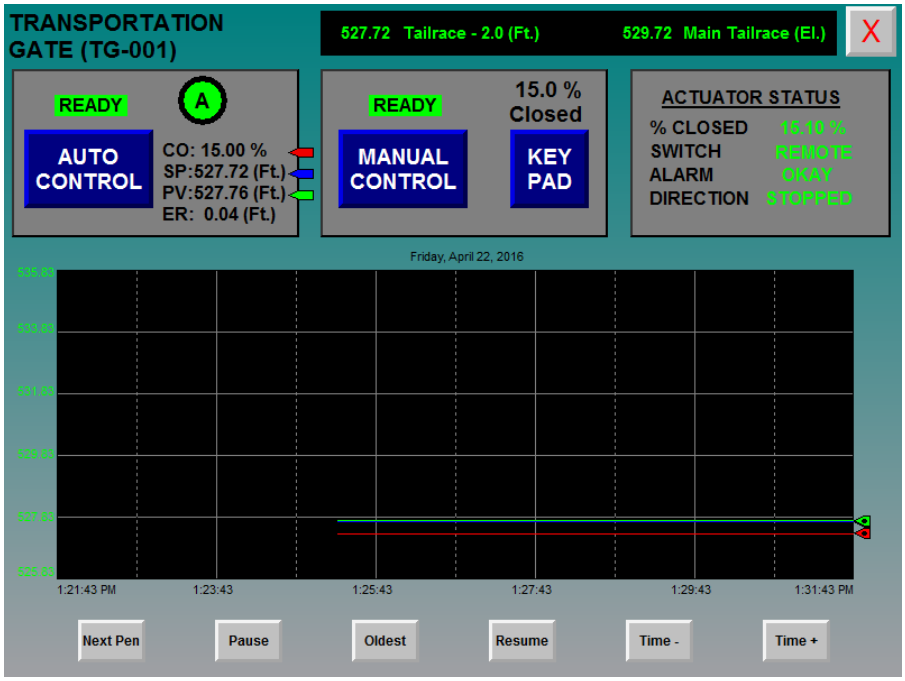


Figure 10

The transportation channel gate control display is shown in figure 10. The screen permits manual and automatic control of the transportation channel gate, which connects the side fish entrance to the main fish ladder entrance. The display includes the actuator description, gate position (% closed), selector switch status, alarm status, current movement, and historical graph.

The "*MANUAL CONTROL*" pushbutton permits manual positioning of the gate actuator through a virtual on-screen KEYPAD. The minimum setting is 15% closed (gate lowered allowing full flow). The maximum setting is 100% closed (gate raised blocking flow). A visible lock symbol will appear after selecting *MANUAL CONTROL*, indicating the controller will not attempt to return the process to automatic mode. A green "*READY*" symbol above the "*MANUAL CONTROL*" pushbutton indicates all required prerequisites listed below are present. A red "*NOT READY*" symbol indicates at least one permissive is missing.

- Actuator's selector switch is in remote
- No actuator internal warnings
- No actuator internal faults
- No actuator internal not-ready indication. (Various collective internal signals from actuator.)
- No actuator loss of phase
- No actuator network alarm

The "AUTO CONTROL" pushbutton permits automatic positioning of the transportation channel gate by the controller to maintain the transportation gate position at the desired set-point +/- the deadband. If the green "READY" symbol above the "AUTO CONTROL" button is not visible then the system cannot be placed in "Auto". A red "NOT READY" symbol indicates one or more of the following prerequisites is missing.

- The actuator is ready for manual control. (See above.)
- Tailrace water Level Transmitter LT.003 is functional.
- The Transportation Channel Gate process alarm is not disabled.

The graph displays the SP, CO, and PV over the last 10 minutes. Only the Control Room and Sorting Facility graphic terminals log historical data, enabling graph data to be available anytime the display is selected. All other terminals capture graph data only while the display is open for viewing.

- CO represents Controller Output, which is the desired gate position sent to the actuator.
- The SP (setpoint) is the tailrace water elevation – 2.0 Ft. The top of the transportation gate should equal the set point elevation. The actuator has an internal 0.10 Ft positioning deadband.
- PV represents Process Variable and is the actuator position feedback signal converted to top of gate elevation. Maximum top of gate elevation is 535.55 ft and the minimum top of gate elevation is 526.37 ft.
- ER (error) is the difference between the actual SP and the measured PV.

6.12. CONSOLIDATED GATE SCREEN

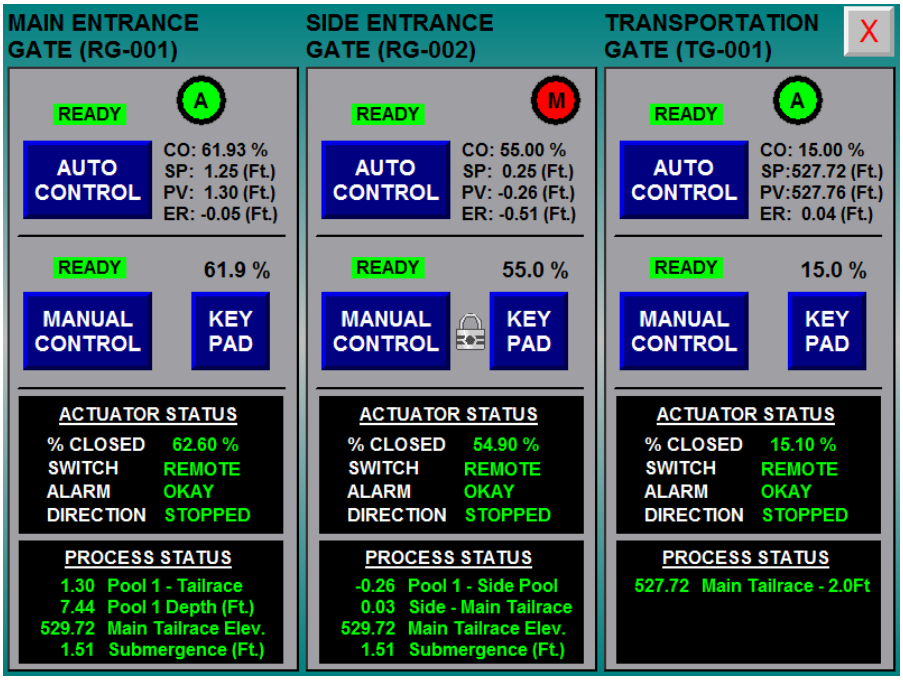


Figure 11

The consolidated gate control screen is shown in figure 11 and provides similar control and information as the individual Gate Control Screens. The letter “A” within a green circle indicates automatic mode. A letter “M” within a red circle indicates manual mode. Reference the respective gate control screen for operating instructions.

6.13. PORT SORT RACEWAYS

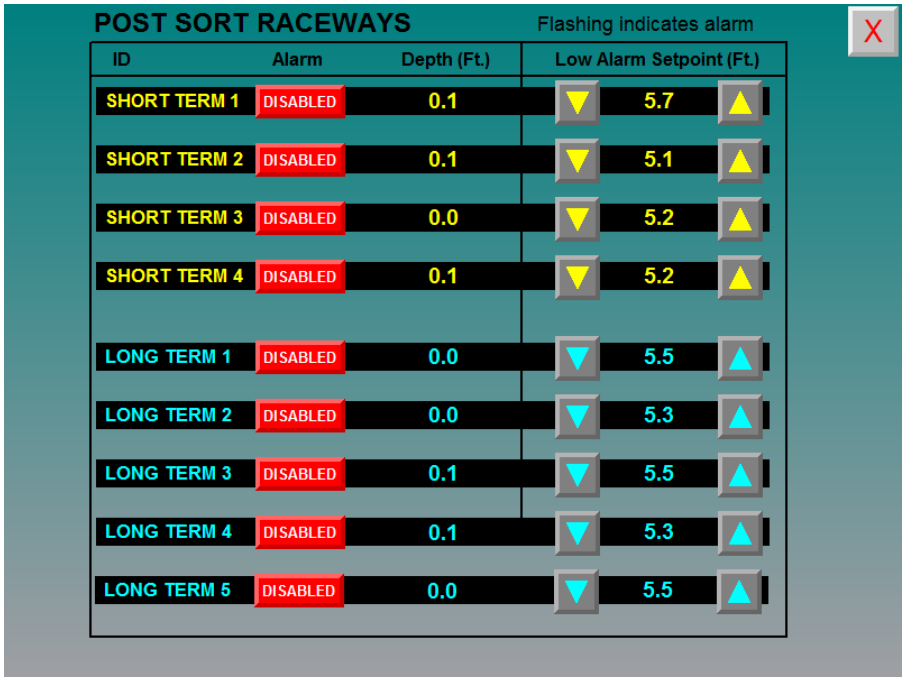


Figure 13

The post soft raceway alarm configuration screen is shown in figure 13. The screen permits adjusting, enabling, and disabling the water level alarm for each raceway. The low water level alarm setpoint is adjustable for each raceway using the up/down arrow, while the upper water level alarms are fixed at 7.0 Ft. The actual water depth of each raceway is also indicated.

6.14. DIAGNOSTICS, I/O, & CONFIGURATION

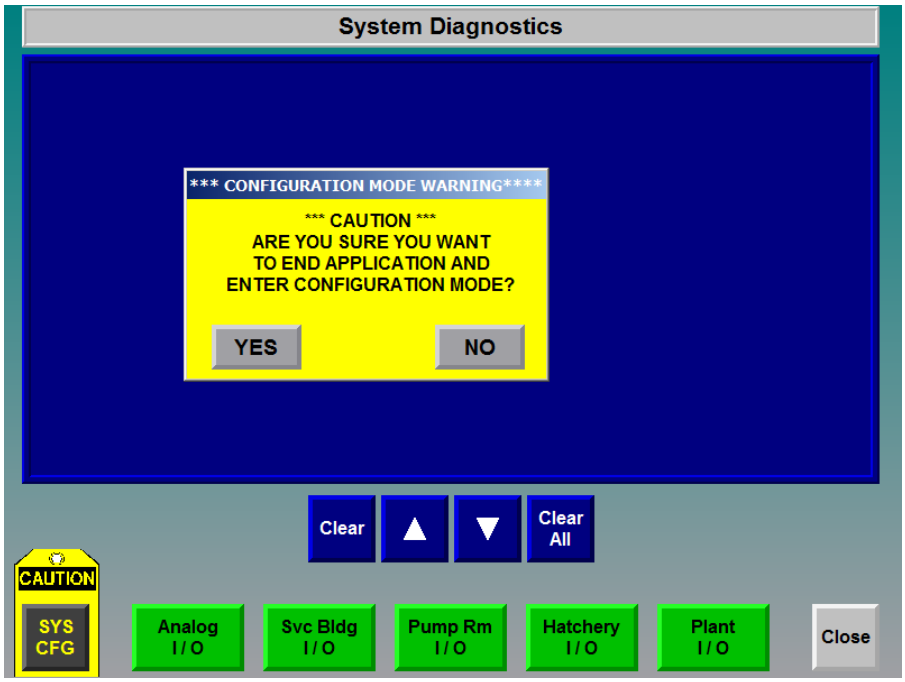


Figure 14

The diagnostics, I/O, and graphic terminal configuration screen is shown in figure 14. The screen displays information and messages generated by the graphic terminal, and provides links to input/output (I/O) screens to facilitate checkout and testing. The yellow pushbutton provides a method for configuring that graphic terminal, but requires an administrator account at login. A confirmation warning is provided (shown above) to prevent accidental shutdown of the terminal and access to the unit's configuration menu.

6.15. SORT FACILITY - DISCRETE I/O

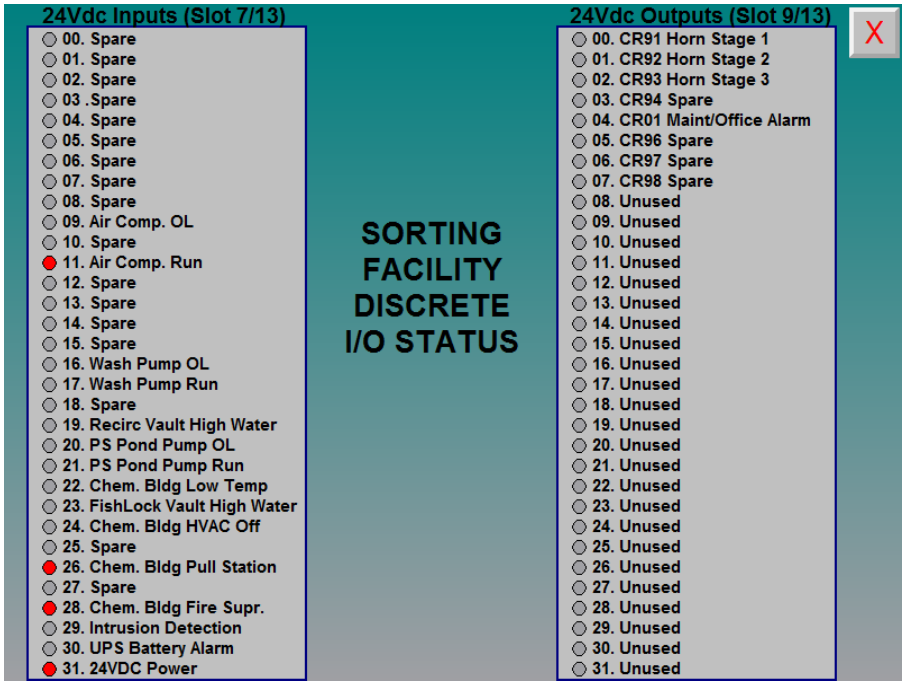


Figure 15

The sort facility discrete I/O screen is shown in figure 15, and displays channel status for the 24VDC input module. A red light indicates a voltage present at the input module. Channel status for the 24VDC output module is also shown, and a red light indicates the output is energized by the controller. The input and output modules depicted are located within the electric room PLC cabinet.

6.16. PUMP ROOM - DISCRETE I/O

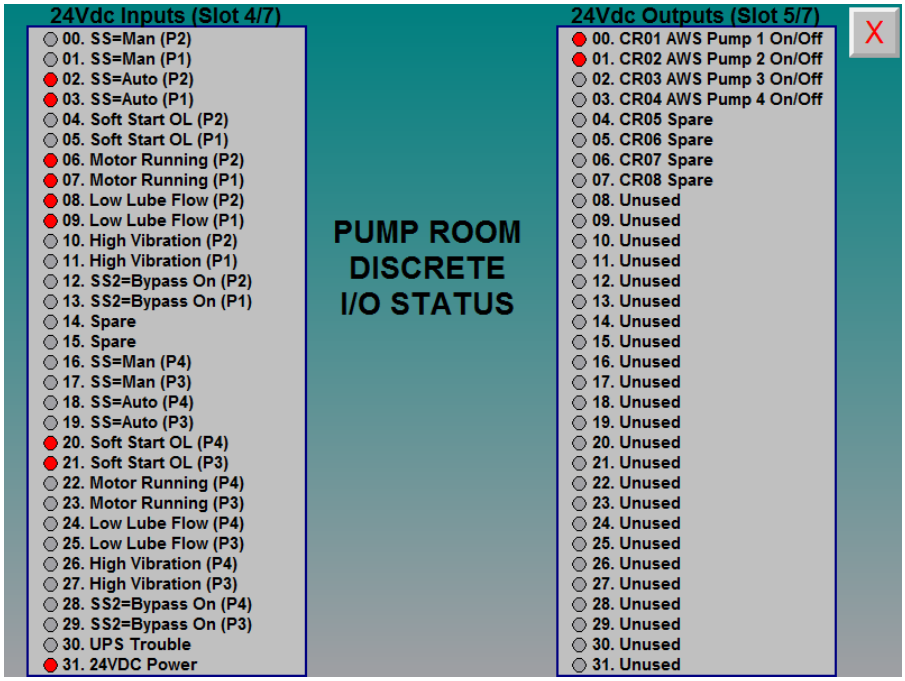


Figure 16

The pump room discrete I/O screen is shown in figure 16 and displays channel status for the 24VDC input module. A red light indicates a voltage present at the input module. Channel status for the 24VDC output module is also shown, and a red light indicates the output is energized by the controller. The input and output modules depicted are located within the pump room remote I/O cabinet.

6.17. HATCHERY - DISCRETE I/O

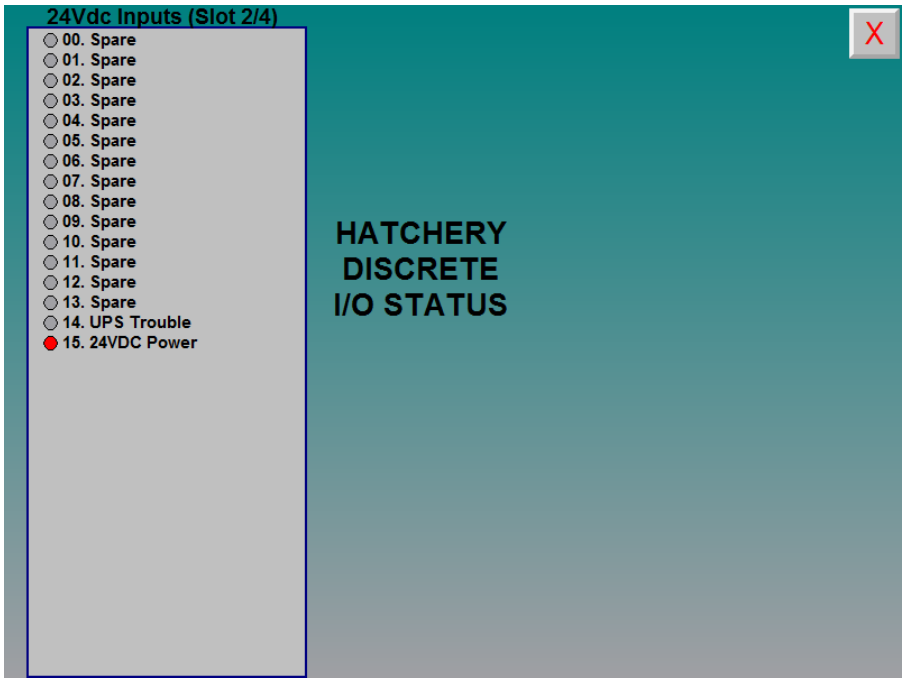


Figure 17

The fish hatchery discrete I/O screen is shown in figure 17 and displays channel status for the 24VDC input module. A red light indicates a voltage present at the input channel. The input and output modules depicted are located within the fish hatchery HMI cabinet.

6.18. PLANT OVERVIEW

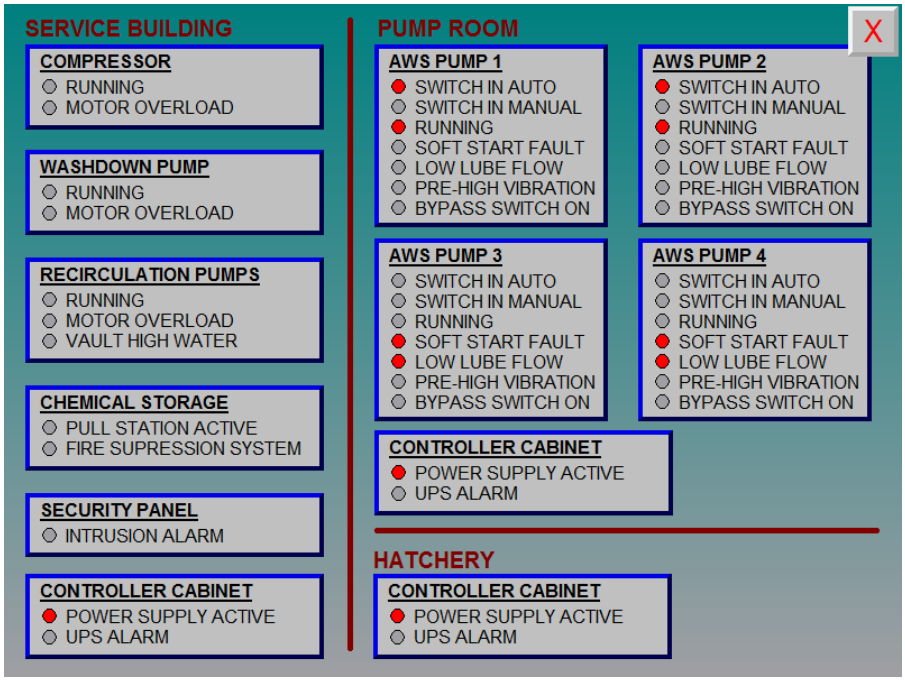


Figure 18

The fish collection facility plant I/O screen shown in figure 18 displays all 24VDC discrete inputs utilized throughout the facility. A red light indicates a voltage present for the respective input listed.

6.19. KEY PAD

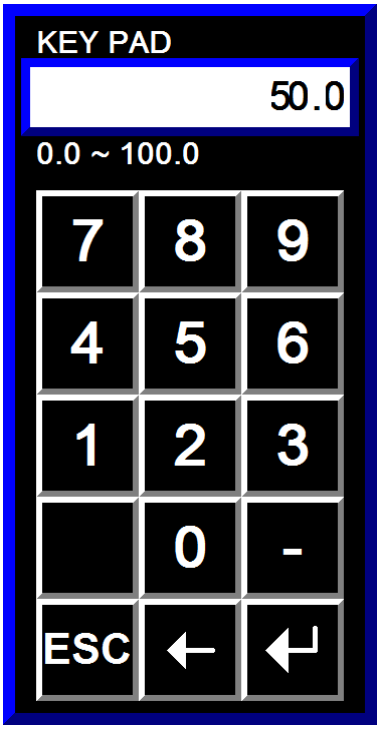


Figure 19

The touchscreen keypad shown in figure 19 permits data entry as required for manual operation. The allowed data range is displayed above the numbers, and is 0.0 to 100.0 for figure 19. Attempts to enter data outside the listed range will be rejected by the graphic terminal. The *ENTER* button is in the lower right corner.

6.20. LOGIN

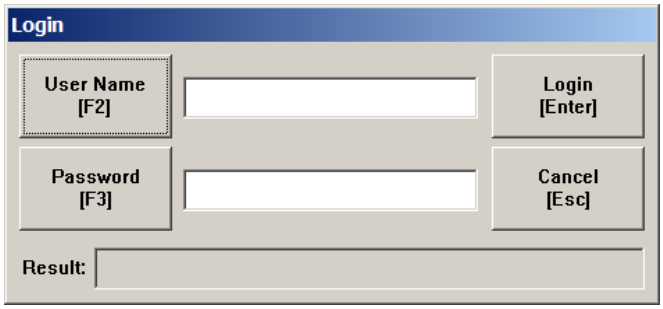


Figure 20

The login prompt is shown in figure 20. The login/enter pushbutton must be pressed after entering both the user name and password. All graphic terminals will automatically logoff the user after 30 minutes of inactivity.

6.21. ALARM HISTORY

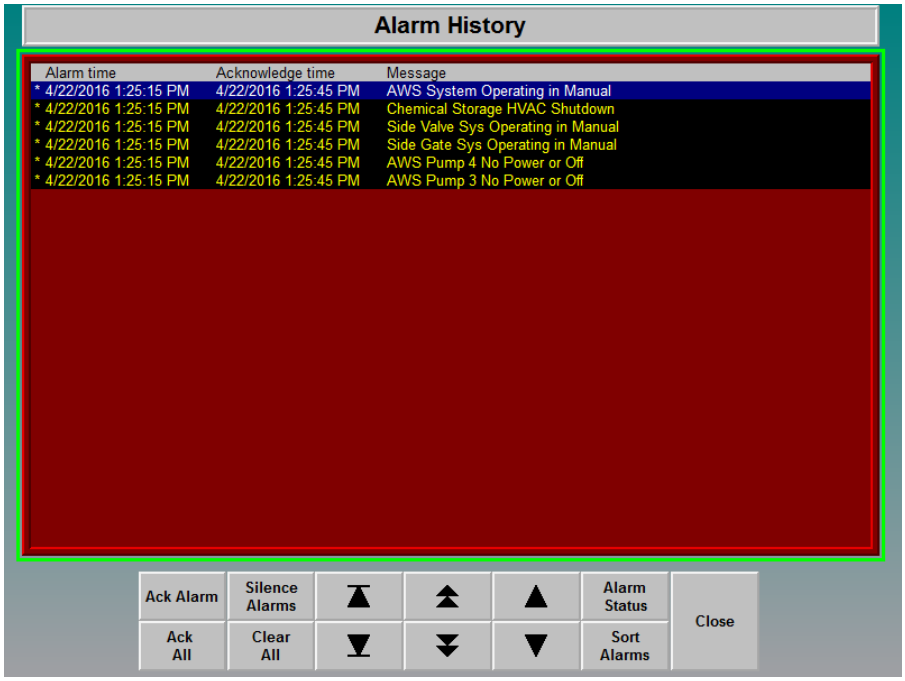


Figure 21

The alarm history screen is shown in figure 21 and is used to acknowledge, clear, and sort past alarms that have not yet been cleared. The “clear all” button will remove all historical alarms from view, even if the alarm is still active.

6.22. ACTIVE ALARM STATUS

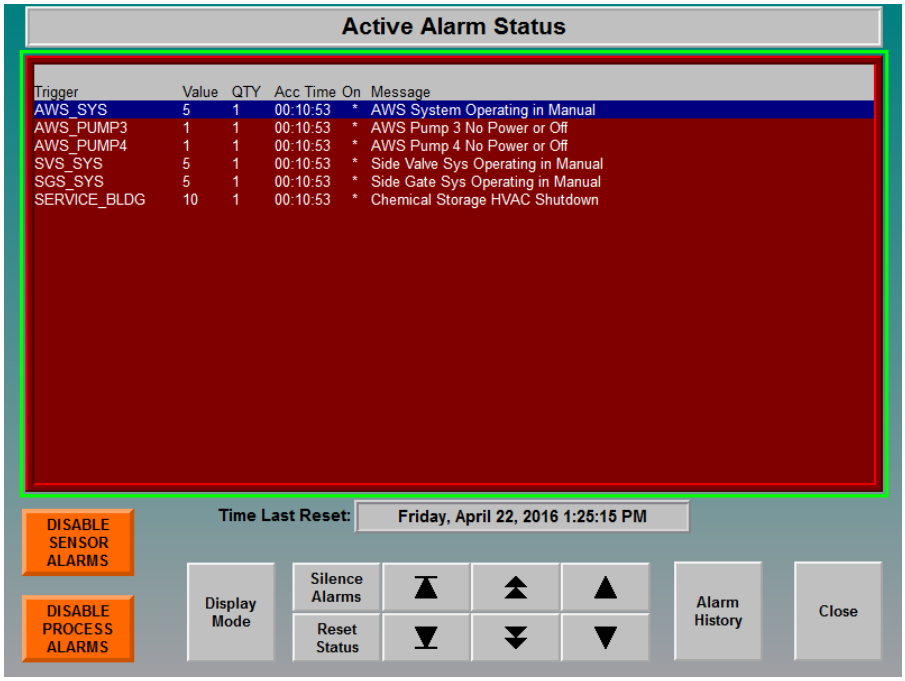


Figure 22

The active alarm status screen displays all active alarms and is shown in figure 22. The *"RESET STATUS"* button restarts the accumulated time shown. The *"SILENCE ALARMS"* pushbutton is not functional since the graphic terminals do not have an integral speaker. The orange "DISABLE SENSOR ALARMS" and "DISABLE PROCESS ALARMS" buttons open screens for alarm management.

6.23. ALARM MANAGEMENT - ANALOG SENSORS

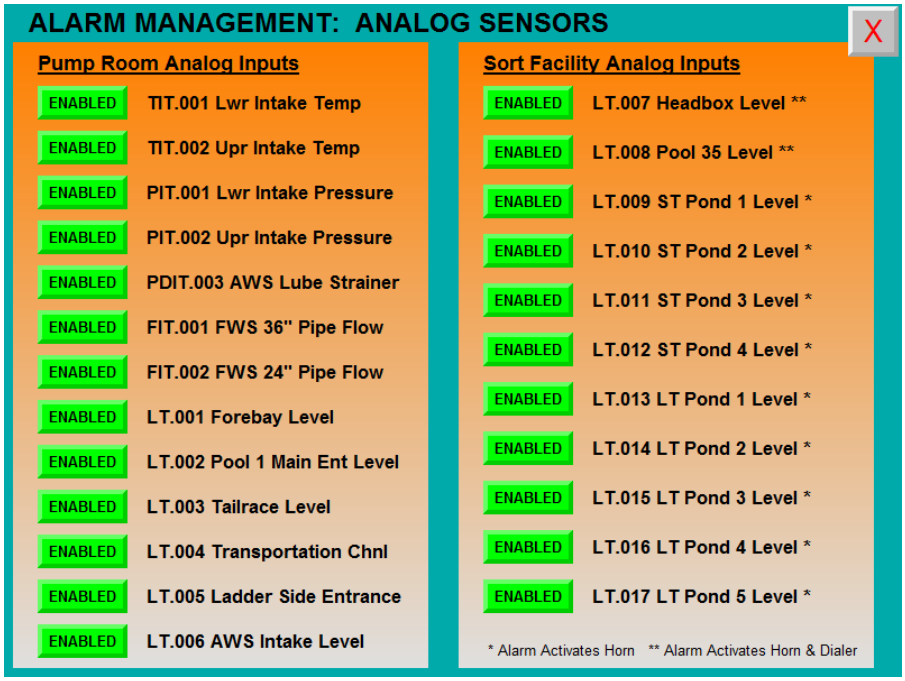


Figure 23

The analog sensor alarm management screen shown in figure 23 permits specific analog sensor alarms to be disabled or enabled. Sensor alarms should only be disabled if the device is out-of-service for repair or the fish collection facility has been shut down. An “ENABLED” alarm is indicated by a green pushbutton while a red pushbutton indicates a “DISABLED” alarm. Pressing a button will switch the alarm mode to the opposite state currently shown.

6.24. ALARM MANAGEMENT - ACTUATORS AND PROCESS CONTROL

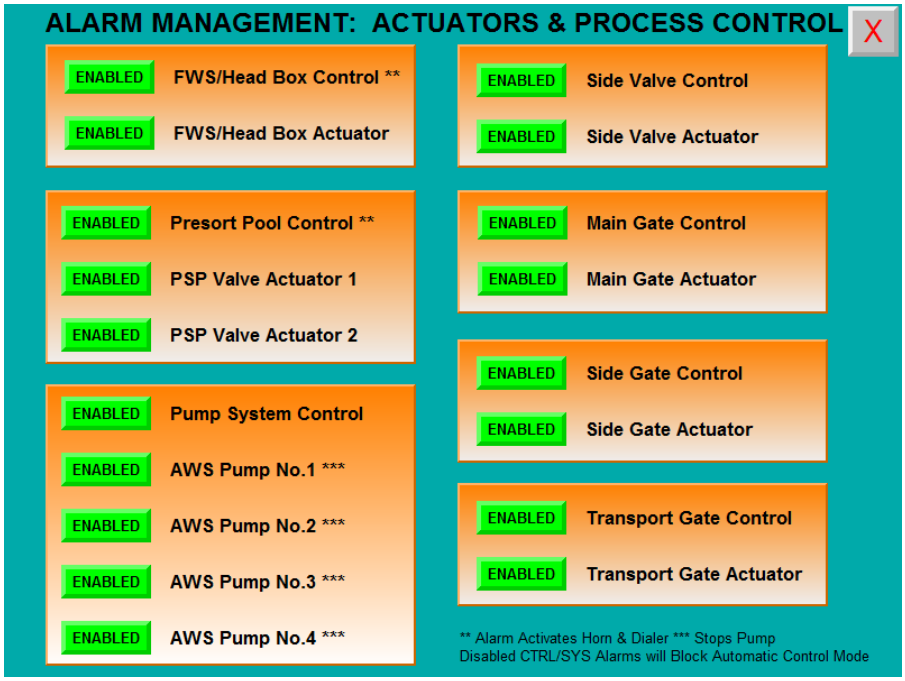


Figure 24

The actuator and process control alarm management screen shown in figure 24 permits alarms related to specific actuators and processes to be disabled or enabled. Actuator and process alarms should only be disabled if the device is out-of-service for repair or the Fish Collection Facility has been shut down. Note that disabling certain alarms will force a process running in automatic mode to switch to manual mode. See the alarm summary matrix for further information. An “ENABLED” alarm is indicated by a green pushbutton while a red pushbutton indicates a “DISABLED” alarm. Pressing a button will switch the alarm mode to the opposite state currently shown.

APPENDICES

Appendix A: As-Built Drawings

Appendix B: Contractor's O&M Manuals

Appendix C: FOSTER FISH COLLECTION FACILITY GRAPHIC TERMINAL ALARM SUMMARY

Draft Version. Last Updated April 21 2016

GRAPHIC TERMINAL (HMI) ALARM TEXT	ALARM DESCRIPTION	POSSIBLE CAUSE OR ADDITIONAL INFORMATION	ALARM DISABLED ?	ALARM DELAY	* ALARM ACTIVE IN MANUAL MODE?	DISABLE ALARM AT HMI?	** AUDIBLE & ODFW REMOTE NOTIFICATION
ANALOG SENSORS (Sort Area)							
LT.007 Error (Headbox Level)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	Horn & Dialer
LT.008 Error (Pool 35 Level)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	Horn & Dialer
LT.009 Error (ST Pond 1 Lvl)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	Horn & Dialer
LT.010 Error (ST Pond 2 Lvl)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	Horn & Dialer
LT.011 Error (ST Pond 3 Lvl)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	Horn & Dialer
LT.012 Error (ST Pond 4 Lvl)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	Horn & Dialer
LT.013 Error (LT Pond 1 Lvl)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	Horn & Dialer
LT.014 Error (LT Pond 2 Lvl)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	Horn & Dialer
LT.015 Error (LT Pond 3 Lvl)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	Horn & Dialer
LT.016 Error (LT Pond 4 Lvl)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	Horn & Dialer
LT.017 Error (LT Pond 5 Lvl)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	Horn & Dialer
Spare Analog Input Ch.11	n/a	n/a		n/a	n/a	n/a	
Spare Analog Input Ch.12	n/a	n/a		n/a	n/a	n/a	
Spare Analog Input Ch.13	n/a	n/a		n/a	n/a	n/a	
Spare Analog Input Ch.14	n/a	n/a		n/a	n/a	n/a	
Spare Analog Input Ch.15	n/a	n/a		n/a	n/a	n/a	
ANALOG SENSORS (Pump Room Area)							
TIT.001 Error (Lower Intake)	Water Temperature Transmitter (w/Display) Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	
TIT.002 Error (Upper Intake)	Water Temperature Transmitter (w/Display) Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	
PIT.001 Error (Lower Intake)	Water Pressure Transmitter (w/Display) Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	
PIT.002 Error (Upper Intake)	Water Pressure Transmitter (w/Display) Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	
FIT.001 Error (36 Pipe FWS)	Water Flow Transmitter (w/Display) Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	
FIT.002 Error (24 Pipe FWS)	Water Flow Transmitter (w/Display) Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	
LT.001 Error (Forebay)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	
LT.002 Error (Pool 1 Main Ent)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	
LT.003 Error (Tailrace)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	
LT.004 Error (Trans Chnl)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	
LT.005 Error (Ladder Side Ent)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	
LT.006 Error (AWS Pump Intake)	Submersible Water Level Transmitter Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	yes	
PDIT.003 Error (AWS Pump Strainer)	Differential Water Pressure Transmitter (w/Display) Trouble	No Power, Broken wire, Signal Out-of-Range, Out-of-Calibration, Device Failure, etc…		10 Sec	n/a	n/a	
Spare Analog Input Ch.13	n/a	n/a		n/a	n/a	n/a	
Spare Analog Input Ch.14	n/a	n/a		n/a	n/a	n/a	
Spare Analog Input Ch.15	n/a	n/a		n/a	n/a	n/a	
AUXILLARY WATER SYSTEM CONTROL							
AWS Pump / Table Mismatch	Quantity of Pumps running does not match design table.	Total pumps running do not equal the req' quantity based on Tailrace water level (Lt.003)		360 sec	no		
AWS System Forced to Manual	AWS Pump system jumped from Auto to Manual Mode	Pump not in auto, Soft-start fault, High vibration, Low lube flow, LT.003 trouble, PLC module fault,		Instant	no		
AWS System Not Used	n/a	n/a		n/a	n/a	yes	
AWS Upr Intake Trashrack Hi Differential	AWS Intake Pipe High Differential Pressure	(Lt.001 - PT.002) is greater than 10 Ft.		60 Sec	yes		
AWS System Operating in Manual	AWS Pump control system in manual mode	System placed in Manual at HMI or an unscheduled event caused jump from Auto to Manual		60 Sec	yes		
AWS System Return to Auto Attempted	Return to Auto Mode attempted after System Forced to Man	Pump & Process Alms Enabled, Pumps in Auto, LT.003, Vibration, & Low Flow Alarms Cleared.	Disabled	240 Sec	n/a		
AWS Pumps Lube Water Strainer Dirty	AWS Pump Lubrication Water Filter	Differential Pressure across strainer is greater than 50 ft of water.		60 Sec	n/a		
AUXILLARY WATER SYSTEM PUMPS							
AWS Pump 1 No Power or Off	Selector Switch Position = OFF or no control power	120VAC voltage signal not reeceived through control panel selector switch		5 Sec	yes		
AWS Pump 1 Not in Auto	Selector Switch Position Not in Auto	Control Panel Selector Switch not in Auto Position		30 Sec	yes		
AWS Pump 1 Soft Starter Fault	Soft Starter Overload or Fault	Soft Starter Overload or Trouble		30 Sec	yes		
AWS Pump 1 Low Lube Flow	Lubrication Water Flow is Low	Low Water Flow when Pump Running		5 Sec	yes	yes	
AWS Pump 1 High Vibration Warning	High Pump Vibration Detected	Pump Vibration Sensor Active		30 Sec	yes		
AWS Pump 1 Run Failure (Vibration, Flow,or Fault)	Failure due to Low Flow, High Vibration, or Soft-Starter Fault	Feedback from motor contactor does not match PLC output to run		30 Sec	no		

AWS Pump 1 Auto Stop Failure	Pump Failed to Stop	Feedback from motor contactor does not match PLC output to stop		30 Sec	no		
AWS Pump 2 No Power or Off	Selector Switch Position = OFF or no control power	120VAC voltage signal not reeceived through control panel selector switch		5 Sec	yes		
AWS Pump 2 Not in Auto	Selector Switch Position Not in Auto	Control Panel Selector Switch not in Auto Position		30 Sec	yes		
AWS Pump 2 Soft Starter Fault	Soft Starter Overload or Fault	Soft Starter Overload or Trouble		30 Sec	yes		
AWS Pump 2 Low Lube Flow	Lubrication Water Flow is Low	Low Water Flow when Pump Running		5 Sec	yes	yes	
AWS Pump 2 High Vibration Warning	High Pump Vibration Detected	Pump Vibration Sensor Active		30 Sec	yes		
AWS Pump 2 Run Failure (Vibration, Flow,or Fault)	Failure due to Low Flow, High Vibration, or Soft-Starter Fault	Feedback from motor contactor does not match PLC output to run		30 Sec	no		
AWS Pump 2 Auto Stop Failure	Pump Failed to Stop	Feedback from motor contactor does not match PLC output to stop		30 Sec	no		
AWS Pump 3 No Power or Off	Selector Switch Position = OFF or no control power	120VAC voltage signal not reeceived through control panel selector switch		5 Sec	yes		
AWS Pump 3 Not in Auto	Selector Switch Position Not in Auto	Control Panel Selector Switch not in Auto Position		30 Sec	yes		
AWS Pump 3 Soft Starter Fault	Soft Starter Overload or Fault	Soft Starter Overload or Trouble		30 Sec	yes		
AWS Pump 3 Low Lube Flow	Lubrication Water Flow is Low	Low Water Flow when Pump Running		5 Sec	yes	yes	
AWS Pump 3 High Vibration Warning	High Pump Vibration Detected	Pump Vibration Sensor Active		30 Sec	yes		
AWS Pump 3 Run Failure (Vibration, Flow,or Fault)	Failure due to Low Flow, High Vibration, or Soft-Starter Fault	Feedback from motor contactor does not match PLC output to run		30 Sec	no		
AWS Pump 3 Auto Stop Failure	Pump Failed to Stop	Feedback from motor contactor does not match PLC output to stop		30 Sec	no		
AWS Pump 4 No Power or Off	Selector Switch Position = OFF or no control power	120VAC voltage signal not reeceived through control panel selector switch		5 Sec	yes		
AWS Pump 4 Not in Auto	Selector Switch Position Not in Auto	Control Panel Selector Switch not in Auto Position		30 Sec	yes		
AWS Pump 4 Soft Starter Fault	Soft Starter Overload or Fault	Soft Starter Overload or Trouble		30 Sec	yes		
AWS Pump 4 Low Lube Flow	Lubrication Water Flow is Low	Low Water Flow when Pump Running		5 Sec	yes	yes	
AWS Pump 4 High Vibration Warning	High Pump Vibration Detected	Pump Vibration Sensor Active		30 Sec	yes		
AWS Pump 4 Run Failure (Vibration, Flow,or Fault)	Failure due to Low Flow, High Vibration, or Soft-Starter Fault	Feedback from motor contactor does not match PLC output to run		30 Sec	no		
AWS Pump 4 Auto Stop Failure	Pump Failed to Stop	Feedback from motor contactor does not match PLC output to stop		30 Sec	no		
PRESORT POOL SYSTEM							
Pre-Sort-Pool Water Level High or Low	Presort Pool Water Level at Upper or Lower Limit	Pool 35 Water Elev (LT.008) - Top of Weir (560.7) is GEQ than 1.6 Ft or LEQ 1.2 Ft		300 Sec	yes	yes	Horn & Dialer
PRESORT POOL SYSTEM ACTUATORS							
Valve PSP 1 Communication Error	Actuator Communication Error	Rotork Acuator not found on network due to loss of power at actuator or Devicenet problem		30 Sec	yes		
Valve PSP 1 Not in Remote	Actuator Selector Switch Not In Remote	Rotork Actuator Selector Switch in stop or Local position		2 Sec	yes		
Valve PSP 1 Close Failure within Allotted Time	Actuator did not fully close within expetcted time	Verify Rotork Actuator limit switch settings and general operation		60 Sec	no	yes	
Valve PSP 1 Open Failure within Allotted Time	Actuator did not fully open within expected time	Verify Rotork Actuator limit switch settings and general operation		60 Sec	no		
Valve PSP 1 Setpoint Rejected by Actuator	Command for Setpoint Positioning Mode Rejected.	Alarm ignored due to signal loss at 0 and 100% setpoints or when fully open/closed. ONLY ISSUE w/ROTORK.	Disabled	n/a	n/a		
Valve PSP 1 Internal Alarm	Actuator Internal Alarm Active	Rotork Actuator Obstructed, Jammed, Thermal Overload, Low Battery, or Monitor Error.		5 Sec	no		
Valve PSP 2 Communication Error	Actuator Communication Error	Rotork Acuator not found on network due to loss of power at actuator or Devicenet problem		30 Sec	yes		
Valve PSP 2 Not in Remote	Actuator Selector Switch Not In Remote	Rotork Actuator Selector Switch in stop or Local position		2 Sec	yes		
Valve PSP 2 Close Failure within Allotted Time	Actuator did not fully close within expetcted time	Verify Rotork Actuator limit switch settings and general operation		60 Sec	no	yes	
Valve PSP 2 Open Failure within Allotted Time	Actuator did not fully open within expected time	Verify Rotork Actuator limit switch settings and general operation		60 Sec	no		
Valve PSP 2 Setpoint Rejected by Actuator	Command for Setpoint Positioning Mode Rejected.	Alarm ignored due to signal loss at 0 and 100% setpoints or when fully open/closed. ONLY ISSUE w/ROTORK.	Disabled	n/a	n/a		
Valve PSP 2 Internal Alarm	Actuator Internal Alarm Active	Rotork Actuator Obstructed, Jammed, Thermal Overload, Low Battery, or Monitor Error.		5 Sec	no		
FACILITY WATER SYSTEM CONTROL (Headbox)							
FWS Valve Sys Forced to Manual	Unscheduled event caused jump from Auto to Man	System Alm Disabled, LT.007 Error, Network Error, Actuator Alms or Switch Not in Remote		Instant	no		
FWS Valve Sys Controller Output at Limit	Process PLC output at Upper or Lower Limit	PLC output to valve at 70% open (max limit) or 0% open (min limit). Unable to regulate process.		300 Sec	no		
FWS Headbox Water Level High or Low	Process Variable (LT.007) at Upper or Lower Limit	PLC input (LT.007) is greater than 23.5ft or less than 21.5ft.		300 Sec	no	yes	Horn & Dialer
FWS Lwr Intake Trashrack Hi Differential	FWS Intake Pipe High Differential Pressure	(Lt.001 - PT.001) is greater than 10 Ft		60 Sec	yes		
FWS Valve Sys Operating in Manual	FWS Valve (Headbox) control system in manual mode	System placed in manual or event caused jump from Auto. Lock visible if placed in Man by Operator.		60 Sec	yes		
FWS Valve Sys Return to Auto Attempted	Return to Auto Mode attempted after System Forced to Man	FQ1 Power Restored, Process Alm Enabled, SS=Rem, or LT.007, Network & Actuator Errors Cleared.		240 Sec	no		
FACILITY WATER SYSTEM ACTUATOR							
FWS Valve Communication Error	Actuator Communication Error	Rotork Acuator not found on network due to loss of power or Devicenet problem		30 Sec	yes		
FWS Valve Not in Remote	Actuator Selector Switch Not In Remote	Rotork actuator selector switch in Stop or Local position		2 Sec	yes		
FWS Valve Close Failure within Allotted Time	Actuator did not fully close within expetcted time	Verify Rotork Actuator limit switch settings and general operation		60 Sec	no	yes	
FWS Valve Open Failure within Allotted Time	Actuator did not fully open within expected time	Verify Rotork Actuator limit switch settings and general operation		60 Sec	no		
FWS Valve Setpoint Rejected by Actuator	Command for Setpoint Positioning Mode Rejected.	Alarm ignored due to signal loss at 0 and 100% setpoints or when fully open/closed. ONLY ISSUE w/ROTORK.	Disabled	n/a	n/a		
FWS Valve Internal Alarm	Actuator Internal Alarm Active	Rotork Actuator Obstructed, Jammed, Thermal Overload, Low Battery, or Monitor Error.		2 Sec	no		
SIDE VALVE CONTROL							
Side Valve Sys Forced to Manual	Unscheduled event caused jump from Auto to Man	System Alm Disabled, LT.002 or LT.004 Error, Network Error, Actuator Alms or Switch Not in Remote		Instant	no		
Side Valve Sys Controller Output at Limit	PLC output remaining at Upper or Lower Limit too Long	PLC output to valve at 100% open (max limit) or 0% open (min limit). Unable to regulate process.	Disabled	300 Sec	no		
Side Valve Process out of Tolerance	Process Variable (FIT.002) at Upper or Lower Limit	Process Variable (FIT.002) is greater than 65 CFS or less than -5.0 CFS for 5 minutes.		300 Sec	no	yes	
Side Valve Sys Operating in Manual	Side valve control system in manual mode	System placed in Manual at HMI or an unscheduled event caused jump from Auto to Manual		60 Sec	yes		

Side Valve Sys Return to Auto Attempted	Return to Auto Mode attempted after System Forced to Man	FQ1 Power Restored, Process Alm Enabled, SS=Rem, or LT.002, LT.004, Network & Actuator Errors Cleared.	Disabled	240 Sec	n/a		
SIDE VALVE ACTUATOR							
Side Valve Communication Error	Actuator Communication Error	Rotork Acuator not found on network due to loss of power or Devicenet problem		30 Sec	yes		
Side Valve Not in Remote	Actuator Selector Switch Not In Remote	Rotork Actuator Selector Switch in stop or Local position		2 Sec	yes		
Side Valve Close Failure within Allotted Time	Actuator did not fully close within expetcted time	Verify Rotork Actuator limit switch settings and general operation		60 Sec	no	yes	
Side Valve Open Failure within Allotted Time	Actuator did not fully open within expected time	Verify Rotork Actuator limit switch settings and general operation		60 Sec	no		
Side Valve Setpoint Rejected by Actuator	Command for Setpoint Positioning Mode Rejected.	Alarm ignored due to signal loss at 0 and 100% setpoints or when fully open/closed. ONLY ISSUE w/ROTORK.	Disabled	n/a	n/a		
Side Valve Internal Alarm	Actuator Internal Alarm Active	Rotork Actuator Obstructed, Jammed, Thermal Overload, Low Battery, or Monitor Error.		5 Sec	no		
MAIN ENTRANCE GATE CONTROL							
Main Gate Sys Forced to Manual	Unscheduled event caused jump from Auto to Man	System Alm Disabled, LT.002 or LT.003 Error, Network Error, Actuator Alms or Switch Not in Remote		Instant	no		
Main Gate Sys Controller Output at Limit	PLC output remaining at Upper or Lower Limit too Long	PLC output to gate at 85.5% open (max limit) or 10.4% open (min limit). Unable to regulate process.	Disabled	300 Sec	no		
Main Gate Process out of Tolerance	Pool 1 (LT.002) - Tailrace (Lt.003) out of range.	PLC input (LT.002 - LT.003) GEQ than 10.0 ft or LEQ 0.0 ft.		300 Sec	no	yes	
Main Gate Sys Operating in Manual	Main Ladder Entrance Gate system in manual mode	System placed in manual or event caused jump from Auto to Man. Lock visible if placed in manual.		60 Sec	yes		
Main Gate Sys Return to Auto Attempted	Return to Auto Mode attempted after System Forced to Man	FQ1 Power Restored, Process Alm Enabled, SS=Rem, or LT.002, LT.003, Network & Actuator Errors Cleared.	Disabled	240 Sec	n/a		
MAIN ENTRANCE GATE ACTUATOR							
Main Gate Communication Error	Actuator Communication Error	Auma Acuator not found on network due to loss of power or Devicenet problem		30 Sec	yes		
Main Gate Not in Remote	Actuator Selector Switch Not In Remote	Auma Actuator Selector Switch in stop or Local position		2 Sec	yes		
Main Gate Close Failure within Allotted Time	Actuator did not fully close within expetcted time	Verify Auma Actuator limit switch settings and general operation		10 Min	no	yes	
Main Gate Open Failure within Allotted Time	Actuator did not fully open within expected time	Verify Auma Actuator limit switch settings and general operation		10 Min	no		
Main Gate Positioning Failure within Alloted Time	Actuator did not reach setpoint position within expected time	Verify Auma Actuator limit switch settings and general operation		10 Min	n/a		
Main Gate Internal Alarm	Actuator Internal Alarm Active	Auma Actuator internal fault, warning, or not ready signal(s) active.		2 Sec	no		
SIDE ENTRANCE GATE CONTROL							
Side Gate Sys Forced to Manual	Unscheduled event caused jump from Auto to Man	System Alm Disabled, LT.002 or LT.004 Error, Network Error, Actuator Alms or Switch Not in Remote		Instant	no		
Side Gate Sys Controller Output at Limit	PLC output remaining at Upper or Lower Limit too Long	PLC output to gate at 85.5% open (max limit) or 10.4% open (min limit). Unable to regulate process.	Disabled	300 Sec	no		
Side Gate Process out of Tolerance	Pool 1 (LT.002) - Transportation Chnl (LT.004) out of range.	PLC input (LT.002 - LT.004) GEQ than 2.0 ft or LEQ 0.0 ft.		300 Sec	no	yes	
Side Gate Sys Operating in Manual	Side Entrance Gate control system in manual mode	System placed in manual or event caused jump from Auto to Man. Lock visible if placed in manual.		60 Sec	yes		
Side Gate Sys Return to Auto Attempted	Return to Auto Mode attempted after System Forced to Man	FQ1 Power Restored, Process Alm Enabled, SS=Rem, or LT.002, LT.004, Network & Actuator Errors Cleared.	Disabled	240 Sec	n/a		
SIDE ENTRANCE GATE ACTUATOR							
Side Gate Communication Error	Actuator Communication Error	Auma Acuator not found on network due to loss of power or Devicenet problem		30 Sec	yes		
Side Gate Not in Remote	Actuator Selector Switch Not In Remote	Auma Actuator Selector Switch in stop or Local position		2 Sec	yes		
Side Gate Close Failure within Allotted Time	Actuator did not fully close within expetcted time	Verify Auma Actuator limit switch settings and general operation		10 Min	no	yes	
Side Gate Open Failure within Allotted Time	Actuator did not fully open within expected time	Verify Auma Actuator limit switch settings and general operation		10 Min	no		
Side Gate Positioning Failure within Alloted Time	Actuator did not reach setpoint position within expected time	Verify Auma Actuator limit switch settings and general operation		10 Min	n/a		
Side Gate Internal Alarm	Actuator Internal Alarm Active	Auma Actuator internal fault, warning, or not ready signal(s) active.		2 Sec	no		
TRANSPORTATION GATE CONTROL							
Trans Gate Sys Forced to Manual	Control Loop Forced from Auto into Manual Mode	System Alm Disabled, LT.003 Error, Network Error, Actuator Alms or Switch Not in Remote		Instant	no		
Trans Gate Sys Controller Output at Limit	PLC output remaining at Upper or Lower Limit too Long	PLC output to gate at 100.0% open (max limit) or 15.0% open (min limit). Unable to regulate process.	Disabled	300 Sec	no		
Trans Gate Process out of Tolerance	Top of gate out-of-range. Open= 526.37 ft., closed=535.55ft	PLC input (Gate Position) GEQ than 536.0 ft or LEQ 526.0 ft.		300 Sec	no	yes	
Trans Gate Sys Operating in Manual	Transportation Gate control system in manual mode	System placed in manual or event caused jump from Auto to Man. Lock visible if placed in manual.		60 Sec	yes		
Trans Gate Sys Return to Auto Attempted	Return to Auto Mode attempted after System Forced to Man	FQ1 Power Restored, Process Alm Enabled, SS=Rem, or LT.003, Network & Actuator Errors Cleared.	Disabled	240 Sec	n/a		
TRANSPORTATION GATE ACTUATOR							
Trans Gate Communication Error	Actuator Communication Error	Auma Acuator not found on network due to loss of power or Devicenet problem		30 Sec	yes		
Trans Gate Not in Remote	Actuator Selector Switch Not In Remote	Auma Actuator Selector Switch in stop or Local position		2 Sec	yes		
Trans Gate Close Failure within Allotted Time	Actuator did not fully close within expetcted time	Verify Auma Actuator limit switch settings and general operation		11 Min	no	yes	
Trans Gate Open Failure within Allotted Time	Actuator did not fully open within expected time	Verify Auma Actuator limit switch settings and general operation		11 Min	no		
Trans Gate Positioning Failure within Alloted Time	Actuator did not reach setpoint position within expected time	Verify Auma Actuator limit switch settings and general operation		11 Min	n/a		
Trans Gate Internal Alarm	Actuator Internal Alarm Active	Auma Actuator internal fault, warning, or not ready signal(s) active.		2 Sec	no		
HOLDING PONDS (RACEWAYS)							
Short Term Pond 1 Low Water	Water Depth Below Setpoint	Check Pond Water Level, adjust setpoint, or disable alarm		30 Sec	n/a	yes	Horn & Dialer
Short Term Pond 1 High Water	Water Depth Above Setpoint	Check Pond Water Level, adjust setpoint, or disable alarm		60 Sec			Horn & Dialer
Short Term Pond 2 Low Water	Water Depth Below Setpoint	Check Pond Water Level, adjust setpoint, or disable alarm		30 Sec	n/a	yes	Horn & Dialer
Short Term Pond 2 High Water	Water Depth Above Setpoint	Check Pond Water Level, adjust setpoint, or disable alarm		60 Sec			Horn & Dialer
Short Term Pond 3 Low Water	Water Depth Below Setpoint	Check Pond Water Level, adjust setpoint, or disable alarm		30 Sec	n/a	yes	Horn & Dialer
Short Term Pond 3 High Water	Water Depth Above Setpoint	Check Pond Water Level, adjust setpoint, or disable alarm		60 Sec			Horn & Dialer
Short Term Pond 4 Low Water	Water Depth Below Setpoint	Check Pond Water Level, adjust setpoint, or disable alarm		30 Sec	n/a	yes	Horn & Dialer
Short Term Pond 4 High Water	Water Depth Above Setpoint	Check Pond Water Level, adjust setpoint, or disable alarm		60 Sec			Horn & Dialer

Long Term Pond 1 Low Water	Water Depth Below Setpoint	Check Pond Water Level, adjust setpoint, or disable alarm		30 Sec	n/a	yes	Horn & Dialer
Long Term Pond 1 High Water	Water Depth Above Setpoint	Check Pond Water Level, adjust setpoint, or disable alarm		60 Sec			Horn & Dialer
Long Term Pond 2 Low Water	Water Depth Below Setpoint	Check Pond Water Level, adjust setpoint, or disable alarm		30 Sec	n/a	yes	Horn & Dialer
Long Term Pond 2 High Water	Water Depth Above Setpoint	Check Pond Water Level, adjust setpoint, or disable alarm		60 Sec			Horn & Dialer
Long Term Pond 3 Low Water	Water Depth Below Setpoint	Check Pond Water Level, adjust setpoint, or disable alarm		30 Sec	n/a	yes	Horn & Dialer
Long Term Pond 3 High Water	Water Depth Above Setpoint	Check Pond Water Level, adjust setpoint, or disable alarm		60 Sec			Horn & Dialer
Long Term Pond 4 Low Water	Water Depth Below Setpoint	Check Pond Water Level, adjust setpoint, or disable alarm		30 Sec	n/a	yes	Horn & Dialer
Long Term Pond 4 High Water	Water Depth Above Setpoint	Check Pond Water Level, adjust setpoint, or disable alarm		60 Sec			Horn & Dialer
Long Term Pond 5 Low Water	Water Depth Below Setpoint	Check Pond Water Level, adjust setpoint, or disable alarm		30 Sec	n/a	yes	Horn & Dialer
Long Term Pond 5 High Water	Water Depth Above Setpoint	Check Pond Water Level, adjust setpoint, or disable alarm		60 Sec			Horn & Dialer
MISCELLANEOUS HARDWARE ALARMS							
Compressor Overload	Air Compessor Motor Overload Relay.	Check unloaded amps & OL relay. Verify windings not shorted/grounded. Check load & motor rating.		120 sec	n/a	no	
FishLock Vault High Water	High Water Level in Vault	Check for flooding		15 sec	n/a	no	
Washdown Pump Overload	Washdown Pump Motor Overload Relay.	Check unloaded amps & OL relay. Verify windings not shorted/grounded. Check load & motor rating.		15 sec	n/a	no	
Recirculation Vault High Level	Recirculation Vault High Water Level.	Verify fault not flooded.		15 sec	n/a	no	
Recirculation Pump VFD Fault	Variable Speed Drive Fault.	Check VFD alarm log & motor.		15 sec	n/a	no	
Chemical Storage Pull Station Active	Manual Pull Station Alarm.	Check manual pull stations (x2).		15 sec	n/a	no	Horn
Chemical Storage Fire Suppression Active	Fire Suppression System Activated	Check Alarm Initiating Switch SW2.		15 sec	n/a	no	Horn
Chemical Storage HVAC Shutdown	HVAC system not running.	Check power, thermostat, and HVAC equipment.		15 sec	n/a	no	
Chemical Storage Low Temperature	Building Low Air Temperature	Check building for adequate heat.		15 sec	n/a	no	
SvcBldg UPS Battery Trouble	PLC Cabinet UPS Battery Low	Check UPS Battery		15 sec	n/a	no	
SvcBldg 24VDC Power Lost	PLC cabinet 24Vdc power supply missing.	Check power supply.		15 sec	n/a	no	
SvcBldg Security Panel	Not functional. Needs to be completed by construction	n/a		15 sec	n/a	no	Horn
SvcBldg Power Meter COMM Fault	Ethernet Link to Power Meter Lost.	Check Ethernet Switches, Power Supply, Fiber Optic Cables, Patch Cables, etc.		5 Sec	n/a	no	
SvcBldg Output Module Fault	24Vdc output module has detected a fault.	Check for PLC hardware failure.		Instant	n/a	no	
SvcBldg Input Module Fault	24Vdc input module has detected a fault.	Check for PLC hardware failure.		Instant	n/a	no	
Pump Rm UPS Battery Trouble	Cabinet UPS Battery Low	Check UPS Battery		15 sec	n/a	no	
Pump Rm 24VDC Power Lost	24Vdc power supply missing.	Check power supply.		15 sec	n/a	no	
Pump Rm Not Used	n/a	n/a		n/a	n/a	n/a	
Pump Intake Trashrack Hi Differential	Pump Intake Differential Head > 1.0 Feet	Check Trashrack and Pressure Sensors LT.003 & Lt.006		60 sec	n/a	no	
Pump Rm PLC Chassis COMM Fault	Ethernet Link to PLC Chassis Lost.	Check Ethernet Switches, Power Supply, Fiber Optic Cables, Patch Cables, etc.		5 sec	n/a	no	
Pump Rm Power Meter COMM Fault	Ethernet Link to Power Meter Lost.	Check Ethernet Switches, Power Supply, Fiber Optic Cables, Patch Cables, etc.		5 Sec	n/a	no	
Pump Rm Output Module Fault	24Vdc PLC output module has detected a fault.	Possible PLC hardware failure.		Instant	n/a	no	
Pump Rm Input Module Fault	24Vdc PLC input module has detected a fault.	Possible PLC hardware failure.		Instant	n/a	no	
Hatchery UPS Battery Trouble	PLC Cabinet UPS Battery Low	Check UPS Battery		15 sec	n/a	no	
Hatchery 24VDC Power Lost	PLC cabinet 24Vdc power supply missing.	Check power supply.		15 sec	n/a	no	
Hatchery PLC Chassis COMM Fault	Ethernet Link to PLC Chassis Lost.	Check Ethernet Switches, Power Supply, Fiber Optic Cables, Patch Cables, etc.		5 Sec	n/a	no	
Hatchery Output Module Fault	24Vdc output module has detected a fault.	Check for PLC hardware failure.		Instant	n/a	no	
Hatchery Input Module Fault	24Vdc input module has detected a fault.	Check for PLC hardware failure.		Instant	n/a	no	
MISCELLANEOUS CONTROLLER ALARMS							
CPU Not Running	PLC has stopped executing logic.	PLC is being tested, programmed, or has faulted.		Instant	n/a	no	
CPU in Program Mode	PLC has been placed in program mode.	Verify PLC not left unit in program mode.		Instant	n/a	no	
CPU in Debug Mode	PLC has been placed in debug mode.	Verify PLC not left unit in test mode.		Instant	n/a	no	
Not Used - RSVD for Future	n/a	n/a		n/a	n/a	n/a	
CPU Forces Present	PLC has forced I/O (overrides) present.	Verify programmer has not left I/O forces in memory.		Instant	n/a	no	
CPU Forces Enabled	PLC has forced I/O (overrides) enabled.	Verify programmer has not left I/O forces enabled.		Instant	n/a	no	
CPU Bad Flash	PLC memory is bad.	Verify memory is not corrupted.		Instant	n/a	no	
CPU Major Fault	PLC has faulted.	Go on-line with PLC to determine cause. Reset Fault on-line or by switching key to PGRM then RUN		Instant	n/a	no	
Not Used - RSVD for Future	n/a	n/a		n/a	n/a	n/a	
CPU Low Battery	PLC engergy storage device is low or missing	Check energy storage device such as battery.		Instant	n/a	no	
CPU Minor Fault	PLC has detected a minor fault.	Go on-line with PLC to determine cause and correct software.		Instant	n/a	no	
Disabled Sensor Alarm(s) Present	One or more Analog Sensor Alarms are disabled.	From Graphic Terminal go to alarm "STATUS" and "DISABLE SENSOR ALARMS" to change.		Instant	n/a	no	
Disabled Process Alarm(s) Present	One or more Process or Actuator Alarms are disabled.	From Graphic Terminal goto alarm "STATUS" and "DISABLE PROCESS ALARMS" to change.		Instant	n/a	no	

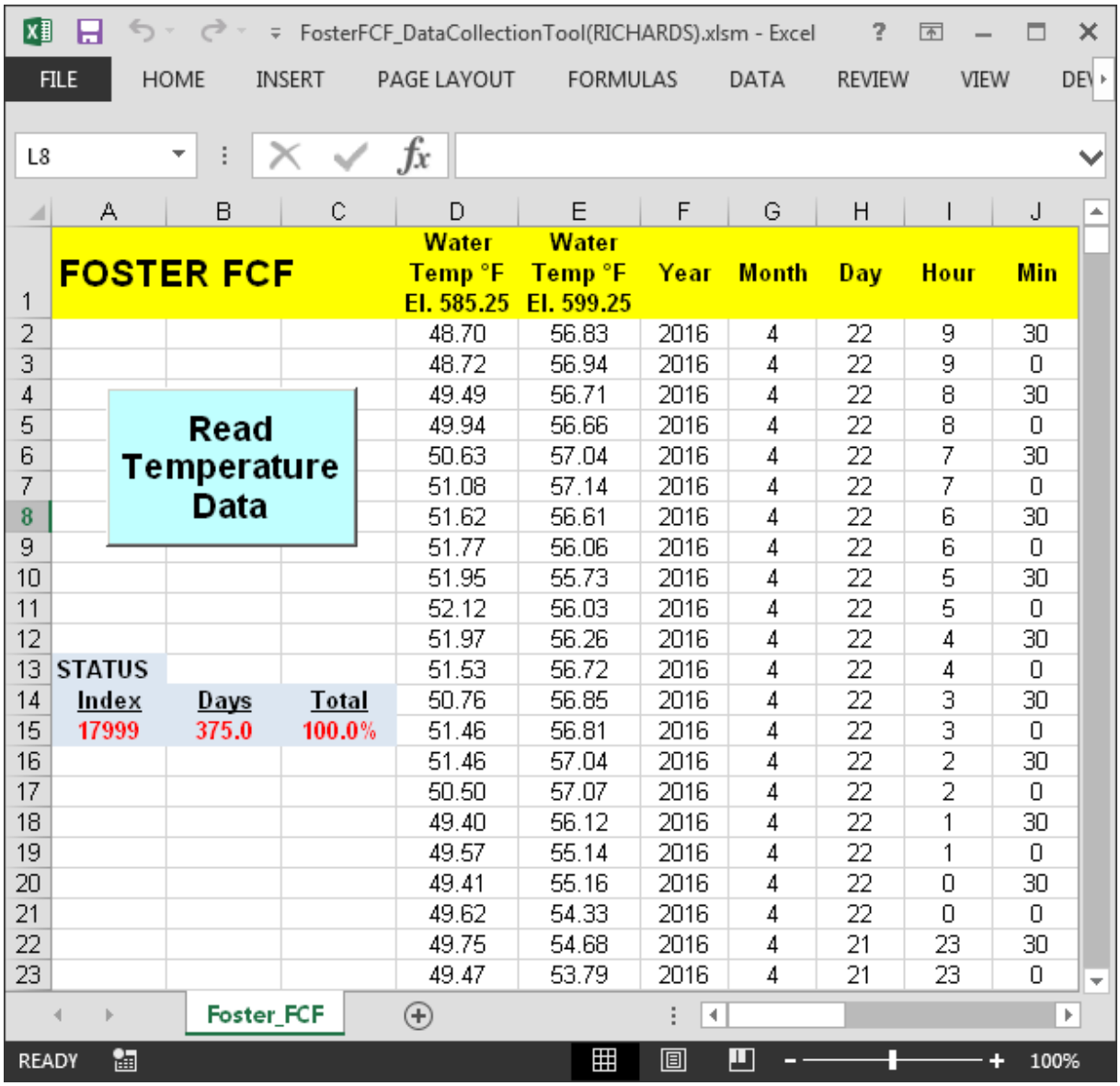
* Manual mode for individual pumps & actuators is set by selector switch at unit. Manual mode for PLC control is set via HMI. Analog sensors and other discrete divices do not have an automatic or manual mode.

** Additional delays exist for autodialer notification to ODFW.

Appendix D: Historical Temperature Data Collection

Description: The fish collection facility (FCF) controller located in the sorting facility electric room logs the forebay water temperature at El. 585.25 (lower intake) and El. 599.25 (upper intake) every thirty minutes. The historical data is stored for 375 days until overwritten by new data. Retrieval of the historical data is performed by the K-grade electrician utilizing RSLinx communications software and a customized Excel spreadsheet as shown in Figure 1. Temperature data should always be retrieved prior to controller software changes. Software should never be downloaded to the controller without first preserving the existing temperature data. Placing the controller in program mode on the hour or half hour should also be avoided. Additional data collection instructions are included on the customized Excel spreadsheet and will not be duplicated here.

Reference Drawings: Sheets EB402 & EI617 for temperature sensors TIT.001 and TIT.002



Appendix E

Appendix E: Stormwater Facilities O&M Manuals

Appendix F: Maintenance Check List and Job Plans