APPENDIX D

Controls Narrative

West Hickman WWTP
Process Equipment and Control Narratives

General For All Equipment

All local alarms will be functional for all control modes and the alarms will be transmitted to Headworks SCADA and WHWWTP main PLC.

All analog indicator signals, flow rate signals and position signals will be transmitted to the Headworks SCADA and WHWWTP main PLC and will be archived.

Software Alarms
The following virtual alarm points are provided for each piece of major equipment monitored and/or controlled through the SCADA system

- Fail to Start
- Fail to Stop
- Uncommanded Start
- Uncommanded Stop

Mechanically Cleaned Bar Screen System

<u>Description</u>
Four mechanically cleaned bar screens remove screenings from the WH WWTP Headworks Facility wastewater influent flow. One (1) screen is located in each of the four (4), 4'-6" wide by 11'-0" deep influent screenings channels. The mechanically cleaned bar screens have 0.25-inch clear openings in the bar field and are equipped with multiple rakes that move the screenings out of the water and deposit them above the grade floor into the screenings compactors. Each mechanically cleaned bar screen has its own washer/compactor unit that washes the screenings to remove organics and then compress them before being discharged into screw conveyors A and B. These screw conveyors transport the screenings to the loading truck for disposal. Each bar screen is rated for 50 million gallons a day (mgd) for a firm capacity of 150 mgd with one screen out of service. The screenings compactor for each screen is sized to treat 104 cubic feet per hour (cf/hr) of un-compacted screenings. The entire automated screening system consists of four (4) mechanical cleaned bar screens, 4 screening washer/compactors with discharge tubes, 2 main control panels, four (4) local control stations, one for the screen, and four (4) local control stations, one for each washer/compactor. The plant non-potable water system supplies washing and flush water for the compactor units and is a critical component for proper compactor operation.

The average plant flow is generally less than 20 mgd which can be treated by one (1) mechanically cleaned bar screen. Alternatively all four (4) screens could be used with each screen treating approximately 5 mgd each. The decision to take screens in and out of service, to rotate the lead screen, or to leave all four (4) in service will be based on operator preference and operational experience. The controls system will be set up to allow several modes of operation to accommodate for operator adjustments.

Each mechanically cleaned bar screen channel has motorized isolation gates on the upstream and downstream side of the screen. When a screen is not in service both of its isolation gates will normally be closed.

The headworks facility has an additional screen channel equipped with a manually cleaned bar rack with 1.5 inch (in.) bar spacing. The manually cleaned bar rack channel is physically located in the middle of the four (4) mechanically cleaned bar screens channels. It has manually operated isolation gates upstream and downstream.

Headworks influent flow is not measured directly but can be estimated by using controls logic to sum up several different flow paths. There will be a time delay between the real time influent flow experienced by the screens and the estimated flow rate determined by the SCADA system. Therefore when entering set point flow rates or when manually placing screens on line based on flow rate, a conservative approach will be needed as actual influent flow could vary from the estimated flow. The magnitude of variation is dependent on the intensity of the storm event.

Hard Wired Devices

- Main Screen Control Panels (BSCP) No. 1 and 2
- Local Screen Control Station (SLCS) No. 1 thru 4
    - Hand-Off-Remote
    - Forward-Off-Reverse (Jog)
    - E-Stop
    - Running Light
    - Alarm Light
- Local Compactor/Washer Unit Control Stations (CCS) No. 1 thru 4
    - Hand-Off-Remote
    - Start – Stop
    - E-Stop
    - Running Light
    - Alarm Light
- Screw Conveyors A and B
- WWS Tank Level Sensor (to calculate WWS flow)
- PTE Parshall Flume Flow Meters 1 and 2
- E-Stop Screen Pull Cord
- E-Stop Compactor Pull Cord
- Compactor Zero Speed Switch
- Compactor Wash and Flush Water Solenoid Valves
- Upstream and Downstream Channel Level Sensors
- Upstream High Level Float Switch
- Upstream and Downstream Motorized Isolation Gates
- Screw Conveyor System Control Panels (SCCP)

Operation

The mechanically cleaned bar screen main panels will be programmed by the manufacturer to operate the screens and washer / compactor units. Plant SCADA logic will control the screen channel motorized isolation gates and the screenings discharge screw conveyor.

Mechanically cleaned bar screen on enable software interlocks.

Equipment	Inlet Gate	Outlet Gate
Mechanically Cleaned	CG.2.1 Open	CG-3.1 Open

Bar Screen 1		
Mechanically Cleaned Bar Screen 2	CG.2.2 Open	CG.3.2 Open
Mechanically Cleaned Bar Screen 3	CG.2.3 Open	CG.3.3 Open
Mechanically Cleaned Bar Screen 4	CG.2.4 Open	CG.3.4 Open

Screenings washer/compactor on enable software interlocks

Equipment	Status
Washer/Compactor 1 & 2	Screw Conveyor A Running (1)
Washer/Compactor 3 & 4	Screw Conveyor B Running (1)

(1) Depends on fault mode setting see below

Control Modes

- Local Manual
- SCADA Manual
- SCADA Automatic

Local Manual. Each screen and its associated compactor can be started and stopped by placing either the main control panel BSCP or the local control station SLCP in hand and using the selector switches and start-stop push buttons on the face of the panel.

SCADA Manual. The mechanically cleaned bar screens and the washer / compactors can be operated manually at the SCADA OIC operating screens. The manufacturers screen system control parameters will be displayed and operational settings will be adjustable on the SCADA OIC.

The estimated headworks influent flow rate will be monitored by SCADA and displayed on the OIC. The influent flow rate through the screens is not measured directly and must be estimated from several different flow paths. SCADA will continually calculate and display the estimated Headworks influent flow and use this value to turn screens on and off, if Auto Flow Based operational mode is selected, as described in the operating modes below.

The influent flow components are listed below:

Flow Path	Measured By	Add or Subtract to Estimate Headworks Influent Flow
PTE Flow	PTE Flumes 1 & 2	Add
WWS Tank Drain	WWS Tank Level Converted to Flow Rate	Subtract
Grit Feed	Grit Feed Meters 1 & 2	Add
WWS FM Drain	Not Measured	Ignore
WWS X-Fill Drain	Not Measured	Ignore

WWS Pump Station Flow	WWS Tank Level Converted to Flow Rate	Add

For more information about the WWS tank drain and WWS pump station flow rate calculation method, see the WWS Tank Filling and Draining description.

SCADA Automatic. Normally the screens will be operated automatically. Operators will be given the choice between flow based or multiple screen modes.

When the mechanically cleaned bar screen control panel calls for a washer/compactor unit to start, a signal will be sent to SCADA which will start the associated screenings screw conveyor. Mechanically cleaned bar screens and washer/compactor 1 and 2 are associated with Screw Conveyor A. Mechanically cleaned bar screens and washer/compactor 3 and 4 are associated with Screw Conveyor B. When the screw conveyor run signal is confirmed SCADA will issue a start enable signal to the bar screen control panel.

When a screenings screw conveyor (A or B) faults or is jammed, the associated washer / compactor units and /or mechanically cleaned bar screens will continue to operate for an Operator adjustable amount of time depending on the fault mode selected. There will also be a fault mode that will turn off both the mechanically cleaned screen and the washer/compactor unit. Operator adjustable countdown timer will start after the conveyor fault is issued. After the timer has expired SCADA will send the operating equipment a stop signal. Default setting = 2 hours.

Flow Based
In this mode plant operators will select the lead, 1st lag, 2nd lag, and standby screen positions, and will enter associated flow rate set points for each and the rotation time period. As default the start 1st lag screen flow set point will be 30 mgd, start 2nd lag = 75 mgd and start standby = 120 mgd. The default rotation time = 1 day. SCADA will automatically rotate the lead screen when the rotation timer expires. When the headworks influent flow rate reaches a set point flow value SCADA will open the lag screen isolation gates. When the open limit is made, it will send the lag mechanically cleaned bar screen control panel a start screen enable signal. If a screen faults the SCADA logic will start the next screen in the rotation including the screw conveyor if it is not already running.

Multiple Operation
Operators will select if they want two screens or three screens to operate at a time. When placing two screens in service, Operators will be given the choice between the screens being side by side and discharging into the same screw conveyor or being opposite with each screen discharging into a separate screw conveyor. In either of these modes Operators will select the lag and standby screen, flow rate set point, and rotation timer setting.

Two screen side by side mode. Screens 1 and 2 will operate together as a pair with screens 3 and 4 as the other pair.

Two screen opposite. Screens 1 and 4 will operate together as a pair with screens 2 and 3 as the other pair.

When the rotation timer expires, SCADA will switch the pair of screens that are in service. Since two screens cannot treat the design capacity, the flow set point will be used to turn on the lag screen when the influent flow rate reaches the operator adjustable set point with initial setting = 75 mgd.

Three screen mode. Operators will select which three screens they want in service initially and a rotation timer setting. When the timer expires, SCADA logic turns off one of the operating screens and turns on the standby screen. The rotation timer will be reset and the cycle will continue in a sequence to provide even run time to each screen. Three screens can treat the design capacity so a flow set point is not needed.

In either two screen or three screen mode if a screen faults the SCADA logic will start the next screen in the rotation.

Truck Loading

The mechanically cleaned screen system operation will need to be interrupted when the loading truck is full and needs to be changed. Prior to initiating a truck change, plant operators will push the “Truck Change” button either locally at the screw conveyor system truck loading control station or at the OIC. SCADA will wait an operator adjustable amount of time before sending a “pause” signal to the mechanically cleaned bars screen(s) that are in service. SCADA will also remove the screen start enable signal for the mechanically cleaned bar screens that are not in service to prevent them from starting during truck change.

The operator adjustable delay time will be coordinated with the grit system run time such that both processes (grit and screenings) complete clean out cycles in preparation for truck changing at approximately the same time. The grit system internal cleanout time is normally longer than the time required for the mechanically cleaned bar screens to internally cleanout; therefore, a time delay is needed for the screening system to make both processes finish simultaneously. See description of the entire truck loading sequence under the Screenings Screw Conveyors operational description below.

After receiving the pause signal from SCADA, the bar screen control logic will immediately start the mechanically cleaned bar screen and its associated washer / compactor unit to operate, regardless of the differential head reading or status of the exercise timer, and run for a preset amount of time in order to clear themselves. The default run time is approximately two (2) minutes. After the washer / compactor unit stops the BSCP will place the screen and the washer / compactor in pause mode until the truck ready signal is received from SCADA, at which time normal operations will resume.

Alarming

Mechanically cleaned bar screen fault modes. At the SCADA OIC Operators will be given a choice between the following fault modes.

Screen System Fault Mode	Action Upon Screenings Screw Conveyor Fault
Washer / Compactor Only	Washer / Compactor Stops and Screen Continues to Run

Screen and Washer / Compactor	Washer / Compactor and Screens Stop

Alarm Reset
If a screen is requested to start and has not started after an operator set number of seconds, a “Fault” alarm is registered. When the fault condition is rectified the fault must be reset by making a selection at the SCADA OIC.

Equipment Alarms

Mechanically Cleaned Bar Screens 1 thru 4	• Not in Remote • Common Fault • E-Stop
Washer / Compactor Units 1 thru 4	• Not in Remote • Start/ Stop Fail • Common Fault • E-Stop

Screenings Screw Conveyors

Description. There are two shaft-less screenings screw conveyors located in the screening room. The screw conveyors carry material from the screenings compactors and discharge into the hauling truck. Screw Conveyor A receives compacted screenings from Screens 1 and 2. Screw conveyor B receives compacted screenings from Screens 3 and 4. During normal dry weather flow conditions, the screening washer compactor discharge will be slow and intermittent. To prevent excessive wear, the conveyor operation will be software interlocked with the screening equipment.

Normally the conveyor will break up the compactor discharge and move it into the hauling truck. In the event that a jamb occurs, the screening conveyor main control panels are equipped with monitoring instruments (shock relays) that will sense when an obstruction is present. When high amp draw fault is registered, an alarm signal will be issued and the screw conveyor will stop. Operators will need to manually check the conveyor and use the local push buttons to jog the conveyor forward and reverse to break up the blockage and reset the alarm before the screw conveyor operation can continue.

Screening screw conveyors A and B will be controlled by a main control panel with PLC logic provided by the conveyor manufacturer. The screw manufacturer will also supply a local control panel for each conveyor and a truck loading panel.

Hard Wired Devices

- Screw Conveyors A and B
- Main Screenings Screw Conveyor Control Panel (SCCP)
- Local Screenings Screw Conveyor Control Panel (SLCP), A and B
    - Remote/Local
    - Hand-Off-Auto
    - Start and Stop
    - E-Stop
    - Running Light
    - Alarm Light

- Truck Loading Control Panel (STLP)
    - Conveyors A, B, C & D Running Light
    - Replace Truck Button
    - Move Truck Light
    - Truck Ready Button
- E-Stop Push Button
- Zero Speed Switches
- Conveyor E-Stop pull cords
- Truck Loading Camera
- Screen System Control Panels (BSCP)

<u>Operation</u>

Screenings Screw Conveyor on enable software interlocks.

Equipment	Status
Screenings Screw Conveyors A & B	Truck Ready

Control Modes

- Local Manual
- SCADA Manual
- SCADA Automatic

Local Manual

Each conveyor can be operated locally by using selector switches and push buttons at the local screw conveyor control panel.

SCADA Manual

The screenings screw conveyors can be operated manually at the SCADA OIC. The manufacturers control parameters will be displayed and operational settings will be adjustable on the SCADA OIC.

SCADA Automatic – Interlocked Operation

When either one or both screening compactors feeding a screw conveyor are running the screw conveyor will also run. When the last washer/compactor unit feeding the screw conveyor stops the conveyor will continue to run for an Operator adjustable time to clear itself. Default run time = 2 minutes.

Screenings screw conveyor software run interlocks.

Screening Screw Conveyor A	
Washer / Compator Units No. 1 or 2	Call to Start
Screening Screw Conveyor B	
Washer / Compator Units No. 3 or 4	Call to Start

To avoid starting a conveyor too many times in one hour, SCADA will keep a running count of motor starts during the previous 60 minutes. If a conveyor motor should reach its allowable number of starts per hour it will remain on until enough time has lapsed to allow it to be turned off. To determine the amount of run time, SCADA logic will assume that the conveyor could be immediately called to start after it is turned off. Allowable starts per hour is adjustable with the default being 10 starts/hour. Allowable starts per hour to be confirmed with the supplied equipment shop drawings.

Truck Loading - Note this section is applicable to both screening screw conveyors A & B and grit screw conveyors C & D.

When the loading truck is changed out, coordination is required between the grit system, mechanically cleaned screening system, screenings discharge screw conveyors (A & B), grit discharge screw conveyors (B & C), and plant operators. The truck change out process will be initiated when plant operators push the "Truck Change" button either locally at the conveyor truck loading control station or at the SCADA OIC. When this occurs the grit system will either be paused or stopped based on operator input as described in the Grit System controls description. Before the grit system is either paused or stopped it will go through an internal clearing routine. Similarly, the mechanically cleaned bar screens and associated washer / compactor units in service at the time will go through an internal clearing routine before being placed in pause mode as described in the Screen System controls description above.

The timer settings for the grit and screen systems clearing routines will be based on the manufacturer requirements and adjustable by plant operators. Manufacturer's literature indicates that the grit system will generally operate for 15 minutes after it is paused and for 20 minutes after it is stopped. The screens will operate for approximately 2 to 3 minutes. The SCADA system will have a truck load out display showing the current grit and screen timer settings for operation information. A time delay will be provided to start screen clearing such that both operations finish at approximately the same time.

Operators will be given the choice to manually enter the delay time or to have SCADA calculate the delay time. To manually set the time, operators will observe the current grit and screen setting and enter a value at the SCADA OIC. If automatic time delay is selected SCADA logic will, after receiving the "Truck Change Out" signal, calculate the time difference between the current grit and screen clearing timers and will send the longest system (normally grit) a pause signal first. After the difference between the two clearing times has elapsed, SCADA will send the shorter system (normally screens) a pause signal.

After the last piece of equipment has stopped, SCADA will send the screenings screw conveyor control panel and the grit screw conveyor control panel a stop signal and conveyors will run until they clear. When the conveyor(s) stop, SCADA will alert plant operators on the OIC and by illuminating the "Move Truck" light on the truck loading control panel in the loading bay, indicating the truck can now be moved and replaced.

When the empty truck is ready and the "Truck Ready" button is pushed at the truck loading control panel or at the OIC, the grit and screening operations will continue as normal.

Alarming

Alarm Reset

If a screenings conveyor is requested to start and has not started after an operator set number of seconds, a "Fault" alarm is registered. When the fault condition is rectified the fault must be reset by making a selection at the SCADA OIC.

Equipment Alarms

Screenings Screw Conveyors A and B	• Not in Remote • Conveyor Jammed • Common Fault • E-Stop

Grit System

Description

Two trains of grit removal equipment makeup the West Hickman WWTP grit system. Each train is rated for 35 mgd and consists of a grit concentrator (Eutek HeadCell), grit feed pump, a grit washer / classifier (Eutek Slurry Cup), a grit dewatering unit (Eutek Snail), control panels, ancillary control valves, solenoid valves, flow meter, pressure gages, and piping. The plant non-potable water system supplies fluidizing water for the headcell, flush and backwash water for the slurry cup, and rinse and spray water for the snail. Non-potable water is a critical component for proper grit system operation. With both grit tanks in service all of the West Hickman Wastewater Treatment Plant (WHWWTP) influent flow can be treated for grit removal. During dry weather average flow only one grit tank is necessary to treat the flow, although both could be used.

The four (4) large IPS pumps lift plant influent from the IPS wet well and discharge into the grit tank influent channel that feeds both grit tanks. During periods of very low flow, flow to the grit system will be maintaining using small IPS pumps. The inlet channel is equipped with a manually operated gate (CG.9.1) located between the two grit tanks. Each grit tank has its own manually operated isolation gate, CG.10.1 and CG.10.2. IPS pumps 1A, 1B and small IPS pumps 1C and 1D discharge on the side of CG.9.1 opposite grit tank 1. IPS pumps 2A, 2B, and small IPS pumps 2C and 2D discharge on the other side of CG.9.1 opposite grit tank 2. Normally, the middle gate, CG.9.1, will be open allowing all the IPS pumps to feed either tank. When both grit tanks are in service with the middle gate open, WWTP influent flow will equally split between the two grit tanks. A fixed weir on the outlet of each grit tank controls the flow split.

Whenever grit containing wastewater is flowing into a grit tank, its associated grit pump and flushing water supply will be in service to continually remove grit from the head cell sump.

When a grit tank is taken out of service for more than a day, the sump should be flushed and pumped out after closing the grit tank inlet gate. The out of service grit tank's associated slurry cup and snail should be flushed out and shut down according to the manufacturer's shut down sequence. During cold weather the grit tanks should be completely drained to prevent freezing. During dry weather when plant influent flow is much less than 35 mgd, plant operators will need to decide if one tank or both tanks should be in service. Each grit pump is rated for approximately 400 gpm and its flow rate cannot be adjusted downward, or the slurry cup will not generate enough centrifugal force and the grit washing/ removal efficiency will be reduced.

Flow exiting the grit tanks is measured in the PTE Parshall flume flow meters. With both grit tanks in service, the influent flow rate in each tank is equal to the sum of both flumes plus the sum of both grit feed meters divided by 2. When one grit tank is in service, the grit tank influent flow is equal to the sum of both flumes plus the grit feed meter. The grit feed flow meters are not used by the manufacturer's control logic. The grit flow meters are provided for operational information, to help determine if there is a feed pump fault. They are also used by SCADA to control the small IPS pumps.

There are 3 grit pumps with the middle pump set up to supply either slurry cup. Normally pumps 1 and 3 will be assigned to slurry cups 1 and 2 respectively. For operational flexibility, when only one grit tank is in service automated valving is provided to allow grit pump 3 to supply slurry cup No. 1 and similarly grit pump 1 can supply slurry cup No. 2.

Hard Wired Devices

- WWTP Influent Parshall Flume Flow Meters 1 and 2
- Grit System Control Panel (GSCP)
- Local Grit Pump Control Station
    - Pump E-Stop
    - Remote-Off-Local
    - Start and Stop
- Local Slurry Cup and Snail Control Station
    - Snail E-Stop
    - Remote-Off-Local
    - Snail Belt Start / Stop
    - Slurry Cup Backwash
    - Reset Button
    - Fail Indicator Light
- Grit Feed Flow Meters
- Grit Feed Pumps
- Grit Pump Seal Water Solenoids
- Conveyor System Truck Loading Control Panel (STLP)

Operation

The grit system control panel will be programmed by the manufacturer to operate the grit system components. The plant SCADA system will control the grit feed pump valves and will monitor the grit feed flow meters.

Grit dewatering unit on enable software interlocks.

Grit Dewatering Unit (Snail) No. 1	
Grit Screw Conveyors C	Running (1)
Grit Dewatering Unit (Snail) No. 2	
Grit Screw Conveyors D	Running (1)

(1) Depends on fault mode setting see below

When the grit system control panel calls a snail unit to start, a signal will be sent to SCADA which will start the associated grit screw conveyor. Grit screw conveyor C is associated with snail No. 1. Grit screw conveyor D is associated with snail No. 2. When the grit screw conveyor run signal is confirmed, SCADA will issue a start enable signal to the grit system control panel.

Control Modes

- Local Manual
- SCADA Manual
- SCADA Automatic

Local Manual

The grit feed pumps can be started and stopped locally by using selector switches and push buttons at the local control station at each pump. The grit washer / classifier (Eutek Slurry Cup) and a grit dewatering unit (Eutek Snail) can be operated by using the control station located at each unit.

SCADA Manual

Grit equipment can operated manually by making selections on the SCADA OIC. The manufacturer's grit system control parameters will be displayed and operational settings will be adjustable on the SCADA OIC.

Operators will be able to manually switch between dry weather and wet weather operation by making a selection at the SCADA OIC.

SCADA Automatic Mode

Operators will enter an adjustable wet weather flow set point into SCADA. When the estimated headworks influent flow is above this set point SCADA will send the grit system control panel a wet weather flow signal. The default setting will be 25 mgd. Operators will assign a grit pump to a slurry cup so the GSCP logic will know which of the three (3) grit pumps should be started when a slurry cup is called for service. Plant SCADA logic will automatically position the suction and discharge valves based on the pump assignments. Before allowing a pump to start, a clear path will be confirmed by SCADA by monitoring the suction and discharge valve limit switches.

Plant SCADA will monitor the grit feed meter in conjunction with the assigned grit pump run signal. If, for example, grit pump 2 has been assigned to slurry cup 2 and grit feed meter No. 2 does not register flow, SCADA will issue an alarm. Plant operators will either need to assign the spare pump to slurry cup 2 or correct the problem before the grit system can go back on line.

Grit system control logic provided by the manufacturer will control and monitor the grit equipment. When operating automatically the slurry cup, grit pumps, and snail will function together and the non-potable water supply to the various components will be controlled during slurry cup backwashing and blow down cycles and during grit snail operation. Grit snail operating signals will be sent to SCADA for control of the conveying system. Slurry cup blow down and start and stop grit pump signals will be sent to SCADA for control of the grit pumps.

Truck Loading

The grit system operation will need to be interrupted when the loading truck is changed out. Operators will select between two loading truck change out modes, 1) pause and 2) shut down.

Grit Pause mode is for truck changes less than 30 minutes. If paused for periods longer than 30 minutes there is increased chance the grit snail could be overloaded when it restarts. Note that 30 minutes is estimated and depends on the amount of grit being processed through the plant. Longer periods may be possible and actual operation experience will be needed to better determine the allowable pause periods. If the pause timer expires before the truck is replaced the grit pump will be stopped and an alarm will be issued.

Grit Shut Down mode should be used when truck changes that are anticipated to be longer than approximately 30 minutes.

Loading truck change is initiated when plant operators push the “Truck Change Out” button, either locally at the conveyor truck loading control station or at the OIC.

Grit Pause
In this mode, SCADA will send the grit system control panel a pause signal. Grit system logic will start and run the grit snail for a stop time delay (typically 15 minutes) so as much grit as possible can be cleared while the grit pump and slurry cup are still operating. When this delay times out, a truck change enable signal will be sent to SCADA and the grit system control logic will place the grit snail in hold mode for the Operator adjustable Grit Pause time. The default Grit Pause time is 30 minutes. SCADA will illuminate the “Move Truck” light at the truck loading control station and at the OIC, alerting plant operators the truck can be moved. During the Grit Pause period the grit pump and slurry cup will remain in service until the pause timer expires, at which time grit system control logic will stop the grit pump and issue an alarm. Upon receiving the “truck ready” signal from SCADA grit system control logic will initiate normal operation.

Grit Shut Down
In this mode, SCADA will send the grit system control panel a stop signal when the “Truck Change Out” button is pushed locally or at the OIC. The normal grit shut down sequence will be initiated by the grit system controls logic. Based on manufacturer’s literature, grit shut down typically entails stopping the grit pumps, opening the slurry cup backwash valve for 20 seconds, closing the supply water valve after 5 minutes, and running the snail for 15 minutes prior to shut down. After the snail stops a move truck enable signal will be sent to SCADA. SCADA will illuminate the “Move Truck” light at the truck loading control station and at the OIC. When the “Truck Ready” button is depressed, SCADA will send a start signal to the grit system and operations will resume normally.

Alarming
When a grit screw faults, there are three potential scenarios that could be implemented for the associated train of grit equipment upstream of the screw conveyor. 1) Stop the entire grit train including grit feed pump, slurry cup, and snail, 2) stop the snail unit only and 3) keep the entire grit train running.

Stopping all the equipment while wastewater is flowing through the grit tank could result in plugging the grit sump which is difficult to repair. Stopping the snail unit only will result in keeping the grit sump clean but the snail unit could become plugged with potential damage to the snail when it is restarted. To be safe, the snail unit would need to be cleaned before restart if the grit system was operated this way longer than 30 minutes. Continuing to run the entire train would eventually result in grit from the snail filling up the screw conveyor inlet hopper and falling on the floor, which could be the easiest of the three scenarios to clean up and has the least chance of equipment damage.

The two (2) grit equipment fault modes the Operators will be able to select from then are as follows with the default being "Snail Run".

Grit System Fault Mode	Action Upon Grit Screw Conveyor Fault
Snail Run	Entire Grit Train of Equipment (Snail, Grit Feed and Slurry Cup) Continues to Run
Snail Stop	Snail Stops. Grit Feed and Slurry Cup Continue to Run

Alarm Reset
If a grit feed pump or a snail unit is requested to start and has not started after an operator set number of seconds, a "Fault" alarm is registered. When the fault condition is rectified the fault must be reset by making a selection at the SCADA OIC.

Equipment Alarms

Grit Feed Pumps 1 thru 3	Not in Remote Fault
Grit Snail Unit	Not in Remote Start/ Stop Fail Common Fault E-Stop
Slurry Cup	Common Fault

Grit Screw Conveyors

Description. Grit screw conveyors are of the shafted type. The grit screw conveyors carry material from the grit dewatering unit (Snail) and discharge into the hauling truck. Screw Conveyor C receives grit from Grit dewatering unit No. 1. Screw conveyor D receives grit from grit dewatering unit No. 2.

Hard Wired Devices

- Screw Conveyors C and D
- Main Grit Screw Conveyor Control Panel (GCCP)
- Local Grit Screw Conveyor Control Panel (GLCP), C and D
    - Remote/Local
    - Hand-Off-Auto
    - Start and Stop
    - E-Stop
    - Running Light
    - Alarm Light
- E-Stop Push Button
- Zero Speed Switches
- Conveyor E-Stop pull cords

- Grit System Control Panel (GSCP)

Operation

Grit Screw Conveyor on enable software interlocks.

Equipment	Status
Grit Screw Conveyors C & D	Truck Ready

Control Modes

- Local Manual
- SCADA Manual
- SCADA Automatic

Local Manual

Each conveyor can be operated locally by using selector switches and push buttons at the local screw conveyor control panel.

SCADA Automatic – Interlocked Operation

When a grit dewatering snail unit is called to start, its associated grit screw conveyor will run. After the grit snail stops the conveyor will continue to run in order to clear itself for an operator adjustable time period, with the default value = 2 minutes.

Grit Screw Conveyor software run interlocks.

Grit Screw Conveyor C	
Grit Dewatering Unit (Snail) No. 1	Call to Start
Grit Screw Conveyor D	
Grit Dewatering Unit (Snail) No. 2	Call to Start

To avoid starting a conveyor too many times in one hour, SCADA will keep a running count of motor starts during the previous 60 minutes. If a conveyor motor should reach its allowable number of starts per hour it will remain on until enough time has lapsed to allow it to be turned off. To determine the amount of run time, SCADA logic will assume the conveyor could be immediately called to start after it is turned off. Allowable starts per hour is adjustable with the default being 10 starts/hr. This will need to be confirmed with the supplied equipment shop drawings.

Truck Loading. The truck change out process is covered in the Screenings Screw Conveyors description.

Alarming

Alarm Reset

If a grit conveyor is requested to start and has not started after an operator set number of seconds, a “Fault” alarm is registered. When the fault condition is rectified the fault must be reset by making a selection at the SCADA OIC.

Equipment Alarms

Grit Screw Conveyors C and D	• Not in Remote • Common Fault • E-Stop

IPS Pumps (large) and Wet Well Influent Gates

<u>Description.</u>

Raw sewage entering the headworks facility is first screened and then flows into the common channel adjacent to the pump stations before entering the IPS Pump Station (IPSPS) wet well. The IPS pumps lift screened wastewater from the wet well and discharge into the grit tank inlet channel. There are 4 installed large IPS pumps providing 70 mgd firm capacity with three (3) pumps running. Each pump is a submersible centrifugal type pump equipped with a variable frequency drive and each pump has its own individual discharge pipe connected to the grit tanks influent channel.

After raw sewage influent flow has been pumped by the IPS pumps and has gone through the grit tanks, primary treatment has been completed. The preliminary treatment effluent (PTE) then flows by gravity to the WHWWTP which has a PTE treatment capacity of 70 mgd. Because the WHWWTP treatment capacity is equal to the firm IPS pumping capacity, any extra capacity that could be provided by operating all four (4) IPS pumps at the same time will not be necessary.

The IPS wet well is divided into two (2) halves which are named IPS Pump Station No. 1 and 2. Two (2) large IPS Pumps, 1A and 1B, and two (2) small IPS Pumps, 1C and 1D, are located in IPSPS No. 1 wet well. Similarly two (2) large IPS Pumps, 2A and 2B, and two (2) small IPS Pumps, 2C and 2D, are located in IPSPS No. 2 wet well. The common wall between the two (2) wet wells is equipped with manually operated sluice gate, S.1.1. S.1.1 is normally open allowing both pump stations to operate together.

Screened wastewater enters each IPSPS wet well through an opening in the wall of the common wet well channel. These openings are equipped with motorized gates, CW.6.1 and CW.6.2, for IPSPS No. 1 and 2, respectively.

IPS pump speed control will be based on wet well level until the flow rate reaches the Max PTE Flow Set Point, at which time pump speed control will be switch to being flow based to maintain a set point flow rate. After the storm event subsides wet well level control of pump speed will resume. IPS pump flow is measured by summing PTE flume flow meters 1 and 2. The IPS pumps will alternate starting in a lead lag fashion.

During low flow periods when headworks influent flow is less than the capacity of one large IPS pump wet well level will drop until the stop lead pump level is reached. When this happens at least one of the small IPS pumps will turn on. See IPS Pumps (small) description below.

To isolate one (1) half of the IPS wet well for maintenance, its associated inlet gate and the sluice gate in the common channel wall can be closed and the small IPS pump can be manually operated to pump down water remaining in the wet well before personnel entry. Sluice gate, S.1.1, will also have to be closed prior to pump down of the wet well.

Hard Wired Devices

- Motor thermal switches
- Upper and lower bearing temp sensors
- Seal Leakage sensor
- Motor leak sensor
- Cable terminal box leak sensor
- Large IPS pump VFD's (4)
- Wet well level sensors
- LWCO and High Level Alarm float switches
- Parshall flume PTE flow meters No. 1 and 2

Operation

During start up, the pump manufacturer's representative will set the VFD minimum speed limits based on the provided pump requirements.

Pump protection monitoring device alarms will be tied into SCADA. A general fault will be displayed at the SCADA OIC. To see the actual alarm Operators will need to view the HMI locally at the pump VFD panel.

Normally, both motor operated wet well inlet weir gates, CW.6.1 and CW.6.2, will be fully open to allow solids to freely flow into the wet well. The motor actuators are throttling type with gate position feedback displayed and gate position adjustable by Operators at the SCADA OIC. Gate positions are adjustable on CW.6.1 and CW.6.2 to allow flow splitting between the two (2) wet wells, if required. If the gates are partially closed, solids may build up and need to be flushed out. Operators will be given the choice to place these gates in Automatic Cycle mode. When operated in this mode, Operators will assign a gate position for each gate that is adjustable between 1 and 100% closed. The Operator will also assign an adjustable closed position and an adjustable open position timer between 1 and 24 hours. The gate(s) will automatically close to the assigned position until the closed position timer expires at which time the gate will fully open for an operator adjustable open position timer. When the open timer expires the cycle will repeat.

Control Modes

- Local Manual
- SCADA Manual
- SCADA Automatic

Local Manual

Pumps can be manually started, stopped and speed controlled locally at the VFD panel by placing the Hand-Off-Remote selector switch in Hand.

SCADA Manual

Pumps can be manually started, stopped and speed controlled at the SCADA OIC.

SCADA Automatic

The IPS pumps will normally operate in automatic mode.

IPS Pump in Service and Pump Rotation. Operators will input into the SCADA OIC which pumps are in service. SCADA will receive Remote, Local, VFD and Bypass (contactor) feedback from each pumps drive.

Each of the IPSPS wet wells has a level sensor. Operators will select at the SCADA OIC if they want to control all of the pumps with level signal from either PS No. 1 sensor or PS No. 2 sensor or Both. When Both is selected, controls logic will compare the two (2) readings and use the highest reading to control the pumps. If a sensor faults, controls logic will switch to the other sensor signal and a fault will be issued.

Operators will be given the choice to select between manual pump rotation and automatic. In Manual Rotation, the Operator will select the pump order at SCADA OIC and the pumps will operate in that order. In Automatic Rotation, the Operator will select the lead and 1st lag and controls logic will fill in the rest of the pump order. The lead and lag pumps should be in opposite wet wells to even out flow patterns and minimize dead zones. Lead pump selection prompts will be displayed on the OIC to help remind Operators that the lag should be in the opposite wet well. For example, if either Pump 1A or 1B is selected for lead pump a prompt should be displayed offering 2A or 2B as the 1st lag selection. After the 1st lag is selected the remainder of the pump order will be filled in by controls logic. The pumps will automatically rotate after an Operator adjustable time period expires or after each pump start, whichever comes first. Default value for the run time alternator setting = 4 hours. When switching pumps after the run time period expires, the lag pump shall start before the lead pump turns off to make a smooth transition. There will be an Operator adjustable delay time incorporated into the controls that will be adjusted during startup to provide a smooth transition and avoid flow spiking the grit system.

In the event of a pump VFD failure, controls logic will automatically start the next pump in the rotation which will become the lead pump and an alarm will be issued.

After Operators acknowledge the alarm and controls logic will move the faulted pump to the end of the rotation.

The pump control elevations shall be adjustable with defaults as indicated below:

Description	Elevation	Band 1	Band 2	Band 3
Wet Well Floor under Level Sensor	848.5			
Large IPS Pumps LWCO Alarm	855.5			
Stop Lead Pump	856.0			
Start Lead	857.5	Min Speed		
Stop 1st Lag	859			
Start 1st Lag	860	Max Speed	Min Speed	
Stop 2nd Lag	861.0			Min Speed
Start 2nd Lag	862.5		Max Speed	
Level Control Reset	863.0			
Start Flow Control	865.0			Max Speed

High Level Alarm	873			
WWSPS Weir Elev	868.5			

The default pump control elevations are operator adjustable as noted above.

Each IPS wet well will be equipped with low water cut off (LWCO) and high level alarm float switches. If the LWCO float is tripped, an alarm will be issued and all large pumps that are in operation will be turned off. If the high level alarm float is tripped, an alarm will be issued. No other action from the control system is required as the pump stations and headworks building are designed to withstand a flood with water levels higher than the float switch settings.

Before pump starting is enabled, a confirmation button will need to be acknowledged by the Operator on the SCADA OIC. The confirmation button will confirm grit tank influent, effluent, flume channel, and the junction chamber gates are positioned to provide a clear path to either the BPR or nitrification tanks or both. When the PTE flow control gates (also referred to as the grit channel effluent gates) are in automatic mode, control logic will monitor the gate position. These gates are motor actuated and in the event of a failure they will remain in the last positon. If for some reason control logic receives close gate limits signals from all four (4) of these gates at the same time, an Alarm will be issued and the IPS pumps shall be stopped.

Pump-on enable software interlocks. Before enabling a IPS pump to start the following conditions will be met.

Equipment	Tag	Status
Grit Tanks	No. 1 and No. 2	Either One or Both in Service
Junction Chamber Gate	S.3.1 & S.3.3	Either One or Both Open
Junction Chamber Compartment B Gate	S.4.1	Open

Pump speed control nomenclature will be a percent of full speed. Operating pumps will be sent the same speed signal based on variable speed bands, with the minimum pump speed at the bottom of the band and 100% or full speed at the top of the band. The speed band used will be determined by the number of pumps in service. The largest number of IPS pumps that will be in service at any one time is three (3) and therefore there will be three (3) speed bands.

Speed Band 1 – Lead Pump Operation. Lead pump turns on when the wet well level reaches the start lead pump elevation. It will be controlled in a proportional band with VFD minimum speed at Start Lead elevation and VFD max speed at Start 1st Lag elevation. The elevation associated with minimum speed (in this case Stop Lead) will serve as Level Set Point for the band. Note that minimum pump speed signal will be sent to the lead pump VFD when water elevation is between the start lead and stop lead elevations. This will help extend the lead pump operation during low flow conditions.

Speed Band 2 – Lead and 1st Lag Pumps. Operating pumps will be controlled at the same speed in a proportional band with VFD minimum speed at Start 1st Lag elevation and

VFD max speed at Start 2nd Lag elevation. The elevation associated with minimum speed (in this case Start 1st Lag) will serve as Level Set Point for the band.

Speed Band 3 – Lead, 1st and 2nd Lag Pumps. Operating pumps will be controlled at the same speed in a proportional band with VFD minimum speed at Stop 2nd Lag elevation and VFD max speed at End Level Control elevation. The elevation associated with minimum speed (in this case Stop 2nd Lag) will serve as Level Set Point for the band.

In general, larger operating bands will provide smoother pump operation. The minimum operating band should not be less than 1'.

The Variable Speed Range = VFD max speed – VFD min speed with speed ranges entered at the OIC. VFD speed settings will be Operator adjustable and intially set by the pump manufacturers representative.

Level Weighted Speed = ((Wet well level – Level Set Point) / operating band) x Variable Speed Range.

Speed signal output to VFD = Level Weighted Speed + VFD Min Speed

The Max PTE Flow Set Point should be reached approximately at the End Level Control elevation. Variations of actual hydraulic conditions, pump performance, set point value etc. may cause the set point to be reached when the wet well is a little below this elevation. When this set point is reached, pump speed control will switch from level based to flow based. Controls logic will switch back to level based control after the wet level receeds back down to the level control reset elevation.

Operators will enter an adjustable WHWWTP Max Influent Flow rate that will be something below the treatment capacity of 70 mgd. The default value will be 99.5% of this amount or 69.65 mgd. WHWWTP influent flow consists of PTE flow plus recycle plant flow. Recycle flows are measured in the recycle Parshall flume flow meter. Controls logic will subtract the recycle flow from the WHWWTP Max Influent Flow rate to obtain the PTE Max Flow Set Point that will be used to control the IPS pump speed.

When PTE flow rate reaches the PTE Max Flow Set Point, the method of controlling pump speed control will shift from level based to flow based. Pump speed will be adjusted to maintain the PTE flow rate within an operator adjustable dead band range with initial setting of 0.5%.

While the pumps are maintining the set point, any additional influent flow will cause the wet well level to rise and backup into the common channel until it overflows into the WWS Pump Station (WWSPS). The WWS pumps will turn on and send the excess flow into the WWS Tank.

As the storm event subsides wet well level control of pump speed will resume.

Alarming

Alarm Reset

If a pump is requested to start and has not started after an operator set number of seconds, a "Fault" alarm is registered. When the fault condition is rectified the fault must be reset by making a selection at the SCADA OIC.

Equipment Alarms

IPS Pumps 1A, 1B, 2A & 2B	• Not in Remote • Common Fault • Low Wet Well Level • LWCO • High Wet Well Level
Wet Well Inlet Gates CW.6.1 & 2	• Gate Closed • Common Fault

IPS Pumps (small)

Description.

There are two (2) pairs of small IPS pumps located sumps inside each of the IPSPS wet wells. Each pump is a submersible centrifugal type pump. As noted above the IPS wet well is divided into two (2) halves which are named IPS Pump Station (IPSPS) No. 1 and 2. One (1) pair of small IPS Pumps, 1C and 1D, are located in IPSPS No. 1. Similarly the other pair of small IPS Pumps, 2C and 2D, are located in IPSPS No. 2.

The small IPS pumps serve the main purpose of suppling water to the grit tanks when the large IPS pumps turn off. They also supply water to the BRP tanks and serve as drain pumps that can be used to pump down the wet wells for maintenance. During low flow periods when the large IPS pumps turn off, two of the small IPS pump(s) must turn on and operate until the large pumps turn on again. Controls logic will monitor wet well level and if the level is rising after both small IPS pumps are on the third IPS pump will be started. All four IPS pumps will not operate at the same time as the fourth IPS pump will serve as backup only.

Each pair of small IPS pumps shares a common header that discharges into the grit tank influent channel.

Hard Wired Devices

- Motor thermal switches
- Seal Leakage sensor
- LWCO Float switches – two (2)
- Grit Feed Meters No. 1 and 2

Operation

Pump protection monitoring device alarms will be tied into SCADA. See large IPS pump description above.

Control Modes

- Local Manual
- SCADA Manual
- SCADA Automatic

Local Manual

Pumps can be manually started and stopped at the MCC starter by placing the Hand-Off-Remote selector switch in Hand. Manual operation will be used to drain the wet wells for maintenance.

SCADA Manual

The pumps will be able to start, stop, and be speed controlled by making entries at the SCADA OIC.

SCADA Automatic

The small IPS pumps will normally operate in automatic mode.

Pump Rotation. Each pair of small IPS pumps will alternate pump starts.

The small IPS pumps will normally operate in automatic mode.

Small IPS pumps in Service and Pump Rotation. Operators will input into the SCADA OIC which pumps are in service. SCADA will receive Remote and Local, feedback from each pumps starter.

Operators will be given the choice to select between manual pump rotation and automatic. In Manual Rotation, the Operator will select the pump order at SCADA OIC and the pumps will operate in that order. In Automatic Rotation, the Operator will select the lead and 1st lag and controls logic will fill in the rest of the pump order. The lead and lag pumps should be in opposite wet wells to even out flow patterns and minimize dead zones. Lead pump selection prompts will be displayed on the OIC to help remind Operators that the lag should be in the opposite wet well. For example, if either Pump 1C or 1D is selected for lead pump a prompt should be displayed offering 2A or 2D as the 1st lag selection. After the 1st lag is selected the remainder of the pump order will be filled in by controls logic. The pumps will automatically rotate after each pump start.

In the event of a pump failure, controls logic will automatically start the next pump in the rotation which will become the lead pump and an alarm will be issued.

After Operators acknowledge the alarm and controls logic will move the faulted pump to the end of the rotation.

Pump Control. The lead and lag pump will turn on when the lead IPS pump turns off. Most of the time the headworks influent flow will be greater than two small IPS pumping rate so the wet well will generally always be rising when the small IPS pumps are on. There may be infrequent times when the headworks influent flow rate is less than pumping capacity of two small IPS pumps and when this occurs the third small IPS pump shall be turned on. Controls logic will include an operator adjustable time delay with default = 1 minute. After the lead and lag small IPS pumps turn on the time delay will start. After it times out the wet well level will be monitored for 15 seconds and if it is trending upwards the 2nd lag pump will be called to start and if trending downward (will rarely if ever happen) the 2nd lag will not be started. A second wet well level trending check will occur after another operator adjustable time delay with default = 5 minutes. After this delay the wet well level will monitored the same as before and if trending upwards the pump cycle will complete with 3 pumps running. If the level is trending downward the 2nd lag pump will be stopped and the pump cycle will complete with two small IPS pumps in service. After the second check the number of pumps running (2 or 3) will continue to operate until either the lead IPS pump turns on or the wet well is lowered to the small IPS pump off elevation. Each small IPS pump sump will be equipped with LWCO float switches.

Important elevations related to the small IPS pumps are indicated below:

Description	Elevation
Wet Well Floor under Level Sensor	848.5
Top of Sump Elev	850.0
Small IPS Pumps LWCO	849.75
Small Pumps Off (Falling Wet Well)	854.5
Small Pump Start = IPS Pump Off	856.0
Small Pumps Off = IPS Pump Start (Rising Wet Well)	857.5

The grit tanks' common influent channel is equipped with manual isolation gate, CG.9.1, that separates the channel between the two (2) grit tanks. If this gate is closed for maintenance, then only pumps 1C and 1D can physically discharge into grit tank No. 1 and only pumps 2C and 2D can physically discharge into grit tank No. 2. If gate CG.9.1 is open then it does not matter which small IPS pumps are placed in service.

Alarming

Alarm Reset
If a pump is requested to start and has not started after an operator set number of seconds, a "Fault" alarm is registered. When the fault condition is rectified the fault must be reset by making a selection at the SCADA OIC.

Equipment Alarms

IPS Pumps 1C, 1D, 2C & 2D	• Not in Remote • Common Fault • LWCO

BPR and Nitrification Flow Split

Description.

Effluent from the grit tanks, PTE, flows by gravity to the WHWWTP where it can either be routed to the BPR tanks, the Nitrification tanks, or both at the same time. Both grit tanks discharge into a common channel that is equipped with two (2) flow control throttling sluice gates and two (2) open-shut sluice gates that are used to isolate weir openings in the channel wall. One (1) of the throttling gates and one (1) of the weir opening gates are located in the grit tank effluent channel wall in flume channel No. 1 and the other set of gates is in flume channel No. 2. A throttling gate and the weir opening in the opposite flume channel work together as a pair. Normally, throttling gate S.2.1 in flume channel No 1 and weir opening gate S.5.2 in flume channel No.2 will operate together. The other throttling gate, S.2.2, will be used for maintenance activities and gate S.5.1 will normally always be closed. This will be the case until the future secondary treatment process is constructed on the WHWWTP site.

The BPR and nitrification flow split is achieved by throttling gate S.2.1 to limit the BRP flow rate not to exceed the BRP Flow Limit Set Point. Excess flow above the set point will overflow the weir associated with S.5.2 and flow to the nitrification tanks. The BPR and nitrification influent flow rates are measured with PTE flumes.

When the future secondary treatment process is constructed, it is anticipated that throttling gate S.2.2 will be used in conjunction with the weir opening gate S.5.1. Until that time throttling gate S.2.2 is only needed to function as an isolation gate during maintenance activities when one of the flume channels or one of the 48" flume pipes or a junction chamber compartment must be drained.

Hard Wired Devices

- PTE Flumes 1 and 2
- Grit tank effluent sluice gates and weir gates

Operation

The Parshall flumes flow measurement is calculated from the flume level sensor reading. The flume manufacturer will provide the formula to use and the directions for configuration and calibrating the level sensor span.

Control Modes

- Local Manual
- SCADA Manual
- SCADA Automatic

Local Manual

The flow control sluice gates and weir gates can be manually operated locally using buttons and selector switches on the gate motor operators. Pumps can be manually started, stopped, and speed controlled locally at the VFD panel by placing the Hand-Off-Remote selector switch in Hand.

SCADA Manual Operation

The flow control sluice gates and weir gates can be manually positioned, opened, and closed by making selections at the OIC.

To isolate different areas of the channels, or 48-inch PTE pipes, or parts of the junction chamber for maintenance, manually operated gates have been provided. Taking flume channels out of service can only be accomplished when influent flow rates are below the BPR Flow Limit Set Point. Depending on what maintenance is needed and several other factors such as length of time required, and projected influent flow rates, etc., there are many different combinations of gate positions that could be used. Example gate positions and flume assignments during maintenance activities are shown in tables below.

Example gate positions required to isolate a single flume for maintenance such as level sensor calibration are shown below.

	Gates Open	Gates Closed
Isolate Flume No. 1	CG.15.1, CG.14.2	CG.14.1

Isolate Flume No. 2	CG 15.1, CG.14.1	CG.14.2

Example gate positions to isolate effluent sluice gates and 48-inch PTE piping

	Gates Open	Gates Closed	Flume Assignments
Isolate Grit Tank No. 1 Effluent Gates For Maintenance	S.2.2,	CG.10.1, CG.8.1, S.6.1, S.5.2, CG.15.1, CG.14.1	Flume 2 Assigned to BRP or Nitrification
Isolate Flume No. 1 and Associated 48-inch PTE Yard Pipe	S.2.2	S.2.1, S.5.1, S.5.2, CG.15.1, CG.14.1, Junction Chamber Compartment A*	Flume 2 Assigned to BRP or Nitrification
Isolate Grit Tank No. 2 Effluent Gates For Maintenance	S.1.1	CG.10.1, CG.8.2, S.6.1, CG14.2, CG.15.1	Flume 1 Assigned to BPR or Nitrification
Isolate Flume No. 2 and Associated 48-inch PTE Yard Pipe	S.1.1	S.2.2, S.5.1, S.5.2, CG.14.2, CG.15.1, Junction Chamber Compartment C*	Flume 1 Assigned to BPR

- For junction chamber gate positions see Junction Chamber description

SCADA Automatic Operation

The flow control sluice gates and weir gates will normally be operated in automatic mode.

Operators will be given the choice to place the PTE flow control gates, namely S.2.1 & 2 and S.5.1 & 2 in Automatic or Maintenance Modes. In automatic mode, the gates will be controlled automatically as described below. In maintenance mode, Operators will be responsible to position these gates either by SCADA manual input or locally at the gate actuator.

Operators will manually enter the BPR Flow Limit Set Point (12 to 43 mgd), BPR Start Flow Control Dead Band factor, flow control gate Idol Gate Position setting, Gate Position Adjustment Time Delay, and the BPR Flow Rate Dead Band setting.

Operators will also assign one (1) flume to the BPR tanks and the other flume to the nitrification tanks / future process by making selections at the OIC. Normally PTE flume 1 will be assigned to the BPR tanks and flume 2 assigned to the nitrification tanks.

Gate S.5.2 will always be fully open for normal operation. Controls logic will initially position gate S.2.1 at an Operator adjustable Idol Gate Position with default = 75% open. This gate is relatively slow moving, and having the gate close to the position where it will need to be when flow control is necessary will minimize the time delay. Ideally this setting will be as low as possible but still a little above the water surface to allow floating materials to pass through. The gate will remain in this position whenever the BPR flow rate is below the BPR Flow Limit Set Point minus an operator adjustable BPR Start Flow Control Dead Band factor with default setting = 20%. Controls logic will multiply (1 minus the BPR Start Flow Control Dead Band factor) times the BPR Flow Limit Set Point to obtain the Start BPR Flow Control Flow Rate. When actual BPR flow is less than the Start BPR Flow Control Flow Rate, the gate will remain at the Idol Gate Position. The gate will start to throttle when the BRP flow rate is equal or greater than the Start BPR Flow Control Flow Rate.

BPR Flume Flow	Gates Open	Gates Closed	Flow Control Gate
Less than Start BPR Flow Control Flow Rate	S.5.2	S.2.2, S.5.1	S.2.1 in Idol Gate Position
Equal or Higher than Start BPR Flow Control Flow Rate	S.5.2	S.2.2, S.5.1	S.2.1 throttling

When throttling, the gate position will be adjusted by moving the gate in increments followed by an operator adjustable Gate Position Adjustment Time Delay with initial setting = 20 seconds. Once the gate starts to throttle, the water surface behind the gate will begin to rise until it overflows the weir opening in the opposite flume channel. During throttling the controls system will have an operator adjustable BPR Flow Rate Dead Band initial setting = 0.5 mgd. The gate will be positioned to maintain the BPR flow setting within the set point plus or minus the dead band. Gate throttling control operation will be adjusted and fine-tuned during startup to avoid overflowing to the nitrification tanks before the BPR flow rate is within the BPR Flow Limit Set Point dead band range.

When the influent plant flow subsides and is once again below Start BPR Flow Control Flow Rate, the gate will resume the Idol Gate Position.

Alarming

Alarm Reset
If a gate is requested to open, close, or throttle and has not done so after an operator set number of seconds, a “Fault” alarm is registered. When the fault condition is rectified the fault must be reset by making a selection at the SCADA OIC.

Equipment Alarms

S.2.1 & 2 and S.5.1 & 2	Not in Remote Common Fault

Junction Chamber

<u>Description.</u> The junction chamber is a partially buried concrete structure consisting of five (5) compartments, four (4) motorized gates, one (1) set of stop logs, drain pipes and valves, and a cleaning pump station to aid with cleaning and maintenance. The dual 48-inch PTE pipes from Parshall flumes and the 12-inch recycle FM convey flow into the structure and the various gates and chambers direct flow to the BRP tanks and nitrifying aeration tanks. The junction chamber is designed to accommodate a future treatment process that would be

constructed on the plant site and it can be equipped with future modulating downward opening slide gate to split flow between the nitrifying aeration tanks and future process. The junction chamber operation is controlled manually through the SCADA system.

Hard Wired Devices

- Float switches
- Motorized sluice gates S.3.1 thru 4
- Future modulating slide gate and future mag meter

Operation

Control Modes

- Local Manual
- SCADA Manual

Local Manual

The gates can be opened and closed locally at the motor operator.

SCADA Manual

The gates can be opened and closed at the SCADA OIC.

Normally, the BPR portion of the plant influent flow, flows through the 48-inch PTE pipe, Parshall flume No.1, and is directed to Junction Chamber compartment A and flows through normally open sluice gate S.3.1 into compartment B. Flow then passes through open sluice gate S.3.4 into the 48-inch PTE pipe to BPR special MH. The BPR special MH flow then enters the existing 48-inch and 54-inch PTE pipes, which discharges to the BPR inlet box and then into the BRP influent channel. Sluice gates S.3.2 and S.3.3 are normally closed. The maximum influent flow to the BPR tanks is 43 mgd. Nitrification return sludge (NRSL) is also discharged into the BPR influent channel. The maximum NRSL flow is 17 mgd. Total influent wastewater flow with NRSL to the BPR tanks is 60 mgd.

The portion of influent flow from the 48-inch PTE pipe with Parshall flume No. 2 that is destined for the nitrifying aeration tanks enters the Junction Chamber compartment C and flows through the normally open stop log SL.1.1. It then enters Junction Chamber compartment D and flows into the 48-inch PTE pipe that ultimately discharges into the nitrifying aeration tank. Sluice gates S.3.2 and S.3.3 are normally closed. The range of flows through this flow path to the nitrifying aeration tanks is 0 to 58 mgd. Normal operation is for any flow in excess of BRP Flow Limit Set Point to be routed through this flow path. This flow path may also be used if some or all of the BRP tanks need to be taken out of service. The BRP influent flow rate treatment capacity is 43 mgd and the BPR Flow Limit Set point will not exceed this amount.

Alternatively the sluice gates S.3.1 thru 3 and S.4.1 can be used to isolate the various compartments during average and low plant influent flow rates. It is anticipated that isolating a compartment may be occasionally required for cleaning or inspection purposes.

Isolate compartment A and take 48-inch PTE pipe associated with Parshall Flume No. 1 out of service:

1. Manually position the slide gates upstream of the Parshall flumes to send BRP flow through the 48-inch PTE pipe with Parshall flume No. 2. Close CG.14.1 and gate CG.15.1, which should be normally closed.
2. Close gate S.3.1 and open gate S.3.3. Sluice gate S.3.2 should already be shut and S.4.1 already open. Install stop logs SL.1.1.
3. BRP influent flow from 48-inch PTE with Parshall flume No. 2 will be routed through compartment C and then into compartment B.
4. Open drain valves P.15.1 and P.14.1 to drain the 48inch PTE pipe with Parshall flume No. 1 and compartment A.

Isolate compartment B

1. This compartment can only be taken out of service if the BRP tanks are also taken out of service. All flow will be routed to the nitrifying aeration tanks. This flow route is for the 48-inch PTE pipe with Parshall flume No. 1 to compartment A. For 48-inch PTE pipe with Parshall flume No. 2 to compartment C see the previous discussion.
2. Open sluice gate S.3.2 and close sluice gates S.3.1 and S.4.1. Sluice gate S.3.3 should already be closed.
3. All plant influent flow will be routed into the nitrifying aeration tanks thru compartments A, C, and D.
4. Open recycle valve P.9.2 to BPR special MH and close recycle valve P.9.1 to compartment B.
5. Open valve P.15.2 and P.14.1 to drain compartment B.

Isolate compartment C and take 48-icnh PTE pipe associated with Parshall Flume No. 2 out of service:

1. Operate the slide gates upstream of the parshall flumes to route all flow through the 48-inch PTE pipe with Parshall flume No. 1. Close gate CG.14.2 and CG.15.1 which should already be closed.
2. Insert Stop log SL.1.1
3. Sluice gates S.3.2 and S.3.3 should already be closed.
4. All of the plant influent flow will be routed from the 48-inch PTE pipe with Parshall flume No.1 to the BRP tanks through compartments A and B.
5. Open drain valves P.15.3 and P.14.1 to drain 48-inch PTE pipe with Parshall flume No. 2 and compartment C.

Isolate compartment D

1. Use same procedures for isolating compartment C only do not install stop log SL.1.1.
2. A temporary plug may be required in the 48-inch PTE pipe out of compartment D to nitrifying aeration tanks if water is expected to be in the secondary clarifier effluent channel.

Isolate compartment E

1. For this project, compartment E is normally isolated. If it needs to be drained occasionally open drain valves P.15.4 and P.14.1 to drain.

Alarming

Alarm Reset

If a gate is requested to open, close, or throttle and has not done so after an operator set number of seconds, a "Fault" alarm is registered. When the fault condition is rectified the fault must be reset by making a selection at the SCADA OIC.

Equipment Alarms

S.3.1 thru 3 and S.4.1	Not in Remote Common Fault

Recycle Pump Station

There will be four (4) pumps located in the recycle pump station wet well. Three (3) large pumps (two (2) operational, one (1) standby) and one (1) small pump. Recycle pump station influent flow is measured by the recycle Parshall flume flow meter. Flow meter reading will be displayed for operation information.

Hand Wired Devices

- Motor thermal switches
- Upper and Lower bearing temp sensors
- Seal Leakage sensor
- Large pump VFDs
- Wet Well level sensor
- High level float switch

<u>Operation</u>

During start up, the pump manufacturer will set the VFD minimum speed limits for the large pumps based on the provided pump requirements.

Pump protection monitoring device alarms will be tied into SCADA. A general fault will be displayed at the SCADA OIC. To see what the actual alarm is, Operators will need to view the HMI locally at the pump VFD panel.

Local Manual

Pumps can be manually started, stopped, and speed controlled locally at the VFD panel by placing the Hand-Off-Remote selector switch in Hand.

SCADA Manual

Pumps can be manually started, stopped, and speed controlled at the SCADA OIC.

SCADA Automatic

The Recycle Pumps will usually operate in automatic mode.

Recycle Pump in Service and Pump Rotation. Operators will input into the SCADA OIC which pumps are in service. SCADA will receive Remote, Local, VFD feedback from each pumps drive.

Operators will be given the choice to select between manual pump rotation and automatic for the three (3) large pumps. In Manual Rotation, Operators will select large pump order at SCADA OIC and the large pumps will operate in that order. In Automatic Rotation, Operators will select the lead and 1st lag large pump. The pumps will automatically rotate after an operator adjustable time period expires or after each pump start, whichever is first.

In the event of a pump VFD failure, controls logic will automatically start the next pump in the rotation which will become the lead pump and an alarm will be issued.

The pumps will be controlled by a level indicator in the wet well. The wet well slab elevation is 865.50’. Below are the original pump operating points, the points shall be adjustable:

- 867.25’ – small pump off
- 868.50’ – large pumps off
- 868.75’ – small pump on
- 870.00’ – large pump min & small pump off
- 871.00’ – large pump max
- 871.50’ – 2 large pumps min
- 872.50’ – 2 large pumps max
- 873.00’ – High level alarm & all pumps on

Before cycling off – all pumps to run at 100% for fifteen (15) seconds to clear vertical stand pipe.

The large pumps will be controlled by a proportional band with VFD minimum speed at “large pump min” and the VFD maximum speed at “large pump max”. The variable speed range and level weighted speed shall be defined as done in the IPS pump operation section of the controls narrative.

The wet well will be equipped with an “All pumps off” low level cut off and an “all pumps on” high level alarm.

Pump speed nomenclature will be percent of full speed. Operating large pumps will be sent the same speed signal.

WWS Pumps and Wet Well Influent Gates

<u>Description.</u>

The WWS pump station (WWSPS) is equipped with five (5) submersible pumps each with a variable speed drive. 80 mgd firm pumping capacity is provided with four (4) pumps running. The WWS pumps lift screened wastewater from the wet well and discharge it into the WWS tank.

Screened wastewater enters the WWS wet well through openings in the wall of the common wet well channel. When the headworks influent flow rate exceeds the Max PTE Flow Set Point, the excess flow will overflow into the WWS wet well through wall openings in the common wet well channel. These openings are equipped with motorized gates, CW.7.1 and CW.7.2.

All five (5) WWS pumps discharge into a common header that is routed through the pipe gallery and extends underground to a tee where the flow splits to the south WWS tank and the future north WWS tank, which will be constructed under a separate Phase 2 contract. Each branch of the tee is equipped with a motor operated plug valve to allow Operators to select which tank is filled first. Due to the pipe layout, the WWS pumps will always pump against the full tank head which is beneficial for consistent pump operation.

The WWSPS flow rate is not directly measured. The estimated flow rate will be calculated and displayed as described under the WWS Tank Filling and Draining description.

The number of WWS pumps in operation at any one time and the WWS pump speed will be controlled based on wet well level. WWS flow rate is measured indirectly by monitoring the rate at which the WWS tank level changes. This flow rate will be displayed for operator information only on the OIC and will not be used for pump control.
To isolate the WWS wet well for maintenance, the inlet gates can be closed. Small sump pumps located in the WWS wet well can be used manually to pump down any remaining water.

<u>Hard Wired Devices</u>

- Motor thermal switches
- Upper and lower bearing temp sensors
- Seal Leakage sensor
- Motor leak sensor
- Cable terminal box leak sensor
- WWS pump VFD's - five (5)
- Wet well level sensors
- LWCO and High Level Alarm float switches
- WWS Tank inlet valves
- Parshall flume meters – two (2) – for wet well inlet gate control
- Wet Weather Storage Tank level signals

<u>Operation</u>

During start up, the pump manufacturer's representative will set the VFD minimum speed limits based on the provided pump requirements.

Pump protection monitoring device alarms will be tied into SCADA. A general fault will be displayed at the SCADA OIC. To see what the actual alarm is, Operators will need to view the HMI locally at the pump VFD panel.

Wet well inlet gates, CW.7.1 and CW.7.2, are downward opening weir gates, motor actuated, throttling type with gate position feedback displayed and gate position adjustable by Operators at the SCADA OIC. Whenever the WWS pumps are in service, these gates will be fully open. However, there could be times when turbulence and wave action in the common channel will result in water splashing into the WWS wet well before the pumps are needed for service. To eliminate this problem, Operators will be given the choice to place these gates in Automatic Service mode. When operated in this mode, Operators will assign a gate position for each gate that is adjustable between 1 and 100% closed with default value = 50%. Controls logic will monitor the IPS wet well level and when it rises to an Operator adjustable Open WWS Gate Level setting initially equal to 863.00' (2' below the End Level Control elevation), the gates will open fully in preparation of WWS pumps going into service. The gates will remain fully open until Operators acknowledge "Storm Over" at the SCADA OIC. In the event that the wet well level were to rise high enough to trigger gate open but then fall again before the WWS pumps were called into service, Operators will be prompted to reset the gate position after a one (1) hour time delay.

Control Modes

- Local Manual
- SCADA Manual
- SCADA Automatic

Local Manual

Pumps can be manually started, stopped, and speed controlled locally at the VFD panel by placing the Hand-Off-Remote selector switch in Hand.

SCADA Manual

Pumps can be manually started, stopped, and speed controlled at the SCADA OIC

SCADA Automatic Operation

The WWS pumps will normally operate in automatic mode.

WWS Pump in Service and Pump Rotation. Operators will input into the SCADA OIC which pumps are in service. SCADA will receive Remote, Local, VFD, and Bypass (contactor) feedback from each pump drive.

The WWS wet well has one level sensor which will be used to control the WWS pumps.

Operators will be given the choice to select between manual pump rotation and automatic. For manual rotation, Operators will select the pump order at SCADA OIC and the pumps will operate in that order. For automatic rotation, Operators select the lead and 1st thru 3rd lag and standby positions and the pumps will automatically rotate after an Operator adjustable time period expires or after each pump start, whichever comes first. Default value for the run time alternator setting = 4 hours.

In the event of a pump VFD failure, controls logic will automatically start the next pump in the rotation which will become the lead pump, and an alarm will be issued.

After operators acknowledge the alarm, they will need to place the pump in Bypass mode by placing the VFD panel Bypass–Off–VFD selector switch in Bypass. Controls logic will move the Bypass drive pump(s) to the end of the rotation. If more than one pump is in Bypass, these pumps will be rotated separately to avoid starting the same pump across the line twice in a row.

The pump control elevations shall be adjustable with defaults as indicated below:

Description	Elevation	Band 1	Band 2	Band 3	Band 4
Wet Well Floor under Level Sensor	850.0				
WWS Pumps LWCO Alarm	855.5				
Stop Lead Pump	856.0	Min Speed			
Start Lead	857.0				
Stop 1st Lag	858.5		Min Speed		

Start 1st Lag	859.5	Max Speed			
Stop 2nd Lag	859.5			Min Speed	
Start 2nd Lag	862.0		Max Speed		
Stop 3rd Lag	862.0				Min Speed
Start 3rd Lag	864.5			Max Speed	
Stop Standby	866.0				
High Operating Level	868.0				Max Speed
Start Standby / Alarm	868.5				
WWSPS Weir Elev	868.5				

The default pump control elevations are operator adjustable as noted above.

The WWS wet well will be equipped with low water cut off (LWCO) and high level alarm float switches. If the LWCO float is tripped, an alarm will be issued and all operating pumps will be turned off. If the high level alarm float is tripped, an alarm will be issued and, if enabled, the standby pump will start and run full speed.

Pump on enable software interlocks. Before enabling a WWS pump to start the following conditions will be met.

Equipment	Tag	Status
FM Drain Valves	P.18.1 & 2	Closed
Tank Drain Valves	P.11.1 & 2	Closed
X-Fill Pipe Drain Valves	P.12.1 & 2	Closed
IF X-Fill Valve P.13.1 is Open		
WWS Tank Inlet Valve	P.10.1	Open
WWS Tanks	North & South	Water Depth below High
IF X-Fill Valve P.13.1 is Closed		
South WWS Tank Inlet Valve	P.10.1	Open
and		
South WWS Tank	LIT	Below High Level

Pump speed control nomenclature will be a percent of full speed. Operating pumps will be sent the same speed signal based on variable speed bands with the minimum pump speed at the bottom of the band and 100% or full speed at the top of the band. The speed band used will be determined by the number of pumps in service. The largest number of WWS pumps that will be in service at any one time is 4 and therefore there will be 4 speed bands. Controls logic will include starting the standby pump at full speed, however this will be locked out and not used.

Speed Band 1 – Lead Pump Operation. Lead pump turns on when the wet well level reaches the start lead pump elevation. It will be controlled in a proportional band with minimum VFD speed at Stop Lead elevation and 100% speed at Start 1st Lag elevation. The elevation associated with minimum speed (in this case Stop Lead) will serve as Level Set Point for the band.

Speed Band 2 – Lead and 1st Lag Pumps. Operating pumps will be controlled at the same speed in a proportional band with minimum VFD speed at Stop 1st Lag elevation and VFD max speed at Start 2nd Lag elevation. The elevation associated with minimum speed (in this case Stop 1st Lag) will serve as Level Set Point for the band.

Speed Band 3 – Lead, 1st and 2nd Lag Pumps. Operating pumps will be controlled at the same speed in a proportional band with minimum VFD speed at Stop 2nd Lag elevation and VFD max speed at Start 3rd Lag elevation. The elevation associated with minimum speed (in this case Stop 2nd Lag) will serve as Level Set Point for the band

Speed Band 4 – Lead, 1st thur 3rd Lag Pumps. Operating pumps will be controlled at the same speed in a proportional band with minimum VFD speed at Stop 3rd Lag elevation and VFD max speed at High Operating Level elevation. The elevation associated with minimum speed (in this case Stop 3rd Lag) will serve as Level Set Point for the band

In general larger operating bands will provide soother pump operation. The minimum operating band should not be less than 1'.

The Variable Speed Range = VFD max speed – VFD min speed with speed ranges entered at the OIC. VFD speed settings will be Operator adjustable and intially set by the pump manufacturers representative.

Level Weighted Speed = ((Wet well level – Level Set Point) / operating band) x Variable Speed Range.

Speed signal output to VFD = Level Weighted Speed + VFD Min Speed

The WWS pumps will be called to stop when the WWS tank is full.

If the storm event is not large enough to fill the WWS tank and the influent flow rate drops below the Max PTE Flow Set Point, the common wet well channel level will also drop and water will stop overflowing into the WWS wet well. The WWS pumps will pump the wet well down to the lead pump off elevation and then turn off.

After it is determined the storm event is over and it won't start raining again, plant Operators will manually confirm this by selecting a "Storm Over" button on the OIC.

Alarming

Alarm Reset

If a pump is requested to start and has not started after an operator set number of seconds, a "Fault" alarm is registered. When the fault condition is rectified the fault must be reset by making a selection at the SCADA OIC.

Equipment Alarms

WWS Pumps 1 thru 5	• Not in Remote • Common Fault • Low Wet Well Level • LWCO • High Wet Well Level
Wet Well Inlet Gates CW.7.1 & 2	• Gate Closed • Common Fault

WWS FM Draining

Description.

At the end of a storm event the vertical portion of the 60-inch WWS FM inside of the WWS tank should be drained to prevent freezing. There are two FM drain valves located in the drain valve vault in the yard south of the headworks building. The valves are physically located at a low point on the WWS FM allowing the entire WWS FM to be emptied through the valves.

Normally, after each storm event the WWS FM, WWS tank and the WWS X-fill pipes will be drained. Each drainage operation has its own drainage flow rate and none of them are measured independently. Therefore each drainage operation will be accomplished one at a time to avoid multiple and competing control loops.

Drainage from the WWS FM flows by gravity into the common wet well channel and then into the IPSPS wet well. The FM drain valve will be positioned to restrict the drainage flow such that the PTE flow rate will not exceed the Max PTE Flow Set Point. Only one drain valve will be open at a time. Drain valve control is most efficient when the valve is positioned in a range between 20% and 80% open. The estimated flow rate thru one drain valve that is 20% open and with full force main is approximately 2.5 mgd. This will be the default value for the operator adjustable FM drain dead band. FM draining will be enabled when the PTE flow rate is equal or less than the PTE Max Flow Set Point minus the FM dead band.

Hard Wired Devices

- PTE Parshall flume meters (2)

Operation

Control Modes

- Local Manual
- SCADA Manual
- SCADA Automatic

Local Manual

Drain valves can be manually opened, closed, and positioned locally by using buttons on the valve motor actuators.

SCADA Manual

Drain valves can be manually opened, closed, and positioned by making entries at the SCADA OIC.

SCADA Automatic

Normally the valves will be operated in Automatic mode. Only one FM drain valve will be allowed to open at a time.

WWS FM Drain valves P.18.1 &2 will not be enabled to open until the following conditions are met:

Equipment	Tag	Status
PTE Flumes	No. 1 and 2	Summation less than Max PTE Flow Set Point minus FM drain dead band
WWS Tank Inlet Valve	P.10.1	Open
Tank Drain Valves	P.11.1 & 2	Closed
FM Drain Valves	P.18.1 & 2	Software Interlocked - To open one valve the other must be Closed
WWS Pumps	1 thru 5	Off

SCADA will alternate the FM drain valves after each use. The drain cycle will continue for an Operator adjustable period of time. The required FM drainage time is estimated to be from 45 to 100 minutes. Actual drainage time will depend on several variables including the headworks influent flow rate. The default value for the FM Drain Time is 120 minutes to ensure full pipe drainage. After this time has elapsed the drain valve will close.

If the drain valve enable signal is removed during draining, the drain valve will close and an operator alert message will be displayed. The valve will reopen to resume the drain cycle where it was paused when the enable signal is restored.

Operators will make a selection on the OIC to drain the FM before or after the WWS tank is drained. If it is elected to drain the FM first, then the drain valve will open after the Storm Over Button is selected by plant operators. If it is elected to drain the FM after the WWS tank is emptied, then the FM drain valve will open after the tank drain valve, P.11.1 closes.

WWS FM Drain valve position will be controlled to keep the PTE flow rate below the Max PTE Flow Set Point. To account for the time delay between making a valve position adjustment and having the corresponding flow rate registered by the PTE flumes, there will be an operator adjustable WWS FM Drain Valve Dead Band with initial setting = 45 seconds.

WWS FM Drain valve position will be displayed at the SCADA OIC for operator information.

Alarming

Alarm Reset
If a valve is requested to open, close or throttle and has not done so after an operator set number of seconds, a “Fault” alarm is registered. When the fault condition is rectified the fault must be reset by making a selection at the SCADA OIC.

Equipment Alarms

Valves P.18.1 & 2	• Not in Remote • Common Fault

WWS Consecutive Fill Pipe Draining

Description.

After the WWS tank has been emptied the 54-inch consecutive fill (X-fill) pipe inside of the WWS tank should be drained to prevent freezing. There are two 8-inch X-fill drain valves located in the valve vault in the yard between the south WWS tank and the future north WWS tank. The valves are located on either side of the 54-inch X-fill valve such that one X-fill drain valve can drain either side of the 54-inch X-fill valve, P.13.1, if the valve is open. If the 54-inch X-fill valve is closed both drain valves will need to be used to drain the entire line.

Normally, after each storm event the WWS FM, WWS tank and the WWS X-fill pipes will be drained. Each drainage operation has its own drainage flow rate and none of them are measured independently. Therefore each drainage operation will be accomplished one at a time to avoid multiple and competing control loops.

X-fill drainage flows by gravity into the common wet well channel and then into the IPSPS wet well. The X-fill pipe can only be drained after the WWS tank is empty.

The estimated flow rate through one X-fill drain valve that is 20% open with a full X-fill pipe is approximately 2 mgd. This will be the default value for the operator adjustable X-fill drain dead band. X-fill pipe draining will be enabled when the PTE flow rate is equal or less than the PTE Max Flow Set Point minus the X-fill dead band.

Hard Wired Devices

- PTE Parshall flume meters – two (2)

Operation

Control Modes

- Local Manual
- SCADA Manual
- SCADA Automatic

Local Manual Operation

Drain valves can be manually opened, closed, and positioned locally by using buttons on the valve motor actuators.

SCADA Manual

Drain valves can be manually opened, closed, and positioned by making entries at the SCADA OIC.

SCADA Automatic

Normally the valves will be operated in Automatic mode. Only one X-fill drain valve will be allowed to open at a time.

X-fill drain valves P.12.1 & 2 are normally closed and will not be enabled to open until the following conditions are met:

Equipment	Tag	Status
PTE Flumes	No. 1 and 2	Summation less than Max PTE Flow Set Point minus FM drain dead band
X-Fill Pipe Drain Valves	P.12.1 & 2	Software Interlocked - To open one valve the other must be Closed
X-Fill Valve	P.13.1	Open
FM Drain Valves	P.18.1 & 2	Closed
WWS Pumps	1 thru 5	Off

If the X fill drain valve enable signal is removed for any reason after a drain cycle has started, the X-fill drain valve will close and an operator alert message will be displayed. The valve will reopen to resume the drain cycle where it was paused when the enable signal is restored.

The X-fill drain valve will either open after the WWS FM drain valves close (if WWS tank is drained first) or after the tank drain valve closes (if the FM is drained first). The WWS tank must be drained prior to the X-fill drain valve.

X-fill drain valve position will be controlled to keep the PTE flow rate below the Max PTE Flow Set Point. To account for the time delay between making a valve position adjustment and having the corresponding flow rate registered by the PTE flumes, there will be an operator adjustable X-Fill Drain Valve Dead Band with initial setting = 90 seconds.

SCADA will alternate valves. The drain cycle will continue for an Operator adjustable period of time. The X-fill drainage rate will depend on several variables including the headworks influent flow rate. The default valve for the FM Drain Time is 45 minutes to allow for full drainage of the X-fill. After the time period has elapsed the drain valve will close.

Drain valve position will be displayed at the SCADA OIC for operator information.

Alarming

Alarm Reset

If a valve is requested to open, close, or throttle and has not opened after an operator set number of seconds, a “Fault” alarm is registered. When the fault condition is rectified the fault must be reset by making a selection at the SCADA OIC.

Equipment Alarms

Valves P.12.1 & 2	• Not in Remote • Common Fault

WWS Tank Filling and Draining

Description

The south and north (future) WWS tanks have a capacity of 22 million gallons (MG) each. The tanks are circular concrete structures with domed concrete covers. Each tank has one associated 60-inch fill valve, 24-inch drain valve, 54-inch overflow pipe, and a set of dual level sensors. Both tanks share a 54-inch consecutive fill (X-fill) pipe equipped with a single 54-inch isolation valve. Each tank is filled with the WWS pumps and drain by gravity using the 24-inch motor actuated flow control drain valve.

The level in the tank at the end of the storm event will be logged by the controls logic for the purposes of reporting the total volume pumped by the WWSPS and stored on site for each event.

The WWSPS flow rate is not measured directly. It will be estimated by monitoring the rate of level change in the tanks.

The WWS tank drains by gravity into the common wet well channel and then into the IPSPS wet well where it is combined with the headworks influent flow. Tank drainage rate will be indirectly measured using the WWS tank level sensors.

Normally, after each storm event the WWS FM, south WWS tank, and the WWS X-fill pipes will be drained. Each drainage operation has its own drainage flow rate and none of them are measured independently. Therefore each drainage operation will be accomplished one at a time to avoid multiple and competing control loops.

Tank drainage will be controlled by positioning the tank drain valve, P.11.1, such that the PTE flow rate will not exceed the Max PTE Flow Set Point. Tank drain valve control will work best when the valve is positioned in a range between 20% and 80% open. The estimated flow rate through the tank drain valve that is 20% open with a full tank is approximately 3.5 mgd. This will be the default value for the operator adjustable WWS Tank Drain Dead Band. Tank draining will be enabled when the PTE flow rate is equal or less than the PTE Max Flow Set Point minus the WWS Tank dead band.

Operators will select at the SCADA OIC if they want the WWS tank(s) or FM to be drained first. Draining of either will not be enabled until "Storm Over" is registered.

The lead tank influent valve will always be open.

Hard Wired Devices

- Level Sensors (two (2) for the south WWS tank)
- IPSPS Wet Well Level Sensors

Operation

The calculated WWS tank filling and draining flow rates will be displayed at the SCADA OIC. Rates will be calculated by multiplying the tank diameter times the change in level divided by the time interval between level readings. Generally the rate will be updated every 10 seconds and displayed with units = MGD. The design tank diameter is 260 feet.

The motor actuated valves associated with the WWS tanks are listed below:

	Valve Tag
South WWS Tank Fill	P.10.1
WWS Tank X-Fill	P.13.1
South WWS Tank Drain	P.11.1
North WWS Tank Drain (future)	P.11.2

Control Modes

- Local Manual
- SCADA Manual
- SCADA Automatic

Local Manual

Drain valves can be manually opened, closed, and positioned locally by using buttons on the valve motor actuators.

SCADA Manual

Drain valves can be manually opened, closed, and positioned by making entries at the SCADA OIC.

SCADA Automatic

Normally the tank fill, X-fill, and drain valves will be operated in Automatic mode.

The WWS Tank control and reference elevations are as follows:

Description	Elevation
Approximate WSE when a Tank is Overflowing at Full Capacity	967.7
High-High (Alarm and WWS Pumps Off)	965.5
Overflow Elevation	965.5
High Level (Alarm)	965.0
Consecutive Fill Top of Pipe	947.0
Low-Low (Tank Floor Under Level Sensor)	910.0
Tank Center (Low Point)	906.0

Tank Filling

The tank is equipped with dual level sensors. Operators will be given the choice to select either sensor or both sensors. The default will be both are used and the highest level will be used for control. If one sensor faults, the control logic will automatically switch the sensor remaining in service to use for control.

If the WWS pumps turn off due to high WWS Tank level, “Storm Over” will be registered by the controls system which will enable dewatering operations to proceed. If the WWS pumps turn off due to low level in the wet well, Operators will need to manually enter “Storm Over” at the SCADA OIC.

Until the North tank is constructed in Phase 2, inlet valve P.10.1 will remain open at all times.

The volume stored in the WWS tank will be recorded for each storm event. Total tank volume consists of the measured volume in the straight wall area and the cone bottom. Measured volume will be calculated by multiplying the tank area times the depth of water in the tank. The design tank diameter is 260 feet. Final tank volume and constructed diameter will need to be verified with the tank shop drawings. Cone bottom volume will be a fixed amount that is added to the measured volume of each storm. This volume is estimated to be approximately 0.5 MG. Actual volume will need to be calculated based on the tank shop drawings and the actual tank foundation configuration below the level sensor zero elevation that is somewhere near the tank wall.

Valve P13.1 to be closed at all times until Phase 2 construction, completed under a separate contract.

Tank Draining
When Storm Over is registered, the WWS Tank Drain valve P.11.1 will not open until the following conditions are met:

Equipment	Tag	Status
PTE Flumes	No. 1 and 2	Summation less than Max PTE Flow Set Point minus WWS Tank Drain Dead Band
X-Fill Drain Valves	P.12.1 & 2	Closed
Tank Drain Valves	P.18.1 & 2	Closed
WWS Pumps	1 thru 5	Off

The WWS Tank Drain Valve P.11.1 will remain closed during normal operation.

If the WWS Tank drain valve enable signal is removed after a drain cycle has started the drain valve will close and an operator alert message will be displayed. The valve will reopen to resume the drain cycle where it was paused when the enable signal is restored.

The WWS tank drain valve will either open after “storm over” has been registered (if the tank was selected to drain first) or the tank drain valve will open after the WWS FM drain valves closes (if the WWS FM was selected to drain first).

Tank Drain valve position will be controlled to keep the PTE flow rate below the Max PTE Flow Set Point. To account for the time delay between making a valve position adjustment and having the corresponding flow rate registered by the PTE flumes, there will be an operator adjustable Tank Drain Valve Dead Band with initial setting = 90 seconds. SCADA logic will also monitor the IPSPS wet well level. The effect of making adjustments to the Tank drain valves will first be noticed before the IPS pump speed is adjusted and the subsequent flow rate change is measured at the PTE flumes. The IPSPS wet well level (average of both level sensors if both IPSPS’s are in service) will be used to make trim adjustments to drain valve dead band. When the IPSPS wet well is rising, the dead band should be increased to allow more time for the pumps to catch up. When PTE flow is greater than 50 mgd the dead band should be reduced to account for faster pipeline velocities and relatively shorter holding time in grit tanks.

There will be two (2) sets of trim factors applied to the WWS Tank drain valve dead band as shown in tables below, based on both the PTE Flume Reading and the IPS Wet Well Level.

Drain Valve Dead Band Factor Based on PTE Flume Reading

PTE Flume Measurement, MGD	Trim Factor
0 – 25	2.0
>25 – 35	1.0
>35 – 50	0.75
>50 - 70	0.5

Drain Valve Dead Band Factor Based on IPS Wet Well Level

Wet Well Level	Trim Factor
Rising	1.5
Falling	1.0

The trim factors will be Operator adjustable with initial setting fine-tuned during start up when operating under actual conditions.

The WWS Tank drain cycle will drain the tank to low-low level and then be allowed to continue for an Operator adjustable period of time. The default value for the WWS Tank Bottom Drain Time is 5 hours. After this time has elapsed the Tank drain valve will close.

Alarming

Alarm Reset

If a valve is requested to open, close, or throttle and has not done so after an operator set number of seconds, a "Fault" alarm is registered. When the fault condition is rectified the fault must be reset by making a selection at the SCADA OIC.

Equipment Alarms

Valves P.10.1 & 2, P.11.1 and P.13.1	• Not in Remote • Common Fault

West Hickman WWTP
Non-Potable Water Equipment and Control Narratives

DESCRIPTION

The Non-Potable Water (NPW) system at the West Hickman Wastewater Treatment Plant (WHWWTP) provides process water to a variety of treatment processes and plant functions. These processes include, but are not necessarily limited to, the following:

- Chlorine Dilution Water (CLDW) — provides water to the chlorine contact tank to maintain desired levels of chlorine concentration. CLDW lines are also tapped to serve other processes (e.g., clarifiers).

- Effluent Flushing Water (EFW) — provides general plant water, including water for washdown functions, hoses, hydrants, etc. EFW lines are also be tapped to serve other processes (e.g., clarifiers).

- Foam Spray Water (FSW) — provides flow to nozzles which break up any foam collecting on the surface of nitrification basins and clarifiers.

- New Headworks Water (HWRK) — provide flow to the new headworks facility, including the screening and grit processes as well as hose bibs and flush hydrants around the facility. The new headworks water line will also provide cleaning water to the south tank and tank valve vaults.

- Solids Processing Water (SPW) — provides service to the solids processing building.

- Thickener Dilution Water (TDW) — provides flow to gravity thickeners for maintaining desired sludge concentrations.

All NPW water is supplied off of the top of the final clarifiers. A booster pump station is provided at the tanks to provide the required tank wash down flow and pressure. The booster pump station is a manually operated within the booster pump station vault. The booster pump station will be manual turned on by the Operators when tank wash down occurs.

The NPW pump room consists of two pump stations. The first pump station, known as NPW 1, provides energy to the TDW service. NPW1 consists of one (1) duty pump and one (1) redundant pump. The second pump station, known as NPW 2, provides energy to the services of Effluent EFW, SPW, CLDW, and FSW. It consists of three (3) duty pumps and one (1) redundant pump.

The NPW 1 and NPW 2 systems are isolated by a gate valve located on a 10-inch common discharge header. On one side of the isolation valve, the NPW 1 pumps discharge to the common discharge header, and a 10-inch tee valve taps off of the common discharge header to provide flow to the TDW service. On the other side of the isolation valves, the NPW 2 pumps discharge to the common discharge header, and tee valves of varying size tap off the common discharge header to provide flow to each of the services.

Instruments and Valves

A flow meter (FM) is located on each service line. Further, on each service line except for TDW, there is a Flow Control Valve (FCV) and Pressure Transmitter / Transducer (PIT). One PIT is on the common discharge header on each side of the isolation gate valve separating TDW from the other processes. Lastly, one Pressure Reducing Valve (PRV) is on the CLDW line and one is on the 4-inch EFW line that exits the southern wall of the building, given that these lines have experienced damage from over-pressure in the past. In this way, NPW 2 can provide the pressure and flow required for the most demanding service, without risking damage to the remaining lines or overwhelming the other lines during periods of low demand on said lines.

Each FM, PIT, and FCV will provide flow, pressure, and position feedbacks, respectively, to the control system. The FCVs will be capable of accepting position commands from the control system. The set pressures of the PRVs are manually adjusted at the valve; each value will be hard-coded into the SCADA logic, and must be changed if the set pressure on the PRV is changed.

For several processes, bypasses already exist in the system. For example, a normally-closed cross-connection exists between the 10-inch FSW and the 6-inch EFW line, near a booster pump station located north of the NPW pump room. By opening this cross-connection, the FSW line can serve as a bypass for this EFW, and vice-versa. For processes that do not have such existing bypass lines, there will be parallel lines with redundant PRVs, FCVs, FMs, and gate valves.

Hard Wired Devices

- NPW 1 VFD’s – two (2)
- NPW 2 VFD’s – four (4)
- Flow Control Valves – eight (8)
- Pressure Transmitter / Transducer – ten (10)
- Flow Meter – nine (9)
- Pressure Reducing Valve – two (2)
- Pump motor thermal switches – six (6)

Table 1: Instruments

Name	Size	Quantity	Joint
FLOW METERS			
CLDW FM 1	6”	1	FJ
EFW FM 1, 2, 3, 4	6”	4	FJ
FSW FM 1	10”	1	FJ
SPW FM 1, 2	6”	2	FJ
TDW FM 1	10	1	FJ
PRESSURE TRANSMITTERS/TRANSDUCERS			
CD PIT 1, 2	10”	2	NPT
CLDW PIT 1	6”	1	NPT
EFW PIT 1, 2, 3, 4	6”	4	NPT
FSW PIT 1	10”	1	NPT
SPW PIT 1, 2	6”	2	NPT

Table 2: NPW Pump Room Valves

Name	Size	Quantity	Joint	Operator	Accessories	Remarks
GATE VALVES						
CD GV 1,3,4	6”	3	FJ	HW		
CD GV 2	10”	1	FJ	CW (7’)		
CLDW GV 1-2	6”	2	FJ	CW (8’)		
EFW GV 1-8	6”	8	FJ	CW (6’)		
FSW GV 1-2	10”	2	FJ	CW (7’)		
HWRK GV 1	6”	1	FJ	HW		Part of a tapping sleeve assembly
SPW GV 1-4	6”	4	FJ	HW		SPW GV 2 is a cut-in valve
TDW GV 1-2	10”	2	FJ	CW (5’)		
SWING CHECK VALVES						
CD CV 1-3	6”	3	FJ	HW		
PRESSURE REDUCING VALVES						
CLDW PRV 1	6”	1	FJ	HW		Pilot handwheels control set pressure; 80 PSI
EFW PRV 1	6”	1	FJ	HW		Pilot handwheels control set pressure; 80 PSI
FLOW CONTROL VALVES						
CLDW FCV 1	6”	1	FJ	M	RPI	0-1200 GPM
EFW FCV 1, 2, 3, 4	6”	4	FJ	M	RPI	0-1200 GPM
FSW FCV 1	10”	1	FJ	M	RPI	0-1200 GPM
SPW FCV 1-2	6”	2	FJ	M	RPI	0-1200 GPM

CD = Common Discharge Header; GV = Gate Valve; CV = Swing Check Valve; FCV = Flow Control Valve; PRV = Pressure Reducing Valve; FJ = Flanged Joint; HW = Handwheel; CW = Chainwheel; RPI = Remote Position Indicator; M = Motor-Actuator

<u>Operation</u>

During start up the pump manufacturer’s representative will set the VFD minimum speed limits based on the provided pump requirements.

Control Modes

- Local Manual
- SCADA Manual
- SCADA Automatic

Local Manual (sometimes known as "Hand")

Permits on/off/ramp options via push-button interfaces for the pumps. Permits hand-operated positions for the valve actuators. To initiate the local manual mode for testing or maintenance, place the local-off-remote (LOR) selector switch in the "L" position. Start/stop push buttons allow for control of the starter driven pumps. Running light, and flow indication are displayed at CP-100.

SCADA Manual

Permits operator to directly specify pump status/speed and position of FCV via the Operator Interface Computers (OIC).

When the local switch is in the "Remote" position, the operator can select between SCADA Manual and SCADA Automatic. In SCADA Manual mode, the operator may start/stop pumps that are selected as SCADA Manual and open/close FCVs through a control pop-up display on the OIC. The PLC program outputs the start/stop commands and open/close commands to the pumps and FCVs, respectively.

In SCADA-Manual mode, the PLC only makes changes to the process (or related equipment) that are Operator initiated. From the OIC, the Operator is able to manually control the process equipment. Hardware and software safety interlocks will remain in place to prevent the system from exceeding operating limits.

SCADA Automatic

Permits operator to request a flow in each meter; system responds by opening/closing FCVs and adjusting pump speeds to achieve the most efficient configuration while still meeting the requested demands.

In SCADA Automatic mode, the operator requests the desired flows in each process, system responds by adjusting FCV positions and adjusting pump speeds to achieve the most efficient configuration while still meeting the requested demands.

NPW 1

For NPW 1, the Operator will request flow in the TDW line. If the requested flow is greater than the flow seen in the TDW flow meter, the pump will increase speed until the target flow is met. If the requested flow is less than the flow seen in the flow meter, the pump will decrease speed until the target flow is met.

Operators will be given the choice to select between manual pump rotation and automatic. For manual rotation, Operators will select the pump order at SCADA OIC and the pumps will operate in that order. For automatic rotation, Operators select the lead and lag and standby positions and the pumps will automatically rotate after an Operator adjustable time period expires or after each pump start, whichever comes first. Default value for the run time alternator setting = 6 hours.

In the event of a pump VFD failure, controls logic will automatically start the next pump in the rotation which will become the lead pump and an alarm will be issued.

NPW 2

For NPW 2, the system will continuously monitor the pressures and flows and respond when flows are outside of desired values by some pre-determined degree, for some pre-determined amount of time. The degree of flow variation and time of variation will be operator adjustable with the default Flow Variation = 5%, and the Time of Variation = 120 seconds. Should this happen, the system will begin an assessment to determine whether it must adjust FCV positions, or adjust pump speeds. This assessment will also begin if the Operator specifies new requested flows in the system. The control logic will achieve the desired flows with the fewest possible number of active pumps, and with all active pumps operating at the lowest possible speed. For each FCV, to account for the time delay between valve positioning adjustments and the corresponding flow rate registering in SCADA, there will be an operator adjustable FCV Dead Band with an initial setting of = 90 seconds.

Once the analysis begins, the system will rank the flows in order from highest pressure (receiving rank 1) to lowest pressure (receiving rank 5) using the Pressure Indicators on each line. Beginning with the service that has the highest rank, the SCADA system will check to see if the requested flow is different from the current flow, using the Flow Meters on each line and the Operator input flow required. If the current flow is within the allowable Flow Variation of the Operator requested flow, SCADA will assess the process of next priority until all processes have been assessed with no changes. If the current flow is outside of the allowable Flow Variation, SCADA will assess whether the requested flow is greater or less than the current flow.

If more flow has been requested for a process, the system will first try to open the process's FCV until the requested flow is met. If the FCV is 100% open and more flow is still required, the system will check to see whether the pressure in the process line is equal to the hard-coded PRV set pressure. If so, a warning message will be sent to the OIC indicating that the system is receiving the maximum amount of flow permitted by its PRV. No changes will be made to the conditions of the pumps and the process of next-highest rank will be assessed.

If the process's pressure is less than the hard-coded PRV set pressure, the system will increase pump speed or activate an additional pump, according to the pump logic, until either the PRV set pressure is reached or the requested flow is met. The current process will be assigned rank 1, and the process of next-highest rank will be assessed.

If less flow has been requested, the system will first assess whether the process being analyzed is the highest-ranked process. If the process is not the highest ranked process, the system will close the process's FCV until the desired flow condition is met.

If the process is the highest-ranked process, the system will check to see if the process's FCV is 100% open. If the FCV is not 100% open, the system will open the FCV. This will cause a momentary increase in the flow in the line, but the pump speed will decrease immediately thereafter; in this way, the pumps will decrease to their lowest possible energy consumption state.

The pump speed will decrease according to the pump logic until either the flow condition is met or the pressure in the process currently being analyzed equals the pressure in the second-highest-ranked process. If a lower-ranked process now controls the pressure in the common discharge header, the system should not continue to decrease pump speed, only to have it increase upon assessment of the next process. Therefore, the system decreases pump speed only to the level of the next-ranked process; if further reduction is required, the FCV closes until the desired flow condition is met. Once the next-ranked process is assessed, the pump speed can decrease if permitted.

Pump speed nomenclature will be a percent of full speed. Operation pumps will be sent the same speed signal. When increasing flow, an additional pump shall not start until the pumps operating are operating at 100% of the permitted operating speed and additional flow is still required. When an additional pump kicks on, all operating pumps shall run at the minimum VFD setting and then ramp up as required.

When decreasing flow, a pump shall not shut off until the operating pumps are at the minimum pump manufacturer set VFD, and less flow is needed .When a pump shuts down, the operating pumps shall ramp up to 100% and decrease from 100% as required.

Operators will be given the choice to select between manual pump rotation and automatic. For manual rotation, Operators will select the pump order at SCADA OIC and the pumps will operate in that order. For automatic rotation, Operators select the lead and 3rd lag and standby positions and the pumps will automatically rotate after an Operator adjustable time period expires or after each pump start, whichever comes first. Default value for the run time alternator setting = 6 hours.

In the event of a pump VFD failure, controls logic will automatically start the next pump in the rotation which will become the lead pump and an alarm will be issued.

ALARMING

Software Interlocks

The local and pump starters are electrically interlocked with similar switches and push buttons in the local control panel. Changing settings or switching positions at one location effects the operation of the other. Software interlocks are initiated through the PLC. These interlocks are in effect in both SCADA Manual and SCADA Auto modes. These PLC interlocks are typically not in effect when controlling the equipment locally. Hardwired interlocks are in effect in all modes.

Alarm Reset

If a pump is requested to start and after five (5) seconds is not running, a “Fault” alarm will be registered. When the fault condition is rectified the fault must be reset by selecting the “Fault Reset” button on the SCADA OIC.

If a valve is requested to open, close, or throttle and has not done so after an Operator set number of seconds, default = 10 seconds, a “Fault” alarm is registered. When fault conditions are rectified the fault must be reset by making a selection at the SCADA OIC.

Alarms

Alarms are operational in each mode, and the alarms will be transmitted to the local starter panel and SCADA PLC. Analog indicator signals and position signals are transmitted to the SCADA PLC for indication on operator interfaces and for long-term archiving.

Discrete

- NPW 1, 1 – 1,2 and NPW 2,1 – 2,4: Start/Stop Fail
- NPW 1, 1 – 1,2 and NPW 2,1 – 2,4: Fault
- NPW 1, 1 – 1,2 and NPW 2,1 – 2,4: Local Emergency Stop
- NPW 1, 1 – 1,2 and NPW 2,1 – 2,4: High Motor Temp