

***XXX Wastewater Pumping Station***

***PLC Name***

**REVISION HISTORY**

**Type I II WWPS Standard Control Narrative (2 Pumps)**

|  |
| --- |
| **Standards Release Date** |
| January 2022 |

This table is to show which version of the SCADA Standards was used as the starting point for the development of the Control Narrative. This table is not to be removed at any point.

**Control Narrative Revision History**

|  |  |  |
| --- | --- | --- |
| **Date** | **Revision By:**  Name of person and company | **Description of Revisions** |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

*Text in Italic and highlighted in yellow are Instructions to the Consultant and are to be removed when the narrative is written.*

*Text Highlighted in green reference other sections in the narrative. The consultant needs to verify all these references when the narrative is complete and remove the green highlighting.*

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# Deviations from the SCADA Standards

Include in this section any deviations from the SCADA Standards) and the reasons for the deviation.

Table: 1‑1 Deviations from the SCADA Standards

| **DEVIATION** | **REASON FOR DEVIATION** |
| --- | --- |
|  |  |
|  |  |
|  |  |
|  |  |

# Process Overview

## Process Control

The XXX Sewage Pumping Station Process is controlled by the following PLC’s:

XXX1.ACD

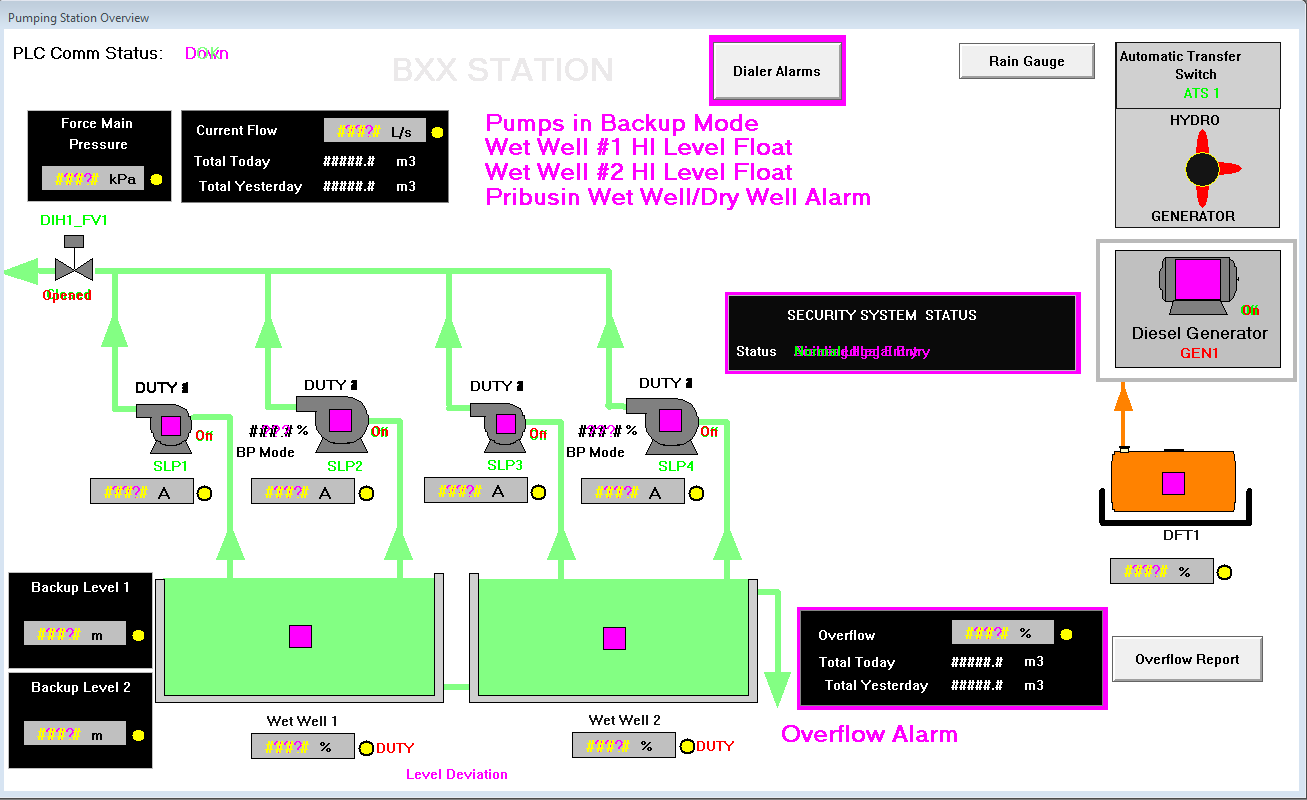
This control narrative is for the PLC: XXX, which controls the wetwell equipment and instrumentation in the XXX Sewage Pumping Station.

## Process Overview Screen

The XXX Pumping Station is a concrete submersible type with a single underground wetwell; it has xxx (X) submersible sewage pumps of the vertical-centrifugal design.

Sewage is fed into and stored in a wetwell. The well is equipped with electrical instrumentation to detect the level of sewage present. When the sewage level rises to a predetermined point, a duty pump will be started to lift the sewage upward through a force main. If a high volume of sewage flows into the wetwell (for example during peak flow periods and wet weather) additional pumps will be used. If this is insufficient, or in the case of failure of the pumping station, a backup of sewage may leak into the environment. An overflow pipe is situated upstream from the pump station to redirect overflows.

HMI Screen: 2.2‑1 Process Overview Screen



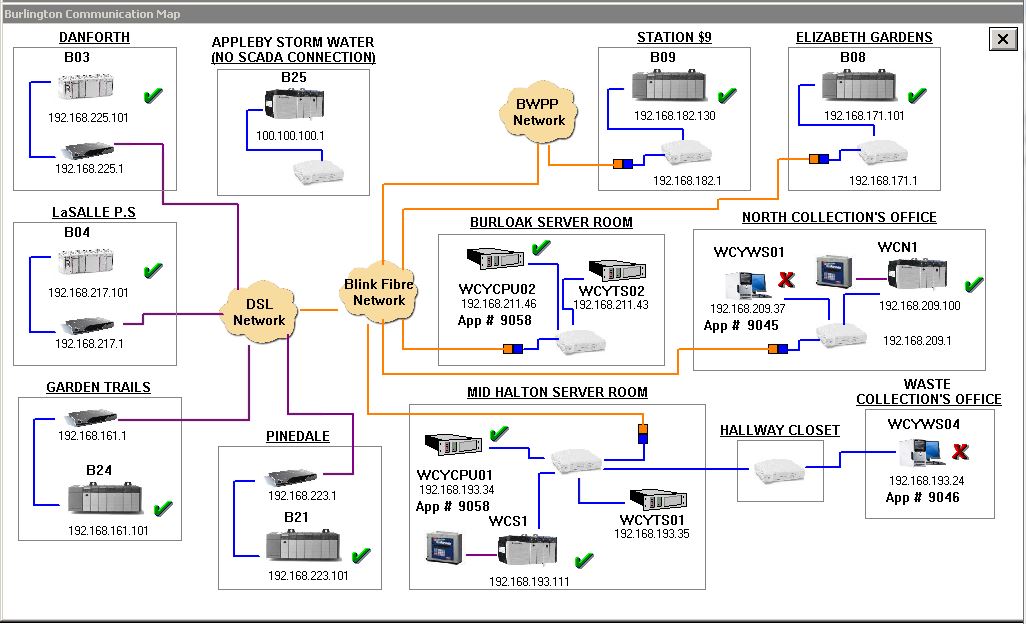
Graphics to be updated with design. Sample graphic included as a place holder.

# Network and control system overview

PLC XXX1 is connected to the wastewater collection system wide area network through the Region’s 3rd party area network provider. The PLC is polled by the 2 I/O servers WCYCPU01 and WYCCPU02.

## Communication Map

HMI Screen: 3.1‑1 Communications link to Pump Station



*Graphics to be updated with design. Sample graphic included as a place holder.*

The Remote Communications Map screen provides information on the health of the communication network at the Pumping Station and monitors the following connections:

1. Wonderware application to the I/O ABCIP driver
2. HMI application to the XXX Wastewater Pumping Station CompactLogix controller

If a device stops communicating, a magenta box will flash on its icon indicating a failure.

## Remote Communications

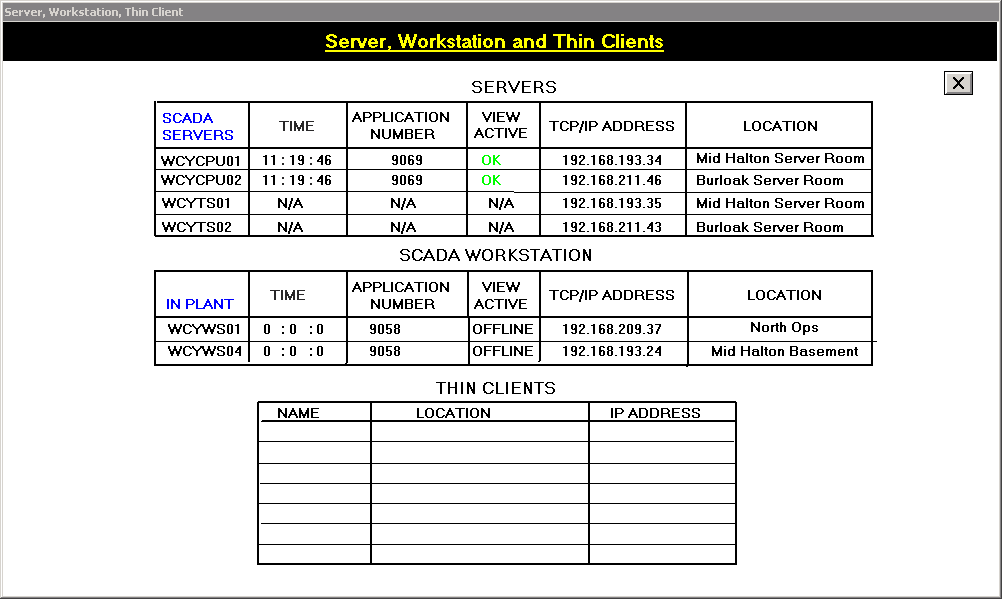
Describe any communications links the pump station has with other Remote facilities or location. North stations will communicate with PLC WCN1 and South stations will communicate with PLC WCS1 The south auto dialer PLC is located at the Mid-Halton WWTP

The wastewater pumping station communicates with the auto dialer PLC WCX1 which is located at the North Operations Center

## SCADA Work Stations

*Consultant to indicate whether there is a thin client or PanelView present at this station and update the graphic below and the narrative accordingly.*

HMI Screen: 3.3‑2 SCADA Work Station Communications Status

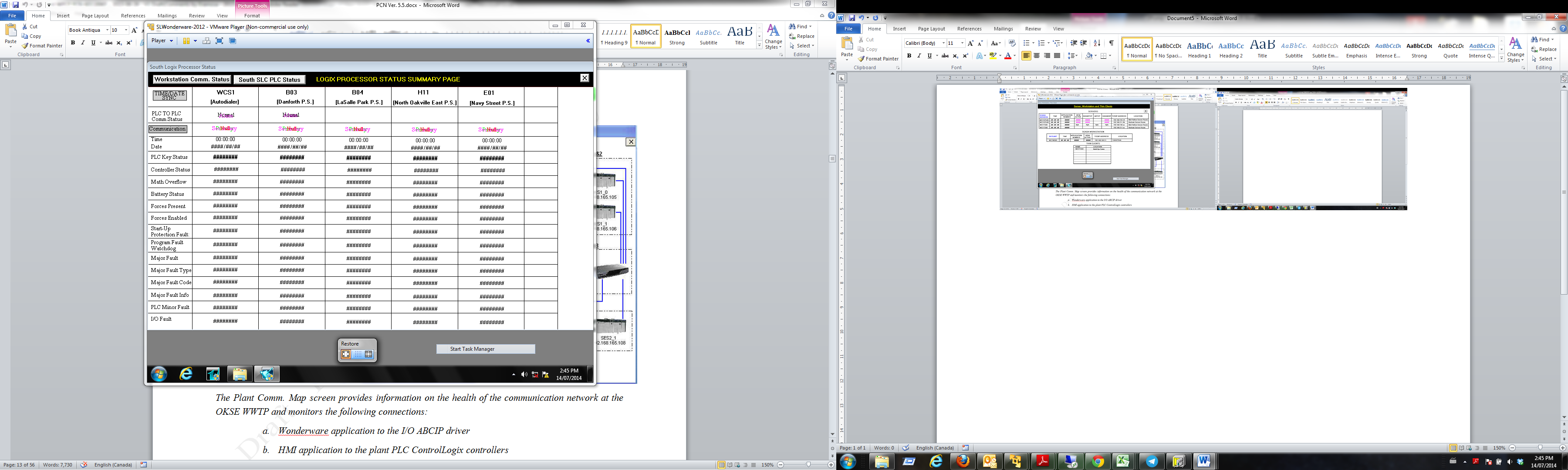


*Consultant to indicate whether there is a work station, thin client or PanelView present at this station and update the graphic below and the narrative accordingly.*

Graphics to be updated with design. Sample graphic included as a place holder.

## PLC Communications and Statuses

HMI Screen: 3.4‑1 Pump Station PLC Status Screen



Graphics to be updated with design. Sample graphic included as a place holder.

*Everything is section 4 is universal and apply to all standard devices. The intent is to state it once here and not have to repeat it for each instance of equipment. Exceptions or deviations from these standards should be documented in the section for the specific device. This section should never have to be changed when writing a narrative*

# STANDARDIZED CONTROL CONFIGURATION

## Control Hierarchy

The control hierarchy to be implemented in the Sewage Pumping Station is based upon the control standards and hierarchy described in the SCADA Design Standards Manual. The hierarchy is based upon the following levels: LOCAL, PLT-MAN, and PLT-AUTO. The hierarchy is described in the following Table.

Table 4.1‑1 Control Hierarchy

| ***Level*** | ***Description*** |
| --- | --- |
| LOCAL/  REMOTE | The selection of LOCAL or REMOTE mode of operation is typically made by an Operator at the device, MCC, or area control panel by means of a two-position selector switch. In LOCAL mode the device can be controlled through the use of pushbuttons in the field. In REMOTE, operation of the devices is passed to the SCADA system and the mode is selected by the Operator using the HMI. Switching from REMOTE to LOCAL will provide a bumpless transfer of device operation. Switching from LOCAL to REMOTE may cause the device to operate if the device is in PLT-AUTO and required to start/stop by the PLC automatic device logic. |
| PLT-MAN/  PLT-AUTO | The selection between PLT-MAN and PLT-AUTO is based upon the last selection made at any of the workstations in the SCADA network or the local Operator Interface. Switching from PLT-AUTO to PLT-MAN will provide a bumpless transfer of the device operation. Switching from PLT-MAN to PLT-AUTO may cause the device to operate if the device is required to start/stop by the PLC automatic device logic. |
| BACKUP CONTROL | Backup control is available for the sewage lift pumps. They will operate outside of the PLC control automatically. This is done to provide redundant control in parallel with PLC control through the use of a hardwired level sensing device with relays that correspond to wetwell level hardwired into the pump circuit. Backup AUTOMATIC control is only active when a device is in REMOTE and the hardwired control operation range is set outside the normal operating range of the PLC such that they would not normally interfere with each other. |

## Analogs

### Analog Alarms

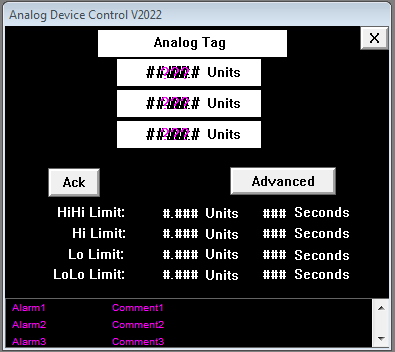
Analog alarms indicate a condition when a measured value has exceeded or fallen below an Operator defined range. Unless noted otherwise, the following virtual alarm points are provided for each analog signal:

1. HiHi;
2. Hi;
3. Lo;
4. LoLo; and
5. Signal Error Alarm.

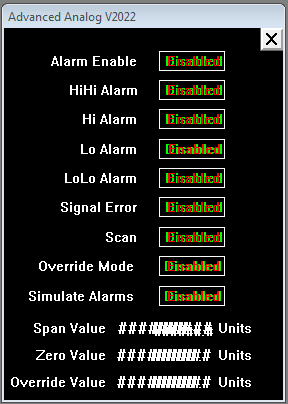
### Analog Pop-Up

Each analog in the system has an associated Analog Device Control pop up and an Advanced Analog pop up display. These pop ups give expanded information regarding the Analog and allows the Operator to adjust the alarm threshold limits, enable and disable each alarm, tank the instrument of scan and and control a few other parameters.

Pop-Up: 4.2.2‑1 Analog Instrument Dialog Box



Pop-Up: 4.2.2‑2 Advanced Analog Instrument Dialog Box



Each analog in the system has alarm limits that trigger analog alarms whenever the analog value passes through a threshold level. The four analog thresholds or alarm limits are HiHi (High-High), Hi (High), Lo (Low) and LoLo (Low-Low). Each of these will generate an analog limit alarm that will be indicated on the analog pop-up. Along with these four standard analog alarms is a fifth alarm - signal error that indicates a problem with the analog field transmitter.

In certain circumstances it is not required or desirable to have all of the above-mentioned analog alarms active. In addition to the data entry field for the analog alarm limits there are enable / disable button that allow the Operator to enable or disable specific alarms. Once an associated analog alarm with a critical priority has been disabled, an entry will be made to the disabled critical alarm summary such that the Operator will be fully aware of all disabled critical analogs alarm in the system.

Once an analog display is selected the alarm limits pertaining to that analog will be shown in a display pop-up. On this display the Operator can adjust the alarm limits to suit the normal operations of the process. The following list summarizes the information displayed on the analog pop-up.

1. Device Tag
2. Current device reading along with engineering units
3. Acknowledge push button (to clear return-to-normal alarms)
4. Advanced push button (to control the operation of the analog alarms for this particular analog instrument

When the advanced push button is pressed, a configuration screen will be displayed that allows the Operator to control the operation of the alarm system for the selected analog device. The following information can be adjusted by the Operator from the advanced screen:

1. Alarm Enable (disable all alarms for this analog);
2. HiHi Alarm (disable only the high high alarm limit for this analog);
3. Hi Alarm (disable only the high alarm limit for this analog);
4. Lo Alarm (disable only the low alarm limit for this analog);
5. LoLo Alarm (disable only the low low alarm limit for this analog);
6. Signal Error (disable limit checking for this analog);
7. Scan (disable processing of this analog);
8. Override (overrides the current analog value with the entered override value); and
9. Engineering Units (set the engineering span for this analog).

The Operator must have sufficient security rights in order to affect any changes on the above-mentioned screens. The ‘X’ button at the top right of each of these screens will dismiss the screen to allow the Operator to view the original process screen.

## Analog Statistical Calculations

*There are provisions in the analog driver in the PLC program to calculate the analog values listed below. However, HMI tags are to be created only for those signals that need to be displayed in the HMI or those that need to be logged in the Historian. Analog statistical calculations need to be reviewed for each analog signal and a determination made as to what values are required*:

The following values are calculated in the analog driver portion of the PLC program. HMI tags will only be create for those tags that are listed in the tables in Section 5 of this narrative.

1. Total Today;
2. Total Yesterday;
3. Maximum Today;
4. Maximum Yesterday;
5. Minimum Today; and
6. Minimum Yesterday.

## Pump / Motor Device Driver

The Pump / Motor Devices are configured as follows:

### Pump / Motor Device Virtual Points

Unless noted otherwise, the following virtual points are provided for each Pump / Motor device that is controlled through the PLC.

1. PLT-AUTO Status;
2. PLT-MAN Status;
3. Control Mode;
4. PLT-MAN Start Request;
5. PLT-MAN Stop Request;
6. Alarm Reset;
7. Runtime Reset;
8. Runtime; and,
9. PLT-MAN Speed set point (if applicable).
10. PLT-MAN Stroke set point (if applicable)

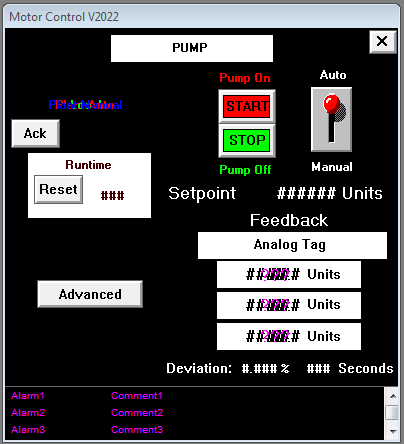
### Pump / Motor Device Alarms

The following virtual alarm points are to be provided for each pump/motor device that is monitored and/or controlled through the SCADA system:

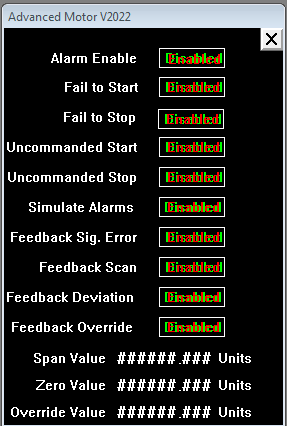
1. Fail to Start;
2. Fail to Stop;
3. Uncommanded Start;
4. Uncommanded Stop;
5. Speed Deviation Alarm (variable speed only); and
6. Stroke Deviation Alarm (if applicable).

## Pump / Motor Control

Pop-Up: 4.5‑1 Pump / Motor Control Dialog Box



Pop-Up: 4.5‑2 Advanced Pump / Motor Control Dialog Box



The pump device control dialog box allows the Operator to control the operating mode, operations and alarming of any controlled pump device in the system.

The pump control dialog box has the following information links:

1. Pump name;
2. Current pump operating mode (Plant Manual / Plant Auto / Local);
3. Pump status (Pump On / Pump Off); and
4. Pump alarm summary.

The pump control dialog box has the following control links:

1. Manual / Auto mode selector;
2. Start / Stop pump request;
3. Speed set point (if applicable);
4. Speed deviation alarm limit and delay control (if applicable);
5. Alarm acknowledge request;
6. Pump runtime reset request;
7. Advanced push button (to control the operation of the virtual alarms and speed feedback for this device); and,X – Close control dialog box.

All device control request links on the pump control dialog box relate to the manual operation of the pump are only visible when the pump is in the Plant Manual mode. These links are invisible when the pump is either in Local mode or in Plant Auto mode.

The device alarm summary for a pump will show any alarms related to the operation of the pump. This is accomplished by displaying only alarms in the alarm group related to the pump in question. The alarm list will include any alarms generated by or related to the operation of the pump.

When the advanced push button is pressed, a configuration screen will be displayed that allows the Operator to control the operation of the alarm system for the selected motor device. The following information can be adjusted by the Operator from the advanced screen:

1. Alarm Enable (disable all virtual alarms for this device);
2. Fail to Start (disable only the fail to start alarm for this device);
3. Fail to Stop (disable only the fail to stop alarm for this device);
4. Uncommanded Start (disable only the uncommanded start alarm for this device);
5. Uncommanded Stop (disable only the uncommanded stop alarm for this device);
6. Simulate Alarms (only visible to users with contractor-level access. Simulates each virtual alarm in turn after a five-second delay);
7. Feedback Sig. Error (only visible for VFD devices. Disable processing of the speed feedback for this device);
8. Feedback Scan (only visible for VFD devices. Disable processing of the speed feedback for this device);
9. Feedback Deviation (only visible for VFD devices. Disable the setpoint deviation alarm for this device);
10. Feedback Override (only visible for VFD devices. Overrides the current speed feedback with the entered override value); and
11. Engineering Units (only visible for VFD devices. Set the engineering span for the speed feedback).

The Operator must have sufficient security rights in order to affect any changes on the above-mentioned screens. The ‘X’ button at the top right of each of these screens will dismiss the screen to allow the Operator to view the original process screen.

## Valve Device Driver

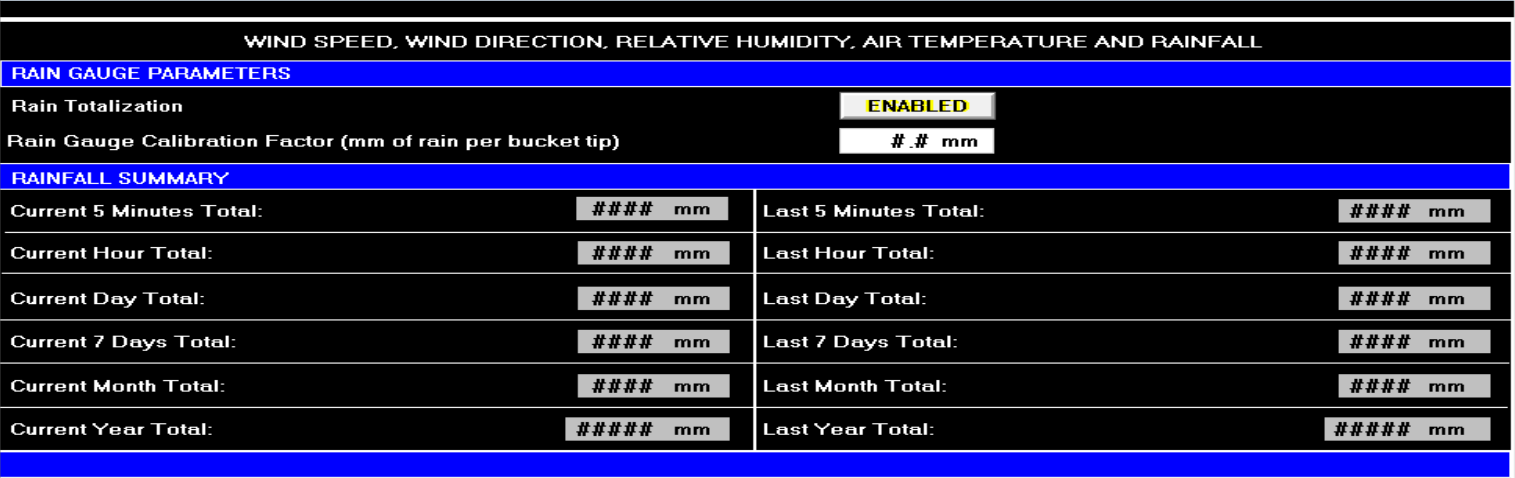
There are no controllable valves at this station.

## Rain Gauge

If there is no rain gauge at this location then remove this section

The HMI window below is used to enable and disable the rain gauge totalization and to calibrate the rain gauge that is installed at this wastewater pumping station. Rain fall is totalized every 5 minutes, every hour, every day, every 7 days and for the year. There are no alarms associated with the rain gauge.

Pop UP: 4.8‑1 Rain Gauge Control Dialog Box



# Process Equipment and Instrumentation

## Equipment

The major equipment associated with the XXX Pumping Station is summarized in the following table.

Table: 5.1‑1 Equipment List

| **EQUIPMENT DESCRIPTION** |
| --- |
| Sewage Lift Pump No.1 (FVNR) |
| Sewage Lift Pump No.2 (VFD) |
| Manual Transfer Switch |
|  |
|  |
|  |

## Instrumentation

The major instrumentation associated with the XXX Pumping Station is summarized in the following tables.

Table:5.2‑1 Discrete Instrumentation List

*This table should only include discrete instrumentation. This is not a list of alarms. Do not include alarms that come from devices that are instrumentation such as UPS, transformers, generators, Backup Control Panels etc.*

|  |
| --- |
| **DISCRETE INSTRUMENTS DESCRIPTION** |
| Wetwell 1 HIHI Level Float |
| Overflow High Level Float |
|  |
|  |
|  |

Table:5.2‑2 Analog Instrumentation List

| **ANALOG INSTRUMENT DESCRIPTION** |
| --- |
| Wetwell 1 Primary Level Transmitter |
| Wetwell 1 Backup Level Transmitter |
| Station Flow |
| Wetwell Overflow Flow Meter |
| Forcemain Pressure |
| Diesel Fuel Level |
| Pump 1 Speed |
| Pump 1 Motor Current |
| Pump 2 Speed |
| Pump 2 Motor Current |

*Most analog instrument do not require the values to be totalized or minimums and maximums displayed such as level transmitters, speed indicators or motor current. The consultant is to prepare a table as shown below only for the instruments that require a totalized value or minimums and maximums to be displayed on the HMI.*

The tables below show only those instruments that will have totalization tags or minimum and maximum tags displayed on the HMI.

Table:5.2‑3 Wetwell 1 Primary Level Transmitter

|  |  |  |
| --- | --- | --- |
| **STATISTICAL TAG** | **REQUIRED (YES/NO)** | **LOGGED (YES/NO)** |
| Total Today | No | No |
| Total Yesterday | No | No |
| Maximum Today | Yes | Yes |
| Maximum Yesterday | Yes | Yes |
| Minimum Today | Yes | Yes |
| Minimum Yesterday | Yes | Yes |

Table:5.2‑4 Wetwell 1 Back-up Level Transmitter

|  |  |  |
| --- | --- | --- |
| **STATISTICAL TAG** | **REQUIRED (YES/NO)** | **LOGGED (YES/NO)** |
| Total Today | No | No |
| Total Yesterday | No | No |
| Maximum Today | Yes | Yes |
| Maximum Yesterday | Yes | Yes |
| Minimum Today | Yes | Yes |
| Minimum Yesterday | Yes | Yes |

Table:5.2‑5 Station Flow

|  |  |  |
| --- | --- | --- |
| **STATISTICAL TAG** | **REQUIRED (YES/NO)** | **LOGGED (YES/NO)** |
| Total Today | Yes | Yes |
| Total Yesterday | Yes | Yes |
| Maximum Today | No | N/A |
| Maximum Yesterday | No | N/A |
| Minimum Today | No | N/A |
| Minimum Yesterday | No | N/A |

Table:5.2‑6 Wetwell Overflow

|  |  |  |
| --- | --- | --- |
| **STATISTICAL TAG** | **REQUIRED (YES/NO)** | **LOGGED (YES/NO)** |
| Total Today | Yes | Yes |
| Total Yesterday | Yes | Yes |
| Maximum Today | Yes | Yes |
| Maximum Yesterday | Yes | Yes |
| Minimum Today | Yes | Yes |
| Minimum Yesterday | Yes | Yes |

## Wetwell

Wetwell is an underground cylindrical concrete tank where sewage is fed into and stored. The well is equipped with electrical instrumentation to detect the level of sewage present.

## Sewage Lift Pumps

Sewage lift pumps are used to pump sewage from the wetwell through the forcemain and onto the associated WWTP.

Table:5.4‑1 Pump Capacity

|  |  |  |  |
| --- | --- | --- | --- |
| **PUMPS** | **PUMP SIZE** | **PUMP SIZE** | **MINIMUM FLOW** |
| Pump 1 | TBD | TBD | TBD |
| Pump 2 | TBD | TBD | TBD |

# Control philosophy

## Modes of Operation

The modes of operation for the major equipment associated with the XXX Pumping Station are summarized in the following table. Local Manual and Remote operation is through operation of local pushbuttons and controls at the device itself or from the equipment MCC panel. Remote operation of equipment is through the SCADA system.

Table:6.1‑1 Modes of Operation

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **EQUIPMENT DESCRIPTION** | **LOCAL** | **REMOTE (PLANT MANUAL)** | **REMOTE (PLANT AUTO)** | **HARDWIRED CONTROL** |
| Sewage Lift Pump No.1 (FVNR) | √ | √ | √ | √ |
| Sewage Lift Pump No.2 (VFD) | √ | √ | √ | √ |
| Manual Transfer Switch | √ |  |  |  |

## Interlocks

The hardwired interlocks at the station are intended to prevent damage to the equipment. The following interlocks are hardwired in the pump control circuit.

1. Overload Fault;
2. Pump Ready Signal;
3. VFD Fault;
4. High Temperature Fault (if installed);
5. Leakage Fault (if installed); and
6. Emergency Stop.

*Consultant to adjust the list above according to the design*

All interlocks immediately shut down the associated pump in all modes and generates an alarm on the SCADA system. The associated alarm can be reset from a local reset pushbutton located on the MCC or pump panel.

## Backup Control Mode

The Backup Control Mode will operate outside of the PLC control parameters through the use of a secondary wetwell level transmitter (utilizing a pressure transducer), relays, process feedback, and other forms of external triggers to activate the pumps. Backup control is only active when a pump is in REMOTE mode but it is independent of PLT-MAN and PLT-AUTO mode. Each pump is provided with a start and stop relay that provides both the initial command to transfer to Backup Control Mode and to control the individual pump in Backup Control mode.

When either the start or stop hardwired level relay for any pump is tripped, an input to the PLC is activated and maintained until the Operator pushes the hardwired RESET pushbutton. A Backup System Active alarm will be generated on the SCADA system whenever the pump station is operating in Backup Control Mode. Whenever this alarm is active, the PLC will be inhibited from controlling any of the pumps and therefore it will not initiate any start or stop commands regardless of the wetwell level.

Variable frequency or speed drive pumps are hardwired to automatically run at a pre-set speed whenever the pump station is operating in Back-up Control Mode. Contacts from the “on backup” relay are wired to the “pre-set speed” digital input on the VFD. The pre-set speed is configured in the VFD settings and will be determined on site.

In this mode the pumps are not assigned a duty; the pumps will start and stop based on the setpoints programmed into the secondary wetwell level transmitter. Pump 1 will have the lower start level and therefore would start first. See Appendix B for the actual Backup Control Mode start and stop levels for each pump. On rising wetwell level, Pump 1 will start when its start level relay activates and will continue running until the wetwell level falls below the Pump 1 stop level relay, at which time it will stop. If the level continues to rise to the point where Pump 2 start relay is activated, then Pump 2 will start and continue to run until the level falls below the Pump 2 stop relay. This cycle will continue until the hardwired Backup System Active reset button located at the pump station is pressed by the Operator.

If at any time while operating in the normal mode of control the wetwell level drops below any hardwired Stop Level relay setpoint, operation of ALL of the pumps will automatically switch to Backup Control Mode and the PLC will no longer control the pumps. The pumping operation will continue in this mode until the issue has been resolved and the hardwired Backup System Active reset button located at the pump stations is pressed by the Operator.

The backup level transmitter is a pressure sensor (HART communication protocol enabled) utilizing a Siemens Milltronics 200 transmitter with 6 output relays. The secondary wetwell level transmitter power is provided from a separate power source and has its own UPS to eliminate power issues from affecting the pumping operation. Note that the ultrasonic wetwell level transmitter is not used in the backup circuit and is used for PLC control and alarming only.

Under normal operating conditions the Station Level is controlled by the Primary Milltronics and ultrasonic level transmitter. The start & stop setpoints, as well as the duty control are directly adjustable from the HMI to the station PLC. If the level measured within the local station deviates outside the normal operational range, the Backup Panel via the backup Milltronics utilizing a pressure probe, will trigger a relay that latches in the backup control panel. This Backup Status will signify the station is on backup control and the PLC will be inhibited from normal REMOTE control until both the level is within the normal range and the local reset push button is set. LOCAL control remains available and is not affected by the backup system. While on backup mode, the start and stop level for a specific pump are governed by the Milltronics programmed levels, which are not adjustable from the PLC or the HMI. The Milltronics unit is capable of controlling both pumps. The speed select for the pump will use a designated VFD input which is intended to operate the pump at full speed (unless otherwise noted). This speed setpoint is controlled via the VFD potentiometer interface and is not normally adjusted unless the station is not operating normally while in backup mode.

*Consultant to remove the sentence above if pumps are not VFD driven.*

The backup strategy uses the same high start level and low stop level strategy that the PLC uses. If the backup panel is powered off or the equipment remains in LOCAL, the backup system in incapable of operating the pump.

The backup system uses a standalone panel with an independent UPS to ensure the pumps continue to operate while power may be off to the control panel. The system also has a high level float for alarming purposes.

## Local Control

All pumps are equipped with a LOCAL-REMOTE selector switch mounted at the MCC or local to the device. In the LOCAL position, the pumps are operated through the START/STOP pushbuttons at the MCC. Both pumps have an E-STOP mounted within the electrical enclosure along side the local pump controls.

## Remote Control

*The pump station may have constant speed pumps, VFD pumps or a combination. This section of the narrative needs to be updated according to the pump configuration. A sample narrative has been provided for a pump station with 4 constant speed pumps and a pump station with 4 variable speed pumps. The consultant is to use the samples provided as a starting point and update the narrative to match the specific conditions of the pump station and remove any text that is not relevant.*

In the REMOTE position, the pumps are controlled through the PLC in either PLT-MAN or PLT-AUTO mode. In the PLT-MAN mode, the Operator can start/stop the pumps through the SCADA system.

In the PLT-AUTO mode, the start/stop of the pumps is based on wetwell level and Start/Stop setpoints defined by the Operator. The pumps are started and stopped automatically based on the wetwell level setpoints. The wetwell ultrasonic level transmitter signal (4-20 mA) is scaled within the PLC according to the wetwell size. When the level rises to the Duty 1 start level setpoint, the Duty 1 pump starts. When the level increases to the Duty 2 start level setpoint, the Duty 2 pump starts. When the level drops to the Duty 2 stop level setpoint, the Duty 2 pump stops. When the level drops to the Duty 1 stop level setpoint, the Duty 1 pump stops. This cycle will continue as the wetwell level rises and falls.

## Control Parameters

Pop UP: 6.6‑1 Pumping Station Control Parameters



Graphics to be updated with design. Sample graphic included as a place holder.

1. For each Pump, there is the ability to enter Start and Stop level setpoint (in %).
2. The LIT number of the Duty Level Transmitter (used in auto control of the pumps).
3. There is an option to Enable or Disable the Security system. The selected choice will be displayed in green or magenta.
4. The Timed Duty Rotation section will display the number of days and amount of time that the system has been in a particular duty rotation mode.

The PLC program carries out the error check for the duty pumps level setpoints when updating the level setpoints from HMI entry. Setpoints are transferred via the Setpoint Update button on the associated screen. If an error occurs with the Operator entered start and stop levels an error message is displayed on the setpoint entry screen. The original Setpoints remain unchanged. All Start/Stop levels are separated from each other by a dead band which is not adjustable via the SCADA system or local HMI. The minimum dead band will be 5%, unless it is indicated during commissioning that it needs to be changed. Level Setpoints are limited within the pump station PLC error checking logic to be within a specific percentage of span.

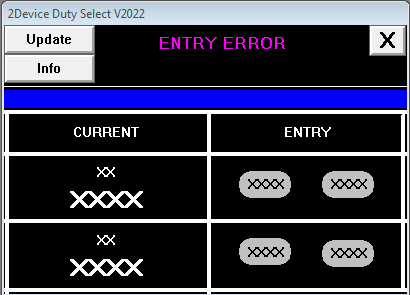
## Pump Duties

Note that if the pump station is in back-up mode, the duties of the pumps are hardwired and they cannot be altered using duty rotation through the SCADA system or PLC.

### Manual Pump Duty Rotation

Under normal operating conditions, the duty table can be updated manually by the Operator to set a designated pump in a specific duty in the duty table. The Operator selects the desired duties and presses the Update button. The PLC error checking logic will ensure that no two pumps are assigned the same duty position. If they are, Error Entry will flash on the Pumping Station Duty Pump Select pop-up. The Operator will then have to correct the duty selection and press the Update button again.

Pop UP: 6.7‑1 Manual Pump Duty Selection



### Automatic Pump Duty Rotation

When the duties are rotated automatically by the PLC and all pumps are in PLT-AUTO and none of the pumps have failed, the pump assigned to duty 1 will be assigned to duty 2, and the pump assigned to duty 2 will be assigned to duty 1.

When the duties are rotated automatically by the PLC and all pumps are in PLT-AUTO and none of the pumps have failed, then each pump will move up one position in the duty table. The pump assigned to duty 1 will be assigned to duty 2.

The Operator can choose to disable the automatic duty rotation by selecting “Disabled” on the Pumping Station Duty Rotation pup-up. This mode prevents the pumps from rotating under all circumstances including on a pump failure. The Operator can choose to have the pump duties rotated automatically. This is done by selecting one of the 3 automatic modes for duty rotation. Those modes are:

Disabled

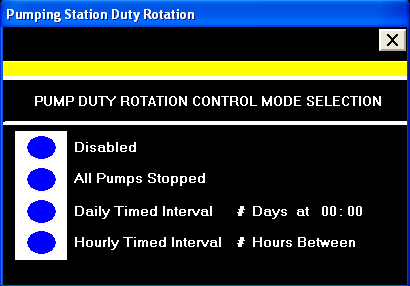
All Pumps Stopped,

Daily Timed Interval or

Hourly Timed Interval.

All pumps must be in PLT-AUTO for the automatic rotation to occur.

Pop UP: 6.7‑2 Pumping Station Duty Rotation



1. Disabled Mode: In this mode the pump duty does not automatically rotate even on a pump failure.
2. All Pumps Stopped Mode: Duty is rotated at the moment when all pumps are stopped.
3. Daily Timed Interval: Duty rotation will be based on a time interval setpoint that is entered from the HMI. The Operator can select a time setpoint between 0-10 days, as well as time of day (0-23 hours and 0-59 minutes). In this mode, when the interval time has elapsed, the pump selected to Duty 2 will change to Duty 1, and the Duty 1 pump will change to Duty 2 immediately.
4. Hourly Timed Interval: Duty rotation will be based on a time interval setpoint that is entered from the HMI. The Operator can select a time setpoint between 0-24 hours in one hour increments. In this mode, when the interval time has elapsed, the pump selected to Duty 2 will change to Duty 1, and the Duty 1 pump will change to Duty 2 immediately. Timer restarts immediately from the last time the mode was selected and/or upon completion of a duty rotation.

### Pump Failure

If one of the pumps fails, it will trigger a duty rotation. If the failed pump is duty 1, it will be moved to duty 2 and the other pump will become duty 1.

## Wetwell Level Transmitter Duties

This section is not applicable as there is only one LIT (backup LIT is not used for PLC automatic control).

## Station Discharge Flow

*The pump station will either have a fixed flow meter or a virtual flow meter or no flow meter at all. If it is a virtual flow meter then the details below must be included in the narrative. Virtual flow meters can only be used a stations with constant speed pumps.*

### Virtual Flow Metering

The Region has developed a PLC algorithm to estimate the flow at the station. This method of monitoring flow cannot be used in stations where variable speed drives have been installed. The purpose of the virtual flow meter is to provide an inexpensive method for measuring flow total at pumping stations. This is accomplished by repeatedly carrying out a draw down test to measure the incoming flow. This method requires the PLC to calculate the volume of wastewater between the Duty 1 Start and Stop points.

The calculation is: **Volume of the Well = (D1 Start Setpoint– D1 Stop Setpoint) \* Area of the Well**. The area of the wetwell needs to be determined and is a hard-coded value. When the Duty 1 Stop is activated, a timer starts calculating the time it takes to fill the well to the Duty 1 Start point (Time to fill the Well). Since this is a known volume, the rate of flow into the well can be calculated by dividing the volume by the time it took to fill the well. Therefore the **Flow Rate into the Well = Volume of the Well / Time to fill the Well.**

This Flow Rate into the Well is compared to previously recoded Flow Rate into the Well, to see if it is today’s maximum value or today’s minimum value and it is recorded as such if it is.

Once the Duty 1 Start is activated, another timer is begins recording the time it takes to empty the well (Pump down Time). This time multiplied by the Flow Rate into the Well provides the volume of sewage that entered the well while pumping it down. Adding this volume to the known volume between the Start and Stop setpoints provides the total volume pumped during that pump cycle.

**Total Volume Pumped Last Cycle = (Pump Down Time \* Flow Rate into the Well) + Volume of the Well**

Each pump cycle volume is added to the total flow for the day. At midnight, today’s total, today’s minimum and today’s maximum Flow Rate into Well is transferred over to yesterday’s total, yesterday’s minimum and yesterday’s maximum Flow Rate into Well respectively. Then today’s total, today’s minimum and today’s maximum Flow Rate into Well is reset to zero.

Similar to all analog signals the tags in Table 5.2-5 will exist related to the pump station flow.

Table:6.9.1‑1 Station Flow Statistics

| **Statistics** | **Range** |
| --- | --- |
| Minimum Today | 0\_-\_\_ m3/day |
| Minimum Yesterday | 0\_-\_\_ m3/day |
| Total Today | 0\_-\_\_ m3 |
| Maximum Today | 0\_-\_\_ m3/day |
| Maximum Yesterday | 0\_-\_\_ m3/day |
| Total Yesterday | 0\_-\_\_ m3 |

## Station Overflow Flow

*This section is to be updated according to the type of overflow measurement that is at the pump station.*

*Manning’s Equation*

The equation requires knowledge of several physical parameter inputs as part of the equation.

**Calculation of overflow rates in wastewater pumping stations using circular pipes**:

1. Water level (WL): invert elevation ≤ WL ≤ obvert elevation (Manning’s formula)

*h1* = height of water above the overflow invert

1. h1  ≤ r = D/2 (open channel flow and assume flow is uniform)

central angle (α in degrees): α = 2cos-1

cross-sectional area (*A*): 

wetted perimeter (*P*):

hydraulic radius (*R*): 

Figure 6‑1 Water Level Geometry



1. h1 > r (open channel flow and assume flow is uniform)

central angle (α *in degrees*): *α* = 360o - **

*where* complementary angle (* in degrees*): 

cross-sectional area (A) : 

wetted perimeter (P):

hydraulic radius (R): 

1. h1 > d (open channel flow and assume flow is uniform)

A = area of the cross-section (full) =

P = wetted perimeter =*2πr*

*R = A/P = r/2*

1. Manning’s formula

*Q = A* *R2/3 S1/2*

Where:

*Q* = overflow rate, m3/s

*A* = cross sectional area of the overflow (wastewater), m2

*D* = diameter of the overflow pipe, m (convert from mm to m)

*P* = wetted perimeter of the pipe, m

*R* = hydraulic radius, m = *A/P*

*n* = Manning’s roughness coefficient; for concrete pipe, typically n=0.015

*S* = is the bed slope of the overflow pipe

References:

1. New Hampshire Manual on Drainage Design for Highways

2. US Dept. of Interior Geological Survey Circular 376, Computation of Peak Discharge at Culverts, 1957.

The Manning Formula is implemented in the Virtual Overflow AOI, with an output flow of m3/s. This is the raw signal for the Overflow analog driver, which will convert the signal to L/s for display on SCADA. The Overflow Report AOI is used in conjunction with the Analog Driver to generate required reporting information when an overflow occurs. This information is to be displayed using the “SPS Overflow Report” Screen on the HMI.

*Weir Overflow Equation*

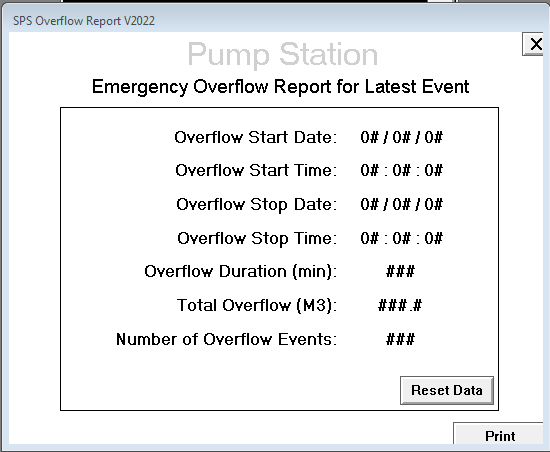
*If the pump station uses a weir to measure the overflow from the station, the consultant is to remove the manning formula above and provide the calculations that will be used to calculate the flow over the weir.*

## Overflow Report

When an overflow is detected and the PLC starts to measure the overflow, an overflow report will be generated and displayed on the HMI. The report will display the parameters shown on the SPS Overflow Report window as shown below.

The Manning Formula or weir overflow calculation is implemented in the Virtual Overflow AOI, with an output flow of m3/s. This is the raw signal for the Overflow analog driver, which will convert the signal to L/s for display on SCADA. The Overflow Report AOI is used in conjunction with the Analog Driver to generate required reporting information when an overflow occurs. This information is to be displayed using the “SPS Overflow Report” Screen on the HMI.

HMI Screen: 6.11‑1 Pump Station Overflow Report



# Alarm Management

There are 5 main components within the SCADA system that play a role in alarm management. They are the station PLC, the InTouch application, the plant Auto dialer PLC and the Auto dialer. Each component has a different role in the determination, annunciation, communication, acknowledgement and resetting of alarms.

1. The primary purpose of the station PLC is to examine certain conditions as dictated by the programming and make the determination if an alarm exists.
2. The HMI (InTouch application) has many purposes, which include the annunciation, display and filtering of alarms and their states, a tool to allow the Operator to acknowledge alarms, determine if an alarm is critical or not, and a tool to allow the Operator to enable and disable Raw Alarms, Call-out alarms and the Auto dialer itself
3. The plant Auto dialer PLC passes alarms to the auto dialler and acknowledges alarms sent to the auto dialler.
4. The Auto dialer is the device that annunciates the alarms to the Operators via the phone line.

## Alarms

*Alarm priorities are to be assigned by referring to Section 2 of the Region’s standards and the HMI tag template Excel Spread sheet that is in Section 6- HMI Programming.*

Almost all alarms are generated by the PLC. The alarms listed below are not generated by the PLC and are generated by the HMI instead.

Table: 7.1‑1 Alarms Generated by the HMI

|  |
| --- |
| **Alarms Generated by the HMI** |
|  |
|  |

*Consultant to list and describe any alarms that are generated in the HMI and not in the PLC*

All alarms generated by the PLC have a Raw Alarm component and the Dial-out component. Both components can be enabled or disabled using the alarm enable and disable windows in the HMI Section 7.5 for more information Alarm conditions are first evaluated at the raw alarm state. If the PLC determines that a raw alarm exists, it is annunciated on the HMI. If the dial-out alarm is enabled the alarm will be sent to the auto dialer PLC and then to the auto dialer to call out to the operations staff as per the auto dialer programming. If an alarm condition exists but the raw alarm is disabled, nothing will be annunciated on the HMI and the alarm will not be passed to the auto dialer PLC

*Consultant to identify which auto dialer PLC the alarms are being sent to-PLC WDN1 or WDS1*

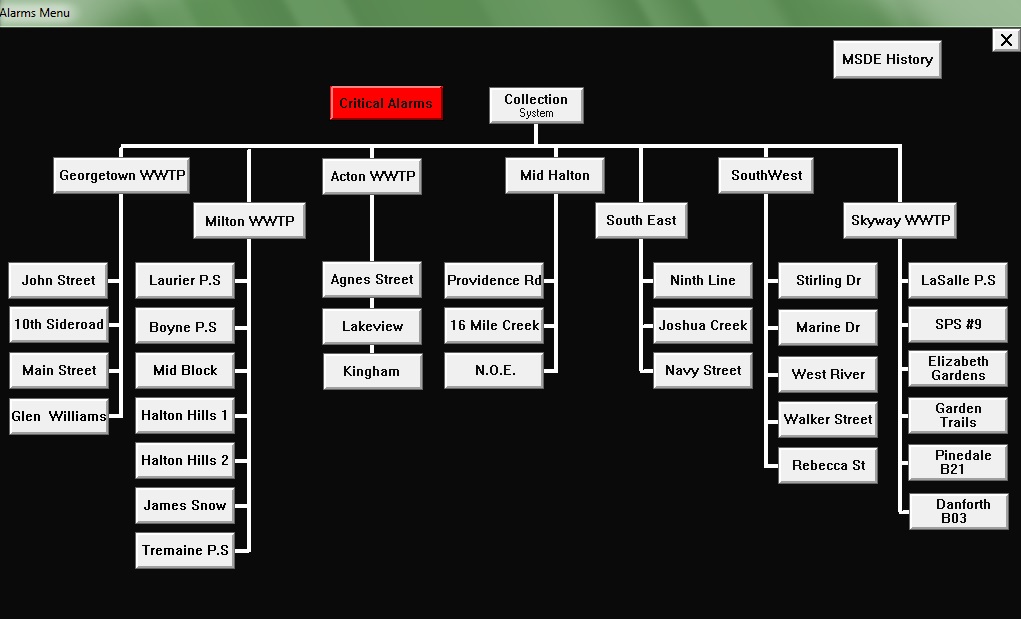
## Critical Alarm

Alarm priority determination is carried out at the HMI level and not in the PLC. When the tag in the InTouch application is created, one of the fields that must be filled-in is the Alarm Priority. These priorities range from 1 to 499. The Region’s standard is that all alarms with a priority of 9 or less are considered Critical Alarms. The alarm priority setting has no impact on the raw alarm or the call out alarm.

## Alarm Groups

The graphic below shows the organization of the alarm groups.

HMI Screen: 7.3‑1 Navigation for the Alarm Grouping

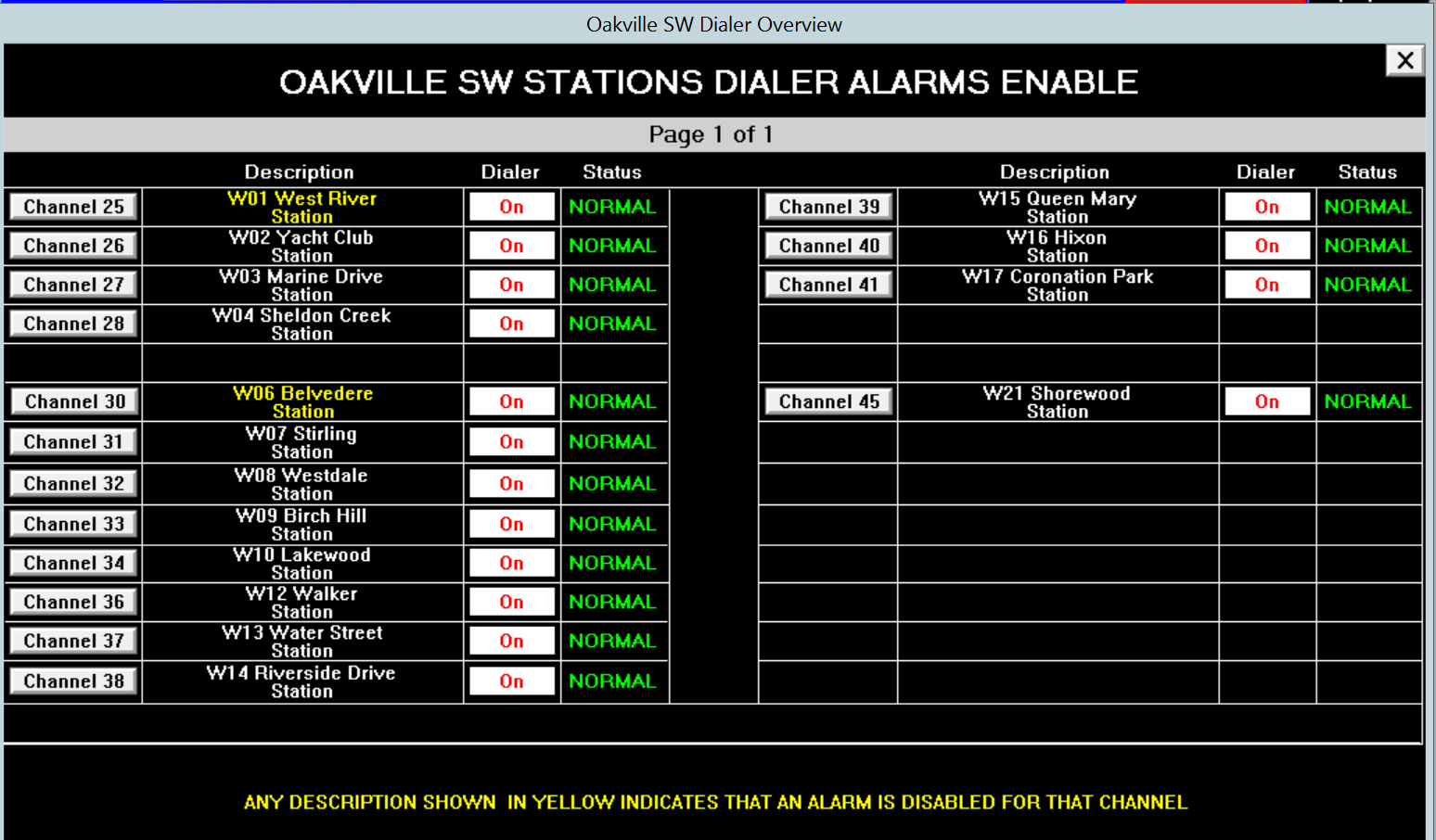


*Update the window above and replace the example*

## Auto Dialer

The pump station uses channel XY on the north/south auto dialer. If any of the call-out alarms are active, the Auto dialer will call-out. Clicking on the Dialer button on the options menu brings up the auto dialer menu that lists the drainage areas. Clicking on the appropriate drainage area brings up the appropriate dialer overview window. From this window, the pump station’s channel can be disabled. Disabling the channel will prevent any alarms that are associated with this channel from being sent to the auto dialer PLC which prevents the alarm from being a call out.

HMI Screen: 7.4‑1 Navigation for the Alarms Grouping



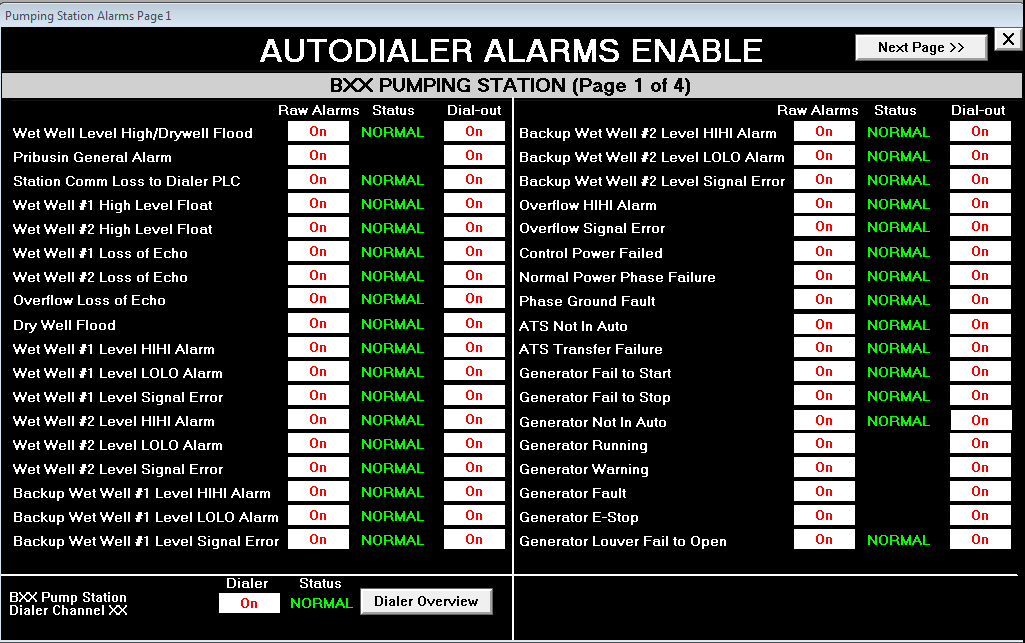
*Update the appropriate window and replace the example above*

## Auto Dialer Channel Enable/Disable Window

Clicking on the Dialer button on the options menu brings up the auto dialer menu that lists the drainage areas. Clicking on the appropriate drainage area brings up the appropriate dialer overview screen. Clicking on channel XY brings up the alarms page for the pump station

*Update the appropriate screens and replace the examples below.*

HMI Screen: 7.5‑1 Auto Dialer Channel Enable/Disable Window



*Update the appropriate window and replace the example above.*

In this case where there is more than one alarms enable screen for the process area, a “Next Page” button is provided at the top right of the screen to advance to the next page. On subsequent pages, there is ability for the user to return to the previous page through the “Previous Page” button provided at the top left of the screen.

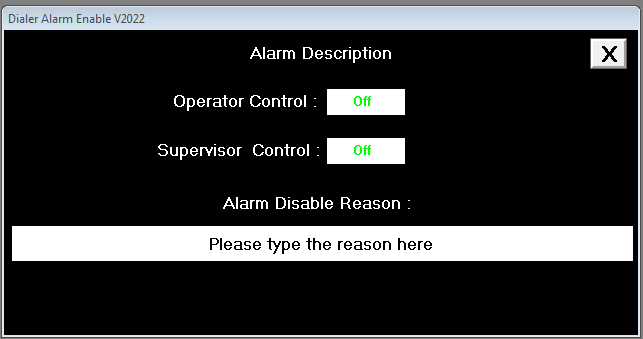
The alarms enable screens are used to enable and disable both the raw alarm and the dial-out alarm. Enabled state is represented by the “on” text and disabled state is represented by the “off” text on the screen. The “alarms” column disables the raw alarm and the “dial-out” column disables the alarms dial-out capability. Disabling the raw alarm will disable the alarm in the PLC logic, SCADA, and dial-out. Disabling the dial-out will only disable the dial-out ability of the alarm. When the dial-out is disabled, the raw alarm (if active) will continue to display on SCADA

.

The status column shows the raw alarm status. “Normal” will be displayed if the alarm is not active or disabled as a raw alarm. “Alarm” will be displayed if the alarm is active.

Virtual alarms for a device (pump, valve, etc.) do not have individual raw alarms that can be disabled/enabled.

HMI Screen: 7.5‑2 Dialer Alarm Enable Pop-up



The Operator Control will disable the Dial-Out and can be activated by users with Operator access and above.

Supervisor Control will disable the Dial-Out and can only be activated by users with Supervisor access and above. If an alarm is disabled by a Supervisor, it cannot be re-enabled by an Operator. Disabling the Supervisor Control will turn the Dial-Out Enable/Disable button yellow

Operators and Supervisors can also type a reason the alarm was disabled. This reason is stored per alarm and is not required to disable the Dial-Out.

# Fault Response

## Alarm / Fault Response.

The section below describes how various Alarms and Faults are responded to.

## PLC Faults

There are minor PLC faults and major PLC Faults. A major PLC fault causes the PLC to stop processing logic while a minor one does not. See below how the system will respond when a minor or major fault occurs.

### Minor PLC Faults

There are a variety of minor PLC faults that can occur. If any of them occur, an alarm will be annunciated on the SCADA system. The PLC will take no further action.

### Major PLC Fault or Catastrophic Failure

If a Major PLC Fault or Catastrophic Failure occurs**,** a PLC*{X} to PLC*{Y} Communication Alarm will be annunciated by the SCADA system. The PLC will be non-functional and will not be able to take any actions. Equipment will remain in its last state. When the level dictates, pump control will revert to Backup Control Mode. See Section 6.3 Backup Control for more details.

*Consultant needs to determine which equipment will maintain last state and which will not. Every piece of equipment must be analysed and a decision made on what the response will be when the PLC shuts down. The response of each piece of equipment must be detailed in this section of the narrative. For every modulating actuator determine if on the loss of a 4-20mA signal from the PLC to the actuator, the actuator will remain in last state, go closed or go fully open and document accordingly.*

## PLC Control Panel Power Failure

When power is lost to the control panel that the PLC resides in, the PLC and related instrumentation will continue to function as it will be powered by the UPS. The PLC program assumes that power has been lost to the equipment it is controlling and therefore the program prevents the PLC from trying to control the equipment. A Control Panel *{Name of PLC Here}* Power Failure Alarm will be annunciated on the SCADA system.

When the level dictates, pump control will revert to Backup Control Mode. See Section 6.3 Backup Control for more details.No further action will be taken by the PLC. If power is not restored, the UPS will eventually run out and the PLC will shut down. At that point a PLC*{X} to PLC*{Y} Communication Alarm will be annunciated by the SCADA system.

*Consultant needs to determine which equipment will maintain last state and which will not. Every piece of equipment must be analysed and a decision made on what the response will be when the PLC shuts down. The response of each piece of equipment must be detailed in this section of the narrative. For every modulating actuator determine if on the loss of a 4-20mA signal from the PLC to the actuator, the actuator will remain in last state, go closed or go fully open and document accordingly.*

## U.P.S. Failure

When the UPS fails, the PLC will lose power as the power for the PLC comes from the UPS. This will cause a Major PLC Fault or Catastrophic Failure. See Section 8.2.2 for the response to this failure

PLC Failure

## Communication Failure to the Pump Station

In the event of Communication Failure between the pump station PLC and North and South Collection’s Operation Center SCADA system, the pump station PLC will continue to run the station in automatic mode based on the last entered setpoints. A PLC*{X} to PLC*{Y} Communication Failure alarm will be generated through the *North/South* Auto dialer PLC at the *North/South* Collection’s Operation Center. The local station PLC will continue to collect data locally when communication fails. The parameters stored on five (5) minute intervals, are as follows:

1. Station Level;
2. Station Flow;
3. Station Overflow Flow Totalizer;
4. Pump Runtime (per pump); and
5. Station Flow Totalizer.

The data can be extracted from the PLC either locally or over the WAN once communications is restored.

## Wetwell Level Transmitter Failure

In the event of a level transmitter failure, an alarm is generated indicating that the transmitter has failed and that the PLC no longer has control of the wetwell pumps. The PLC will no longer try to start or stop any pumps and the pumps will remain in their last state. When the level dictates, pump control will revert to Backup Control Mode. See Section 6.3 Backup Control Mode for more details.

## Pump Failure

In the event of a pump failure an alarm is generated on the SCADA system. If the automatic duty rotation is not disabled, and Duty Pump 2 is in PLT-AUTO mode and there are no faults on the pump, then the duties will be rotated. If Duty Pump 1 fails to start or fails while running, Duty Pump 2 will automatically change to Duty 1. If Duty Pump 2 is not available in PLT-AUTO, no pumps will run. Operations staff must investigate and resolve the issue before normal pumping can resume. Likewise if Duty Pump 2 fails to start or fails while running, Operations staff must investigate and resolve the issue before normal pumping can resume. If the faults on either of the pumps are virtual faults and not hardwired.

When the wetwell level dictates pump control will revert to Backup Control Mode. See Section 6.3 Backup Control Mode for more details.

## Power Failure

In the event of a power failure all pumps would stop. An alarm will be generated on the plant SCADA system. The PLC and wetwell level transmitter would remain powered by the UPS for a period of time. All pump alarms and other failsafe alarms are masked out based on the fact that there is a power failure. If the pump station is equipped with a standby generator refer to Section 9 for its operation.

*Consultant to update this section and Section 9 below depending on whether the station has standby power or not.*

# STANDBY POWER

In the event of an extended power failure, a portable power source such as a portable standby generator must be brought to site to supply power to the station. A power failure alarm will be generated and will be displayed on the SCADA system.

Once the portable generator is connected to the station via the generator receptacle and power is manually transferred to generator power via the Manual Transfer Switch, the PLC and SCADA system or Backup Control Mode will control the pumps as normal.

When reliable utility power returns, operations will need to manually transfer power back utility power via the Manual Transfer Switch. During the transfer of the Manual Transfer Switch from portable generator to utility power, any running pumps will stop as no power is available during the brief period of the transfer.

## Modes of Control

The following table lists the modes of control associated with each piece of equipment in the Standby Power subsystem.

Table:9.1‑1 Modes of Control – Standby Power

| **EQUIPMENT TAG NAME** | **EQUIPMENT**  **DESCRIPTION** | **LOCAL** | **PLT-MAN** | **PLT-AUTO** | **HARDWIRED**  **CONTROL** |
| --- | --- | --- | --- | --- | --- |
| MTS1SG | Manual Transfer Switch | √ |  |  |  |

The standby power system consists of a Manual Transfer Switch (MTS) and a generator receptacle.

## Automatic Transfer Switch

There is no Automatic Transfer Switch (ATS) at this station. A Manual Transfer Switch (MTS) is provided to facilitate the connection of a portable generator.

## Diesel Generator

There is no permanent generator at this site. A portable generator must be brought to site to power the site during an extended power failure event.

## Control Logic

There is no Auto Control of the portable Diesel Generator from the PLC. The Diesel Generator is not monitored for any statuses or alarms. The following section describes the control logic for the station. All connections and power transfer to and from generator power must be done manually at the site. The sequence of operation is generally as follows.

1. At the Manual transfer switch, isolate the station from utility power by transferring MTS to Generator Power.
2. Plug in generator to generator plug. If at all unsure of the generator connection phasing, check phasing before connecting the generator to the station.
3. Place Pumps into LOCAL mode of control.
4. Start the Portable Generator and allow station power to ‘stabilize’.
5. Turn Pumps to Remote mode one at a time. Note that a pump may start automatically. If a pump starts right away, allow it to come to full speed and generator power to stabilize before switching the remaining pump to Remote mode.

When returning back to utility power, place the pumps in Local and stop the pumps. Switch the MTS to Utility power. Place pumps into Remote mode. Monitor the station to ensure pumps do operate properly on utility power.

*If there is a standby power system as this site then the consultant must refer to the standby power section in the Type III IV WWPS Standard Control Narrative (4 Pumps) which is located in Section 8 Wastewater Pumping Stations, Appendix 8A*

## Normal Operation

Normal operation of the stand-by power system is completely manual.

# HISTORICAL LOGGING and trending

## Trending

Unless noted otherwise, historical data logging and trending will be provided for the following list of signals:

1. Analog signals;
2. Equipment runtimes;
3. Pump Running Status
4. Any Analog signal statistical calculations determined by operations needed to be logged; and
5. Tags associated with the overflow reports.

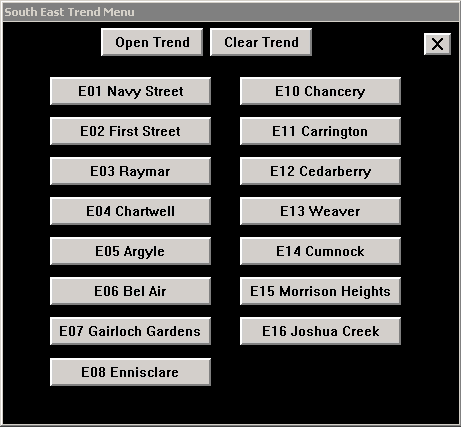
## Trend Navigation Buttons

Trends are accessed by clicking on Trends in the button bar which then brings up the list of drainage areas. Clicking on the appropriate drainage area then brings up the list of pump stations in that particular drainage area.

Pop UP: 10.2‑1 Trends Selection Pop-Up by Drainage Area



Pop UP: 10.2‑2 Trends Selection Pop-Up By Pump Station

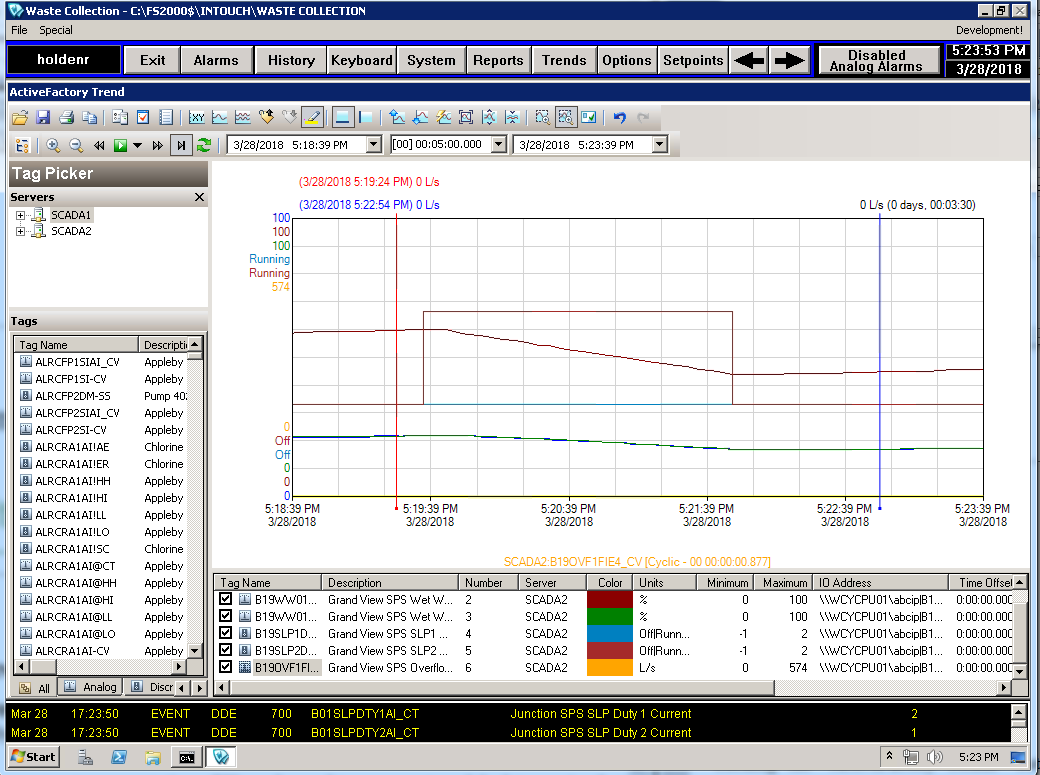


Graphics to be updated with design. Sample graphic included as a place holder.

Clicking on one of the trend buttons on a drainage area menu will bring up the trend for trend with the following tags on the trend:

1. Wetwell 1 primary wetwell level;
2. Wetwell 1 backup wetwell level;
3. On/Off status for pump 1;
4. On/Off status for pump 2; and
5. Discharge pressure.

HMI Screen: 10.2‑1 Active Factory Trend Screen



# Reporting

## Daily Reports

There are no standard daily reports

# BUILDING SERVICES SUBSYSTEM

*Consultant to update this section according to the design. The main thing to be aware of is does this station have a building or is it just an outdoor panel*

## Equipment

The major equipment associated with Building (Panels) Services subsystem of the XXX Wastewater Pumping System is summarized in the following table.

Table: 12.1‑1 Equipment List – Building Services

|  |
| --- |
| **EQUIPMENT DESCRIPTION** |
| Door /Hatch Switches |
| Panel Temperature Alarms |
| Smoke Detector |
| Panel Temperature Alarms (High and Low) |
| Uninterruptible Power Supply #1 (UPS1) |
| Uninterruptible Power Supply #2 (UPS2) |
| Redundant 24 VDC Power Supplies |
| Backup Control Panel 24VDC Power Supply |
| Control Panel Power Failure Relay |
| Key Switch |
| Illegal Entry Light |
| Security System Disarmed Light |
| Eye wash Active Alarm |

The PLC monitors the environmental conditions of the facility and monitors and controls the personnel entry and exit security in the station, as follows.

## Environmental Alarms

The facility building temperature is controlled automatically through hardwired temperature sensors. The PLC will not control the building temperature but will annunciate building environmental alarm conditions to operations through the HMI. A station temperature switch with both independent high and low temperature setting is provided for this purpose. Other field devices that generate environmental alarms on the SCADA system are indicated in Table 12.1.1 Equipment List – Building Services.

Emergency shower/eyewash stations are installed at the pump station. A contact incorporated within the emergency shower/eye wash station activates an alarm to the PLC and SCADA whenever the station is used.

## Building /Panels Security

Security is implemented through the SCADA system to monitor access to the facility. For facility security, switches are installed on all panel doors and wetwell hatches. Each door/hatch has its own input to the PLC. A key switch is installed at the facility which is an input to the PLC and allows authorized personnel to arm/disarm the security system using a key. There is an Illegal Entry indicator light and a Security System Armed indicator light on the PLC panel door.

### Entering the Facility/Panel with Security System Armed

When the security system is armed and the PLC sees one of the monitored doors or hatches open, it starts a 60 second timer. If the timer expires before the Operator disarms the security system by toggling the Key Switch, the PLC will generate an Illegal Entry alarm. The Illegal Entry indicator light on the PLC panel will be illuminated and the PLC will generate an alarm on the SCADA system. If enabled, the PLC will also generate a call out alarm. This alarm will remain active until the key switch is toggled to the disarm position.

### Leaving the Facility/Panel

Before leavening the facility the operator must toggle the key switch to arm the security system. This will illuminate the Security System Armed indicator light and it will start a 60 second timer in the PLC. While this timer is timing, the PLC will ignore the state of any of the door or hatch contacts. This gives the operator time to exit the facility without setting off any security related alarms. Once the timer has expired, the security system is armed.

## Heating, Cooling and Ventilation System

*The control of the heating and ventilation system is not done through the PLC. It is done through hard wired controls of through a heating, cooling and ventilation control system. The SCADA system will only monitor alarm states that result from failures of the heating, cooling and ventilation system or alarms from the heating, cooling and ventilation control system This narrative should give a description of how the heating, cooling and ventilation systems is to operate and be controlled. It should also list the alarms that will be monitored by the SCADA system.*

*The example below is for a station with a wetwell and drywell but no standby power system. This section will need to be adjusted to the particular details of the station.*

### Equipment

The following equipment areas are identified as having a heating, cooling and ventilation system at the Station.

1. Wetwell Area – Exhaust (EF-1/EF-2) and Supply Fans (SF-1/SF-2);
2. Dry Well Area – Exhaust (EF-3/EF-4) and Supply Fans (SF-3/SF-4);
3. Stair Well – Pressurization Fan (SF-8);
4. Electrical Room - Air Conditioner (EF-6/EF-7/SF-6/SF-7); and,
5. Utility Room (EF-8).

The following instrumentation is associated with the operation of the heating & ventilation system at the Station.

1. Thermostats; and
2. Temperature Controllers – Ventilation

In the Wetwell Area during normal operation the exhaust fan is OFF. During occupied periods the fan is to be turned ON by the Operator. The fan also operates whenever a high level of combustible gas is detected through hardwired interlocks.

In a Dry Well Area, unit heaters are operated to maintain space temperature and are controlled from a local thermostat.

In the Electrical Room a unit heaters, exhaust fans and an air conditioner are operated to maintain space temperature and are controlled from a local thermostat.

### Hardwired Interlocks

*Describe any hardwired interlocks between and of the system associated with heating, cooling and ventilating.*

## Combustible Gas Detection

The normal operation of the Combustible Gas system is to monitor the wetwell gas level. If the gas level in the wetwell rises above a specified limit, a warning alarm is generated and hardwired contact closes directing the wetwell exhaust/supply fan to run

If the gas continues to increase above a specified level, a Combustible Gas High alarm is generated on the SCADA system and a local alarm light is illuminated on the gas analyzer.

The Combustible Gas Analyzer constantly monitors the status of the wetwell gas sensor. If the sensor fails an alarm is generated on the SCADA system.

**APPENDICES**

**I/O LISTING**

Appendix A1 I/O Listing

| **PLC** | **RACK** | **SLOT** | **POINT/ CHAN.** | **TYPE** | **TAG NAME** | **DESCRIPTION** | **EVENT LOG** | **ALARM PRIORITY** | **DATA LOG** | **RANGE** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| XXX1 | 0 | 2 | 0 | DI | BXX\_SLP1\_DM1\_DI\_ST | Pump 1 Backup Start Relay | No | 10 | No | N/A |
| XXX1 | 0 | 2 | 1 | DI | BXX\_SLP1\_DM1\_DI\_SP | Pump 1 Backup Stop Relay | No | 10 | No | N/A |
| XXX1 | 0 | 2 | 2 | DI | BXX\_SLP1\_DM1\_DI\_CL | Pump 1 Control Mode | Yes | No | No | N/A |
| XXX1 | 0 | 2 | 3 | DI | BXX\_SLP1\_DM1\_DI\_SS | Pump 1 Running Status | Yes | No | Yes | N/A |
| XXX1 | 0 | 2 | 4 | DI | BXX\_SLP1\_DM1\_DA\_RA | Pump 1 Overload | No | 63 | No | N/A |
| XXX1 | 0 | 2 | 5 | DI | BXX\_SLP1\_DM1\_DA\_TA | Pump 1 Temp/Leakage | No | 58 | No | N/A |
| XXX1 | 0 | 2 | 6 | DI | BXX\_SLP1\_DM1\_DA\_ES | Pump 1 Emergency Stop | No | 63 | No | N/A |
| XXX1 | 0 | 2 | 7 | DI | BXX\_SLP1\_DM1\_DA\_DF | Pump 1 Not Ready | No | 95 | No | N/A |
| XXX1 | 0 | 2 | 8 | DI | SPARE |  |  |  |  |  |
| XXX1 | 0 | 2 | 9 | DI | SPARE |  |  |  |  |  |
| XXX1 | 0 | 2 | 10 | DI | BXX\_BPC1\_LM1\_DA\_RS | Pumps in Backup Mode | No | 50 | No | N/A |
| XXX1 | 0 | 2 | 11 | DI | BXX\_WW01\_LI1\_DA\_EL | Wetwell #1 Level Loss of Echo | No | 63 | No | N/A |
| XXX1 | 0 | 2 | 12 | DI | BXX\_WW01\_LE1\_DA\_HH | Wetwell #1 High Level Float | No | 61 | No | N/A |
| XXX1 | 0 | 2 | 13 | DI | SPARE |  |  |  |  |  |
| XXX1 | 0 | 2 | 14 | DI | SPARE |  |  |  |  |  |
| XXX1 | 0 | 2 | 15 | DI | SPARE |  |  |  |  |  |
| XXX1 | 0 | 3 | 0 | DI | BXX\_SLP2\_DM1\_DI\_ST | Pump 2 Backup Start Relay | No | 10 | No | N/A |
| XXX1 | 0 | 3 | 1 | DI | BXX\_SLP2\_DM1\_DI\_SP | Pump 2 Backup Stop Relay | No | 10 | No | N/A |
| XXX1 | 0 | 3 | 2 | DI | BXX\_SLP2\_DM1\_DI\_CL | Pump 2 Control Mode | Yes | N/A | No | N/A |
| XXX1 | 0 | 3 | 3 | DI | BXX\_SLP2\_DM1\_DI\_SS | Pump 2 Running Status | Yes | N/A | Yes | N/A |
| XXX1 | 0 | 3 | 4 | DI | BXX\_SLP2\_DM1\_DA\_RA | Pump 2 Overload | No | 63 | No | N/A |
| XXX1 | 0 | 3 | 5 | DI | BXX\_SLP2\_DM1\_DA\_TA | Pump 2 Temp/Leakage | No | 58 | No | N/A |
| XXX1 | 0 | 3 | 6 | DI | BXX\_SLP2\_DM1\_DA\_ES | Pump 2 Emergency Stop | No | 63 | No | N/A |
| XXX1 | 0 | 3 | 7 | DI | BXX\_SLP2\_DM1\_DA\_DF | Pump 2 Not Ready | No | 95 | No | N/A |
| XXX1 | 0 | 3 | 8 | DI | BXX\_SLP1\_DM1\_DA\_GA | Pump 2VFD Fault | Yes | N/A | No | N/A |
| XXX1 | 0 | 3 | 9 | DI | BXX\_SLP1\_DM1\_DI\_BP | Pump 2 in Bypass Mode | Yes | N/A | No | N/A |
| XXX1 | 0 | 3 | 10 | DI | BXX\_OVF1\_FI1\_DA\_EL | Overflow Flowmeter Loss of Echo | No | 9 | No | N/A |
| XXX1 | 0 | 3 | 11 | DI | SPARE |  |  |  |  |  |
| XXX1 | 0 | 3 | 12 | DI | SPARE |  |  |  |  |  |
| XXX1 | 0 | 3 | 13 | DI | SPARE |  |  |  |  |  |
| XXX1 | 0 | 3 | 14 | DI | SPARE |  |  |  |  |  |
| XXX1 | 0 | 3 | 15 | DI | SPARE |  |  |  |  |  |
| XXX1 | 0 | 4 | 0 | DI | BXX\_PSB1\_CP1\_DA\_JR | PLC Control Power Failed | No | 50 | No | N/A |
| XXX1 | 0 | 4 | 1 | DI | BXX\_UPS1\_001\_DA\_GA | UPS 1 fault | No | 48 | No | N/A |
| XXX1 | 0 | 4 | 2 | DI | BXX\_UPS1\_BT1\_DA\_JL | UPS 1 Low Battery Alarm | No | 210 | No | N/A |
| XXX1 | 0 | 4 | 3 | DI | BXX\_PSB1\_JI1\_DA\_GA | Normal Power Phase Failure | No | 50 | No | N/A |
| XXX1 | 0 | 4 | 4 | DI | BXX\_DDT1\_LS1\_DA\_KA | Diesel Containment Flood | No | 200 | No | N/A |
| XXX1 | 0 | 4 | 5 | DI | BXX\_PSB1\_JI1\_DA\_NF | Ground Fault | No | 150 | No | N/A |
| XXX1 | 0 | 4 | 6 | DI | BXX\_GEN1\_VV1\_DA\_SF | Generator Louver Fail to Open | No | 150 | No | N/A |
| XXX1 | 0 | 4 | 7 | DI | BXX\_ATS1\_SG1\_DI\_CL | ATS Control Mode | Yes | N/A | No | N/A |
| XXX1 | 0 | 4 | 8 | DI | BXX\_ATS1\_SG1\_DI\_JN | ATS on Normal Power | Yes | N/A | No | N/A |
| XXX1 | 0 | 4 | 9 | DI | BXX\_ATS1\_SG1\_DA\_JE | ATS on Emergency Power | Yes | N/A | No | N/A |
| XXX1 | 0 | 4 | 10 | DI | BXX\_GEN1\_DE1\_DI\_CL | Diesel Generator Control Mode | 700 | N/A | No | N/A |
| XXX1 | 0 | 4 | 11 | DI | BXX\_GEN1\_DE1\_DA\_SS | Diesel Generator Running Alarm | No | 66 | No | N/A |
| XXX1 | 0 | 4 | 12 | DI | BXX\_GEN1\_DE1\_DA\_JW | Diesel Generator Warning Alarm | No | N/A | No | N/A |
| XXX1 | 0 | 4 | 13 | DI | BXX\_GEN1\_DE1\_DA\_GA | Diesel Generator Fault Alarm | No | 112 | No | N/A |
| XXX1 | 0 | 4 | 14 | DI | BXX\_GEN1\_DE1\_DA\_ES | Diesel Generator Emergency Stop Alarm | No | 50 | No | N/A |
| XXX1 | 0 | 4 | 15 | DI | BXX\_GEN1\_JI1\_DI\_OP | Diesel Generator Breaker Open Alarm | No | N/A | No | N/A |
| XXX1 | 0 | 5 | 0 | DI | BXX\_STN1\_001\_DA\_TL | Building Low Temperature Alarm | No | 56 | No | N/A |
| XXX1 | 0 | 5 | 1 | DI | BXX\_STN1\_001\_DA\_TH | Building High Temperature Alarm | No | 56 | No | N/A |
| XXX1 | 0 | 5 | 2 | DI | SPARE |  |  |  |  |  |
| XXX1 | 0 | 5 | 3 | DI | SPARE |  |  |  |  |  |
| XXX1 | 0 | 5 | 4 | DI | BXX\_DW01\_LE1\_DA\_KA | Dry Well 1 Flood Alarm | No | 9 | No | N/A |
| XXX1 | 0 | 5 | 5 | DI | BXX\_STN2\_001\_DA\_YA | Building Fire Alarm | No | 1 | No | N/A |
| XXX1 | 0 | 5 | 6 | DI | BXX\_STN1\_001\_DI\_AR | Building Gas Detector Failure | No | 12 | No | N/A |
| XXX1 | 0 | 5 | 7 | DI | BXX\_STN1\_001\_DI\_AG | Building Gas Detector Alarm | No | 10 | No | N/A |
| XXX1 | 0 | 5 | 8 | DI | BXX\_STN1\_001\_DI\_AW | Building Gas Detector Warning | No | 310 | No | N/A |
| XXX1 | 0 | 5 | 9 | DI | BXX\_PSU1\_001\_DA\_GA | 24 VDC Power Supply Fault | No | 200 | No | N/A |
| XXX1 | 0 | 5 | 10 | DI | BXX\_STN1\_EY1\_DA\_GA | Eye Wash Active | No | 9 | No | N/A |
| XXX1 | 0 | 5 | 11 | DI | BXX\_PSU1\_001\_DA\_GA | Backup Panel 24 VDC Power Supply Fault | No | 200 | No | N/A |
| XXX1 | 0 | 5 | 12 | DI | BXX\_UPS2\_001\_DA\_GA | UPS 2 Fault | No | 48 | No | N/A |
| XXX1 | 0 | 5 | 13 | DI | BXX\_UPS2\_BT1\_DA\_JL | UPS 2 Low Battery Alarm | No | 210 | No | N/A |
| XXX1 | 0 | 5 | 14 | DI | SPARE |  |  |  |  |  |
| XXX1 | 0 | 5 | 15 | DI | SPARE |  |  |  |  |  |
| XXX1 | 0 | 6 | 0 | DI | BXX\_PSB1\_KS1\_DI\_DE | Station Security Key Switch | Yes | N/A | No | N/a |
| XXX1 | 0 | 6 | 1 | DI | BXX\_DR01\_TO1\_DI\_SI | Door #1 Contact | Yes | N/A | No | N/a |
| XXX1 | 0 | 6 | 2 | DI | BXX\_DR02\_TO1\_DI\_SI | Door #2 Contact | Yes | N/A | No | N/a |
| XXX1 | 0 | 6 | 3 | DI | BXX\_DR02\_TO1\_DI\_SI | Door #2 Contact | Yes | N/A | No | N/a |
| XXX1 | 0 | 6 | 4 | DI | SPARE |  |  |  |  |  |
| XXX1 | 0 | 6 | 5 | DI | SPARE |  |  |  |  |  |
| XXX1 | 0 | 6 | 6 | DI | SPARE |  |  |  |  |  |
| XXX1 | 0 | 6 | 7 | DI | SPARE |  |  |  |  |  |
| XXX1 | 0 | 6 | 8 | DI | SPARE |  |  |  |  |  |
| XXX1 | 0 | 6 | 9 | DI | SPARE |  |  |  |  |  |
| XXX1 | 0 | 6 | 10 | DI | SPARE |  |  |  |  |  |
| XXX1 | 0 | 6 | 11 | DI | SPARE |  |  |  |  |  |
| XXX1 | 0 | 6 | 12 | DI | SPARE |  |  |  |  |  |
| XXX1 | 0 | 6 | 13 | DI | SPARE |  |  |  |  |  |
| XXX1 | 0 | 6 | 14 | DI | SPARE |  |  |  |  |  |
| XXX1 | 0 | 6 | 15 | DI | SPARE |  |  |  |  |  |
| XXX1 | 0 | 8 | 0 | DO | BXX\_SLP1\_DM1\_DO\_TS | Pump 1Start | Yes | N/A | No | N/A |
| XXX1 | 0 | 8 | 1 | DO | BXX\_SLP1\_DM1\_DO\_PS | Pump 1 Stop | Yes | N/A | No | N/A |
| XXX1 | 0 | 8 | 2 | DO | SPARE |  |  |  |  |  |
| XXX1 | 0 | 8 | 3 | DO | BXX\_ATS1\_SG1\_DO\_TS | Standby Power Function Test | Yes | N/A | No | N/A |
| XXX1 | 0 | 8 | 4 | DO | SPARE |  |  |  |  |  |
| XXX1 | 0 | 8 | 5 | DO | SPARE |  |  |  |  |  |
| XXX1 | 0 | 8 | 6 | DO | BXX\_STN1\_TO1\_DA\_SI | Illegal Entry Alarm Light | No | N/A | No | N/A |
| XXX1 | 0 | 8 | 7 | DO | BXX\_STN1\_TO1\_DO\_SI | Security System Armed Light | No | N/A | No | N/A |
| XXX1 | 0 | 8 | 8 | DO | BXX\_SLP2\_DM1\_DO\_TS | Pump 2 Start | Yes | N/A | No | N/A |
| XXX1 | 0 | 8 | 9 | DO | BXX\_SLP2\_DM1\_DO\_PS | Pump 2 Stop | Yes | N/A | No | N/A |
| XXX1 | 0 | 8 | 10 | DO | SPARE |  |  |  |  |  |
| XXX1 | 0 | 8 | 11 | DO | SPARE |  |  |  |  |  |
| XXX1 | 0 | 8 | 12 | DO | SPARE |  |  |  |  |  |
| XXX1 | 0 | 8 | 13 | DO | SPARE |  |  |  |  |  |
| XXX1 | 0 | 8 | 14 | DO | SPARE |  |  |  |  |  |
| XXX1 | 0 | 8 | 15 | DO | SPARE |  |  |  |  |  |
| XXX1 | 0 | 9 | 0 | AI | SPARE |  |  |  |  |  |
| XXX1 | 0 | 9 | 1 | AI | BXX\_SLP1\_II1\_AI\_CV | Pump 1 Motor Current | No | N/A | Yes | TBD |
| XXX1 | 0 | 9 | 2 | AI | BXX\_WW01\_LI1\_AI\_CV | Wet Well 1 Level | No | N/A | Yes | 0-100% |
| XXX1 | 0 | 9 | 3 | AI | BXX\_WW01-LI1\_AI\_CV | Wet Well 1 Backup Level | No | N/A | Yes | TBD |
| XXX1 | 0 | 9 | 4 | AI | BXX\_DFT1\_LI1\_AI\_CV | Diesel Tank Level | No | N/A | Yes | 0-100% |
| XXX1 | 0 | 9 | 5 | AI | BXX\_DIH1\_FI1\_AI\_CV | Station Discharge Flow | No | N/A | Yes | TBD |
| XXX1 | 0 | 9 | 6 | AI | BXX\_DIH1\_PI1\_AI\_CV | Forcemain Pressure | No | N/A | Yes | TBD |
| XXX1 | 0 | 9 | 7 | AI | SPARE |  |  |  |  |  |
| XXX1 | 0 | 10 | 0 | AI | BXX\_SLP2\_SI1\_AI\_CV | Pump 2 Speed Feedback | No | N/A | Yes | TBD |
| XXX1 | 0 | 10 | 1 | AI | BXX\_SLP2\_II1\_AI\_CV | Pump 2 Motor Current | No | N/A | Yes | TBD |
| XXX1 | 0 | 10 | 2 | AI | SPARE |  |  |  |  |  |
| XXX1 | 0 | 10 | 3 | AI | BXX\_OVF1\_FI1\_AI\_CV | Station Overflow | No | N/A | Yes | TBD |
| XXX1 | 0 | 10 | 4 | AI | SPARE |  |  |  |  |  |
| XXX1 | 0 | 10 | 5 | AI | SPARE |  |  |  |  |  |
| XXX1 | 0 | 10 | 6 | AI | SPARE |  |  |  |  |  |
| XXX1 | 0 | 10 | 7 | AI | SPARE |  |  |  |  |  |
| XXX1 | 0 | 12 | 0 | AI | SPARE |  |  |  |  |  |
| XXX1 | 0 | 12 | 1 | AO | BXX\_SLP2\_DM1\_AO\_CV | Pump 2 Speed Setpoint | No | N/A | No | 0-100% |
| XXX1 | 0 | 12 | 2 | AO | SPARE |  |  |  |  |  |
| XXX1 | 0 | 12 | 3 | AO | SPARE |  |  |  |  |  |
| XXX1 | 0 | 12 | 4 | AO | SPARE |  |  |  |  |  |
| XXX1 | 0 | 12 | 5 | AO | SPARE |  |  |  |  |  |
| XXX1 | 0 | 12 | 6 | AO | SPARE |  |  |  |  |  |
| XXX1 | 0 | 11 | 7 | AO | SPARE |  |  |  |  |  |

APPENDIX A2 PROCESS ALARMS

The following table lists all the process alarms.

Appendix A2 Process Alarms

| **DESCRIPTION** | **ALARM**  **PRIORITY** | **RAW**  **ENABLE/DISABLE** | **DIALLER**  **CHANNEL #** |
| --- | --- | --- | --- |
|
| Overflow Flow Process HiHi Alarm | 90 | TBD | TBD |
| Overflow Flow Process Hi Alarm | 90 | TBD | TBD |
| Overflow Flow Process Lo Alarm | 90 | TBD | TBD |
| Overflow Flow Process LoLo Alarm | 90 | TBD | TBD |
| Force Main Discharge Pressure HiHi Alarm | 90 | TBD | TBD |
| Force Main Discharge Pressure Process Hi Alarm | 90 | TBD | TBD |
| Force Main Discharge Pressure Process Lo Alarm | 90 | TBD | TBD |
| Force Main Discharge Pressure Process LoLo Alarm | 90 | TBD | TBD |
| Wetwell 1 Level HIHI Alarm | 61 | TBD | TBD |
| Wetwell 1 Level High Alarm | 61 | TBD | TBD |
| Wetwell 1 Level Low Alarm | 61 | TBD | TBD |
| Wetwell 1 Level LOLO Alarm | 61 | TBD | TBD |
| Wetwell 1 Backup Level HIHI Alarm | 61 | TBD | TBD |
| Wetwell 1 Backup Level High Alarm | 61 | TBD | TBD |
| Wetwell 1 Backup Level Low Alarm | 61 | TBD | TBD |
| Wetwell 1 Backup Level LOLO Alarm | 61 | TBD | TBD |
| Pumps In Backup Mode | 50 | TBD | TBD |

**PROCESS SETTINGS**

The following table lists all the process set points and program variables

Appendix A3 Process Set Points and Program Variables

| **DESCRIPTION** | **TAGNAME** | **UNITS** | **SIG. DIGITS** | **INPUT RANGE** | | **SECURITY LEVEL** |
| --- | --- | --- | --- | --- | --- | --- |
| **MIN** | **MAX** |
| Duty 1 Start Evaluation | DUTY\_TWO\_PUMP\_1\_3 | TBD | TBD | TBD | TBD | Operator |
| Duty 1 Stop Evaluation | DUTY\_TWO\_PUMP\_1\_3 | TBD | TBD | TBD | TBD | Operator |
| Duty 2 Start Evaluation | DUTY\_TWO\_PUMP\_1\_3 | TBD | TBD | TBD | TBD | Operator |
| Duty 2 Stop Evaluation | DUTY\_TWO\_PUMP\_1\_3 | TBD | TBD | TBD | TBD | Operator |
| Duty Alternation | DUTY\_TWO\_PUMP\_1\_3 | TBD | TBD | TBD | TBD | Operator |
| Duty Level Transmitter For Failure Rotation | DUTY\_TWO\_PUMP\_1\_3 | TBD | TBD | TBD | TBD | Operator |

Appendix B Acronyms

ATS – Automatic Transfer Switch

HMI – Human Machine Interface

I/O – Input/output

OIT – Operator Interface Terminal (Local)

PLC – Programmable Logic Controller

SCADA – Supervisor Control and Data Acquisition

UPS – Uninterrupted Power Supply