



WATER|SELECTOR®

OPERATING INSTRUCTION MANUAL

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The IXOM logo, featuring the word "IXOM" in white, bold, sans-serif capital letters, centered within a solid teal rectangular background.

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SECTION 1: INTRODUCTION

The purpose of this manual is to detail operational requirements for the Water Selector[®] as detailed below.

This manual is divided into the following sections:

Section 1: Introduction

- General background
- Safety instructions

Section 2: Background & Configuration

- Summary of System Technology and Operation
- Different system configuration descriptions.
- Specification of system configuration.

Section 3: Control System Operator Interface

- Introduction to operation of the interface / SCADA system
- General SCADA navigation
- System operation

Section 4: Routine Maintenance and Calibration

- Maintenance Schedule
- Sonde Sensor Calibration
- Automated Equipment Calibration Routines

Section 5: Process Pause Reasons

- Classification of pause reasons
- Actions to take

Section 6: Appendices

1.1 SAFETY INSTRUCTIONS

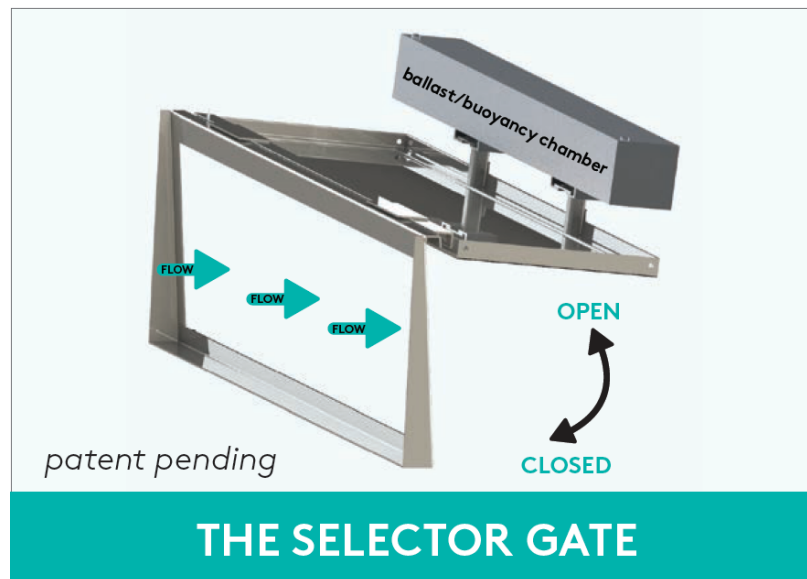
- (a) Only Operators who have been trained in safe start-up and operation of the system should be allowed to run/operate any equipment. If required, limit access to authorized personnel only.
- (b) To prevent personal injury, rotating equipment and other mechanisms must be stopped before performing any maintenance or adjustments. Lockout power before carrying out such work. Ixom Watercare recommends that ALL work should be carried out under a "clearance to work" and "lockout, tagout" system.
- (c) Mechanical: The system utilizes mechanical equipment including pumps and motorized reels. Guards/covers are provided on motorized reel to prevent contact with moving equipment. **DO NOT OPERATE MOVING EQUIPMENT THAT IS NOT PROPERLY GUARDED/COVERED.**
- (d) Electrical: The system operates on 208VAC / 1 Phase (and 120VAC for some panels). **TURN OFF AND ISOLATE ALL POWER TO THE EQUIPMENT PRIOR TO ACCESSING ANY ELECTRICAL EQUIPMENT.**
- (e) NEVER permit people who have been drinking alcohol, using drugs, or are otherwise impaired to operate and/or maintain the system.
- (f) Inspect equipment frequently for loose piping or bolt connections, leaks or malfunctioning equipment. Plan repairs as soon as possible.
- (g) MODIFICATIONS OR CHANGES: It is recommended to consult Ixom Watercare about any proposed modifications (i.e. piping, equipment, control etc) prior to implementation.
- (h) COMPRESSED AIR: The Water Selector™ uses an air compressor to operate gates, valves and bubblers. Equipment should be isolated and the air piping system de-pressurized before any repair or maintenance work is carried out. Specific site safety standards should be followed, or OSHA Standards followed for compressed air safety.
- (i) WORK NEAR BODY OF WATER: The Water Selector™ system is installed alongside a body of deep water. When working on equipment take care to restrain yourself against falls into the water, and use personal floatation devices, and other relevant PPE.
- (j) SUBMERGED EQUIPMENT: The Water Selector™ system contains submerged equipment. Work performed on equipment is to be done by qualified diving professionals only. Work on submerged equipment without proper technology and skills can result in INJURY or DROWNING.

SECTION 2: BACKGROUND & CONFIGURATION

2.1 WATER SELECTOR™ PRINCIPALS OF OPERATION

The Water Selector™ system allows the selection of source water along the depth profile of a lake or reservoir. This selection is informed by the continuous monitoring of water quality parameters along the depth profile by use of the PAMS (Profile Analysis & Monitoring System) unit. Selection of water is enabled by the opening of gates positioned along the depth profile. Each of these gates operates by the filling of a buoyancy chamber with compressed air that causes the submerged gate to float open. Gates close when air is vented out of the chamber, and the chambers can fill with water sinking the gate closed.

Figure 1 Selector Gate



The PAMS unit samples water from the entire depth profile through a multiparameter analytical sonde. This instrument measures up to nine water quality parameters, and this data is used to select which gate or depth is optimal based on operator defined criteria.

2.2 WATER SELECTOR™ CONFIGURATION

- **Tower Attached:** Water Selector™ Barrier and Gates attach to an existing intake structure.

Figure 2 Tower Attached Barrier



PAMS Configuration

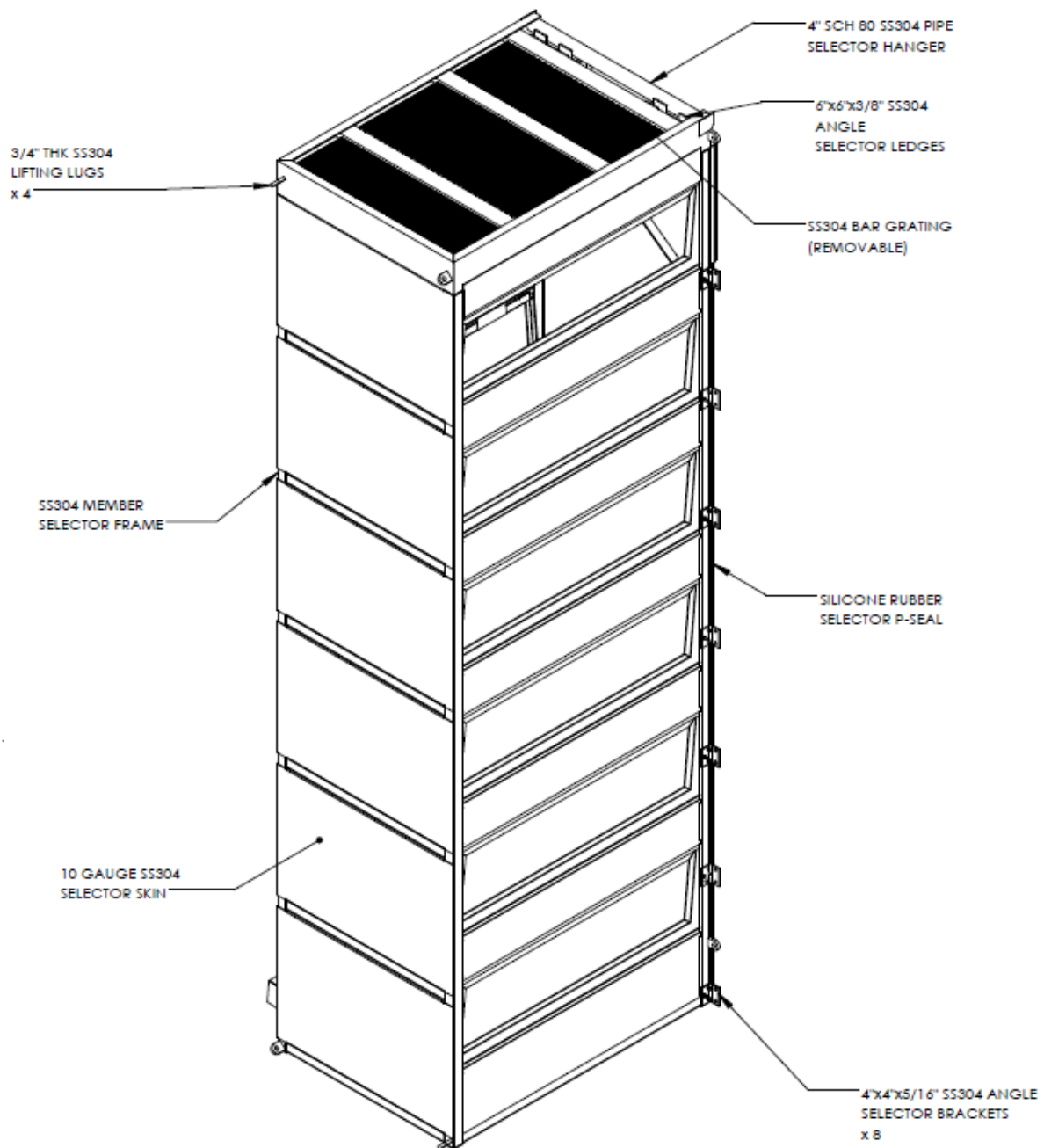
- **Shore Based:** PAMS unit utilizes an automatic hose reel system to move a sample intake screen through the depth profile. Sample water is pulled via diaphragm pump through a process and analytics cabinet which contains the multiparameter sonde.

2.3 TOWER ATTACHED WATER SELECTOR™ EQUIPMENT

The Water Selector™ tower attached configuration is comprised of several features, and components that operators should become familiar with. This equipment is mostly submerged so direct observation will be difficult. Refer to the figure and descriptions below for a summary of equipment items:

- **Barrier & Structure:** The Water Selector™ is arranged within a stainless steel structure designed to resist the forces imparted by submergence in a body of water. This structure is kept effectively watertight using stainless steel plate covering all surfaces not populated by a gate.
- **Gates:** Gates are positioned along the depth profile. The gates are comprised of a stainless steel frame, stainless steel door with gasket seal, and aluminium buoyancy chamber.
- **Barrier Seal:** A rubber gasket attaches to the structure that creates a seal against the existing surface.
- **Air Tubing:** Bundles of air tubing are routed into and within the barrier to deliver and remove air from the gate buoyancy chambers.

Figure 3 Water Selector™ Barrier and Gates Equipment



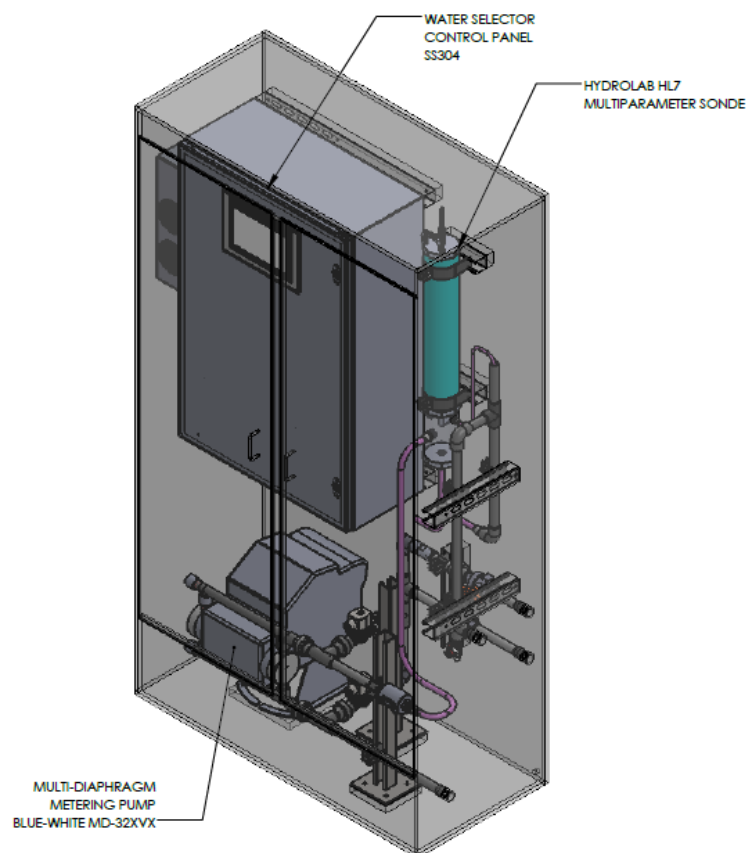
- **Grating:** At the top surface of the selector barrier there is a removable grating surface. This can be used for access to the unsubmerged parts of the selector barrier.

2.4 SHORE BASED PAMS UNIT EQUIPMENT

The Shore Based PAMS unit configuration is comprised of several features, and components that operators should become familiar with. This equipment is contained within a control cabinet with some external equipment. Refer to the below figure and descriptions for more details:

- **Control Panel:** The control panel for both the Water Selector™ barrier and gates, and the PAMS unit is contained within the control cabinet. This panel has an HMI touch screen interface with which both systems can be controlled by operators.

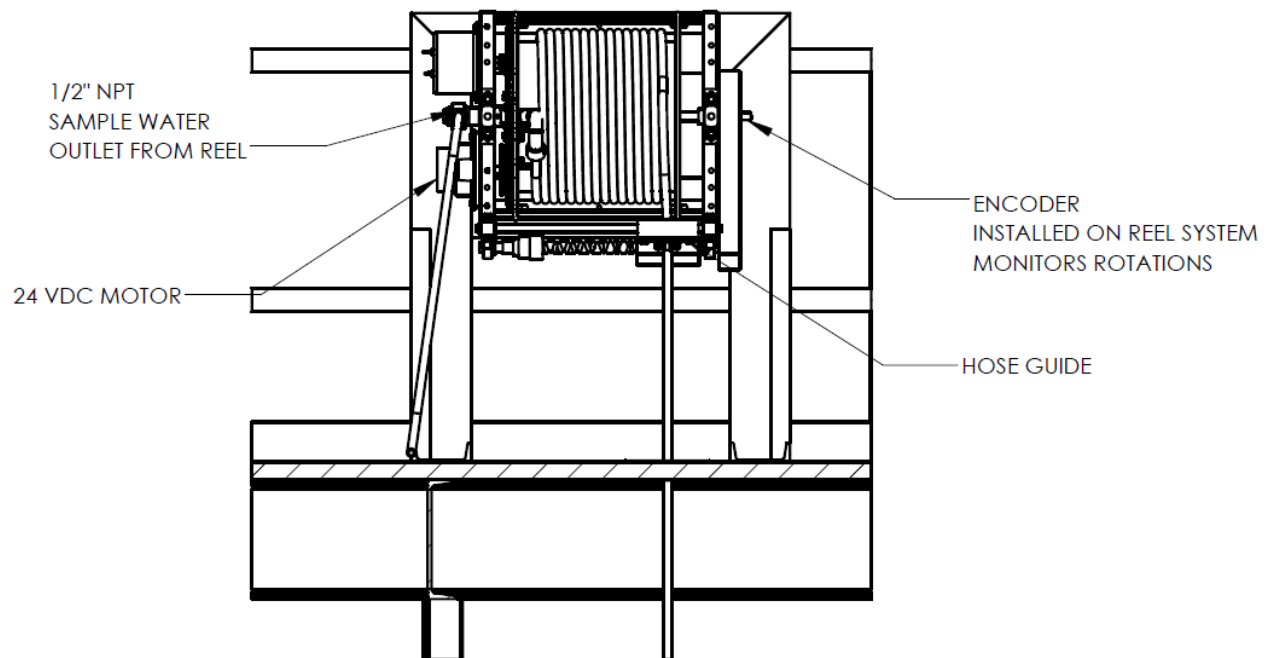
Figure 4 Control Cabinet



- **Multi-Parameter Sonde:** The multi-parameter sonde is contained within the control cabinet and analyses the sampled water moving through its flow cell for up to 9 water quality measurements.

- **Sample Pump:** The multi-diaphragm sample pump is contained within the control cabinet and provides the suction to bring the sample water from the reel system through the multi-parameter sonde, and back into the reservoir.
- **Advanced Air Control Module:** The Water Selector™ control panel houses advanced air handling units capable of producing micro adjustments in air flow rate at precise pressures. These units are used for variable purposes in a Water Selector™ system such as operating pneumatic valves, filling buoyancy chambers for selection and position monitoring, lake level bubbler, and gently scouring the sample system's sensors for cleaning.
- **RIO Panel:** A field panel houses the common solenoid manifold that is used to route air for the opening and closing of the Water Selector gates.

Figure 5 Sample Reel System



- **Sample Reel System:** The Sample Reel System works to move the sample screen through the depth profile. The system reels in and lets out a hose fashioned with a stainless steel sample screen fixed at its end.
- **Encoder:** The encoder is fixed to the side of the reel system where it monitors rotations to keep track of the position of the sample screen.
- **Brake:** the chain drive system features a fail safe brake system which prevents the hose from moving during sample cycles and in the event of a power failure.

2.5 COMMON EQUIPMENT

Below some of the common equipment supplied for both systems is summarized:

- **Air Compressors:** Two air compressors (duty/standby) are supplied to provide compressed air for the opening of gates, the operation of pneumatic valves, and the cleaning of sensors.
- **Air Dryer:** An air dryer is supplied to keep the compressed air supply free of moisture to extend the life of the Water Selector™ pneumatic components.

SECTION 3: CONTROL SYSTEM OPERATOR INTERFACE

3.1 GENERAL

The Water Selector™ system is controlled and operated through an interface designed to run the system continuously with minimal operator attention. The system is automated with a programmable logic controller (PLC) and utilize a Human-Machine Interface (HMI). The HMI system communicates to the PLC and allows the operator to change operational setpoints and parameters. The PLC may also be configured to interact with the plant's SCADA system.

Table 1: PLC and Operator Interface (HMI) Information

Equipment Area	Equipment / Software
Programmable Logic Controller (PLC)	Siemens ET200SP
Operator Interface System (HMI)	Siemens TP900 Comfort Simatic HMI



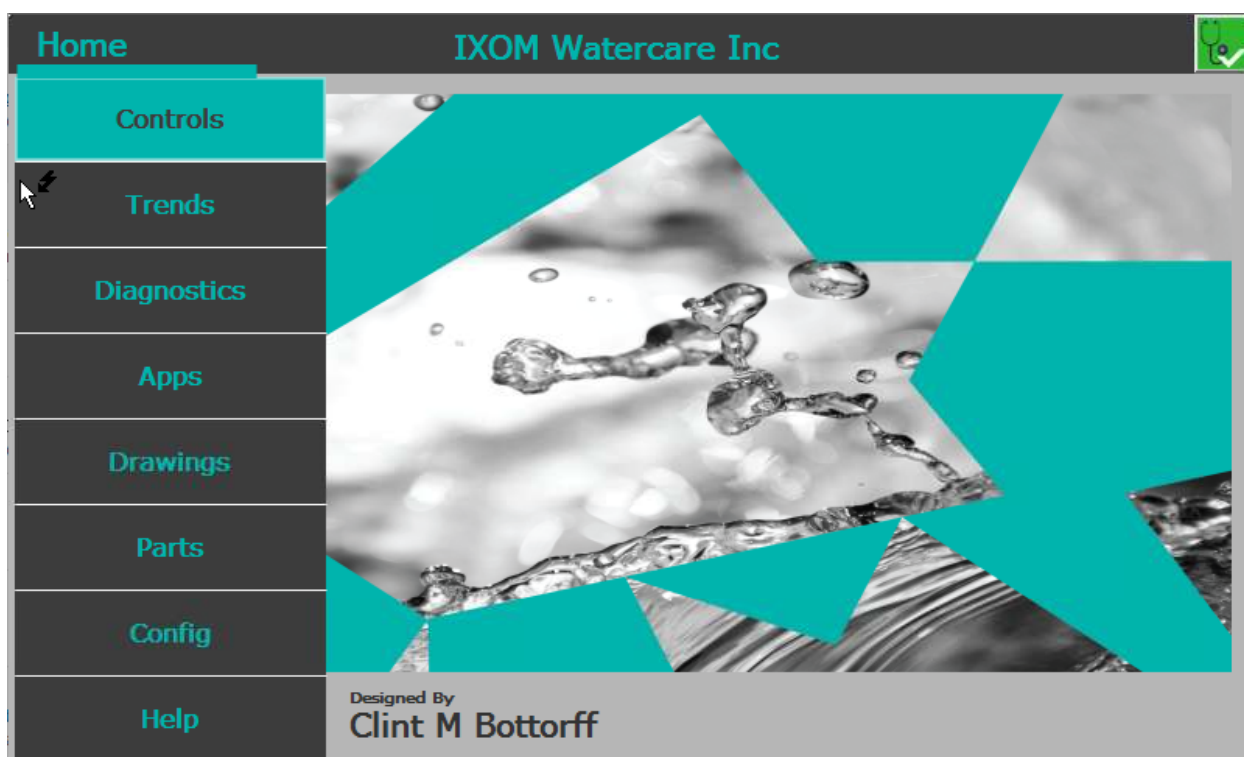
NOTE: If the Water Selector™ system operator interface system has been incorporated into the existing site SCADA system (or replicated), this was developed BY OTHERS. For any SCADA support requirements for items like user access, modification requests to screens should all be directed to the appropriate site controls personnel.

The Water Selector™ control system should run continuously and not be turned off when the system is operating. The Programmable Logic Controller (PLC) operates all the automated process equipment. If the HMI is offline, the PLC will continue to operate equipment, but the operator will have no control or visual cues as to the state of the System. Additionally, data logging will be suspended when the HMI is offline.

3.2 OPERATOR INTERFACE HOME SCREEN

The HMI system has several customized HMI screens. Navigation between these screens is accomplished by use of buttons along the left side and bottom of the interface. The home screen allows the user to browse to all other screens.

Figure 6 Home Screen



The home screen buttons will navigate between different categories of screens. A summary of each of these categories is given below:

- **Controls:** This button navigates to the main control system for the Water Selector™ and PAMS unit.
- **Trends:** This button navigates to historical data collection from the PAMS unit.
- **Diagnostics:** This button navigates to screens that allow the user to monitor the function of various control panel components.
- **Apps:** This button navigates to screens that allow the user to change PLC and HMI settings.
- **Drawings:** This button navigates to drawings of Water Selector™ and PAMS unit equipment items. (This section is currently empty)
- **Parts:** This button navigates to cutsheets for various parts and components of the Water Selector™ and PAMS unit equipment. (This section is currently empty)
- **Config:** (This section is currently empty)
- **Help:** This Button Navigates to contact information for Ixom Watercare, service schedules, and operating instructions. Refer to section 4 for information on the calibration controls contained within this section.

3.3 CONTROLS SCREENS

This section of the HMI screens comprises the main controls for operating the Water Selector™ and PAMS unit equipment and will be the main operator interface for changing gates manually, setting gate control parameters, taking grab samples, and observing data as its collected by the system.

Figure 7 Controls Screens Navigation

Overview	Gate Controls	Sample Controls	Manual Grab	Enable Sampling	Utilities	Setpoints	Alarms
----------	---------------	-----------------	-------------	-----------------	-----------	-----------	--------

Along the bottom of the interface there are several buttons that navigate the various controls screens which are described below: **Note The Current screen being display is highlighted in teal:

- **Overview:** Represents the data currently being collected by the PAMS unit, the currently selected gate, and the state of the sample system.
- **Gate Controls:** Controls associated with gate selection and the IGC (Intelligent Gate Control) system.
- **Sample Controls:** Controls associated with the sample system.
- **Manual Grab:** This screen allows operators to initiate a grab sample from along the depth profile.
- **Enable Sampling:** This screen can enable and disable sampling from different positions along the depth profile.
- **Utilities:** Information and controls associated with the compressed air system, battery backup, and surge protection.
- **Setpoints:** This is a series of screens that allow the user to view and change the various operational setpoints for the Water Selector™ and PAMS unit.
- **Alarms:** Screens that display any active alarms, allow the user to acknowledge and clear alarms, and view historical alarms.

Figure 8 Controls Screens Info Bar



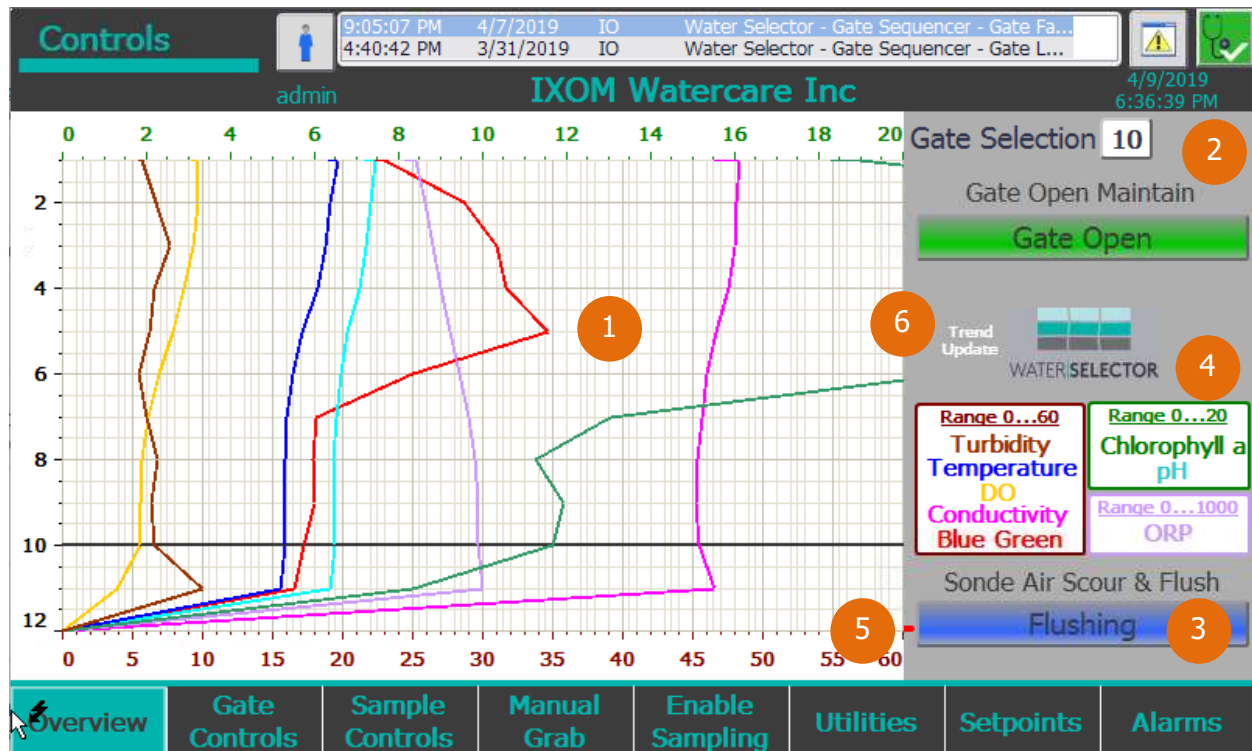
At the top of each controls screen an info bar displays alarm information and allows the operator to access log in screens to input user credentials:

1. **Home/Section:** This Indicates the Section of Screens you are currently viewing and will also take you back to the home screen when pressed to select a different section.

2. **Log on Screen:** Pressing this button brings up a pop-up that allows operators to enter user access credentials.
3. **Active Alarms:** A small view of any active alarms is displayed at the top of each control screen.
4. **Alarms Screen:** Pressing this button navigates to the alarm screen.
5. **Diagnostics:** Navigates to the Diagnostics Viewer Page.

3.3.1 Overview

Figure 9 Overview Screen

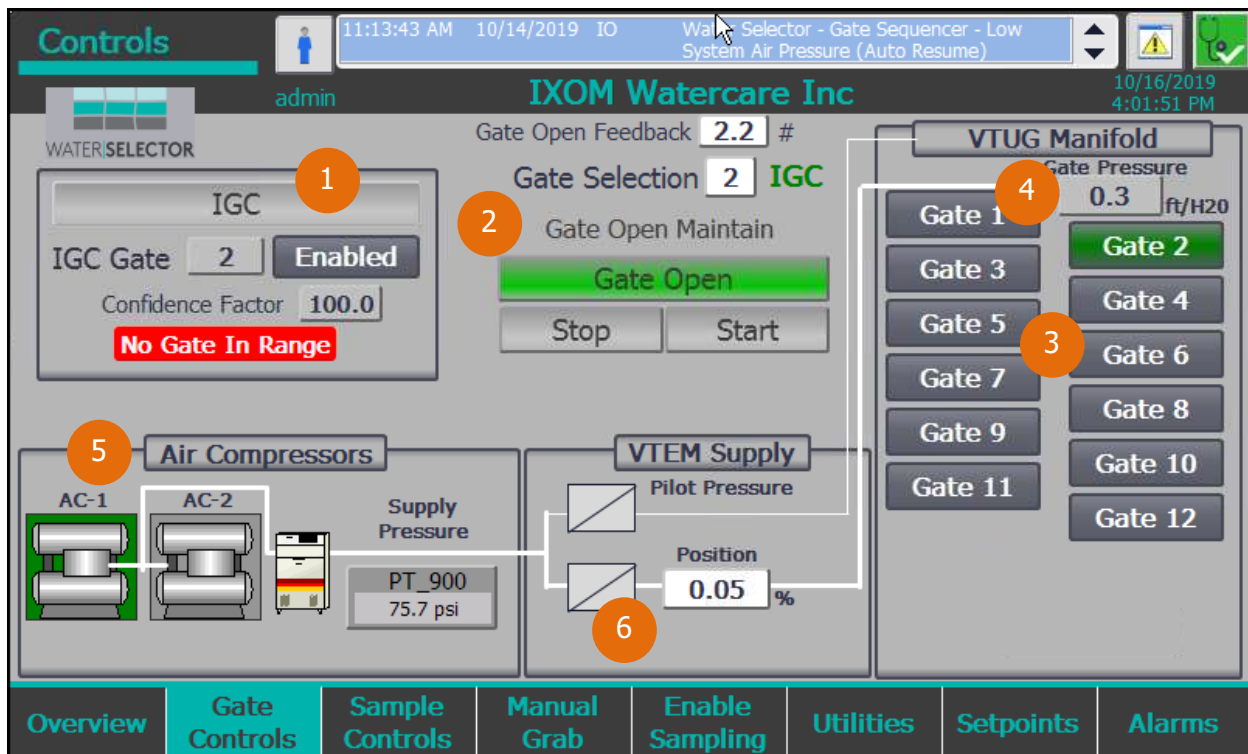


1. **Lake Profile:** A graphical representation of the data currently being collected by the sonde is shown in this window. The Y (vertical) axis indicates the gate number, and the X (horizontal) axes indicate units for the water quality parameters. Each parameter's values are represented as different coloured lines.
2. **Gate Control:** This section of the screen displays a summary of gate control information such as the current step, and currently selected gate.
3. **Sample Control:** This section of the screen displays the current sample system step, and when the sensors are being flushed.
4. **Water Quality Unit Definitions:** This section of the screen defines which water quality parameters correspond to which coloured line in the lake profile and identifies which X (horizontal) axis displays the units for each parameter.

5. **Current Sample Position Indicator:** A small blinking (red/orange) mark will move up and down along the side of the lake profile to indicate the current position of the sample intake as it corresponds to a numbered gate.
6. **Trend Update:** Hitting this Button will perform an update on the profile.

3.3.1 Gate Controls

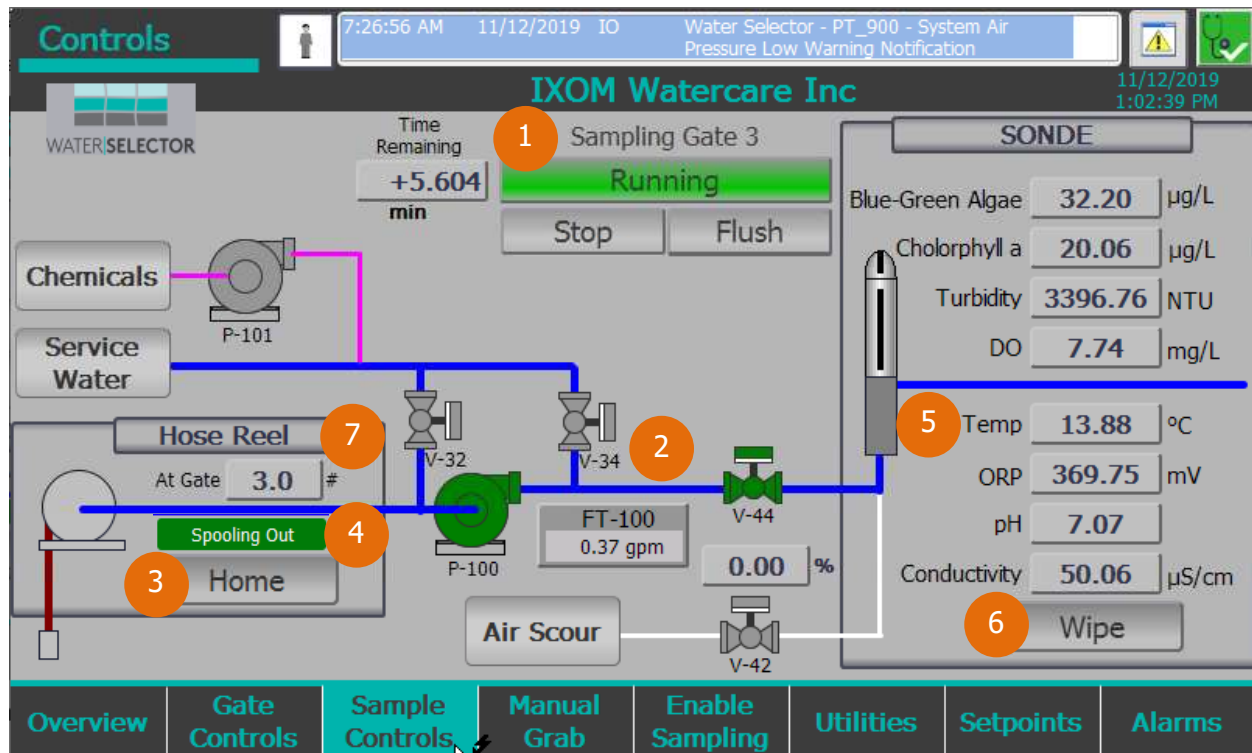
Figure 10 Gate Controls Screen



1. **Intelligent Gate Control:** This section shows the gate selection of the IGC, whether it is enabled, the confidence factor, and an alarm notifier if no gate is in range. Selecting the IGC Button will open a popup for configuring the IGC selection criteria.
2. **Gate Sequencer:** Indicates which gate is selected, indication of manual or automatic gate selection (IGC), step description of the sequencer, and ability to start and stop the gate sequencer
3. **Gates:** This indicates the status of gates. Grey is closed, Orange is transition (opening or Closing), Green is Open.
4. **Pressure at gate:** The pressure here indicates the back pressure on airline to the gate.
5. **Air Compressors:** Indicates the status of the air compressors.
6. **Valve Position:** Indicates the position value of the motion terminal valve. Often time will be a fraction of a percent to slowly tickle air to gate ballast.

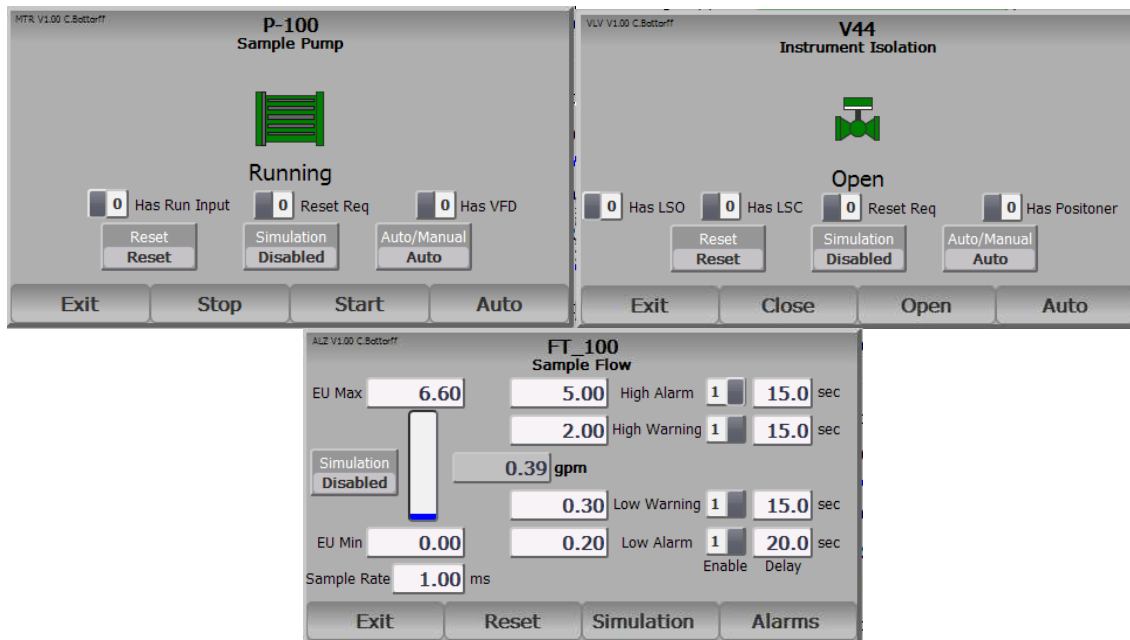
3.3.2 Sample Controls

Figure 11 Sample Controls Screen



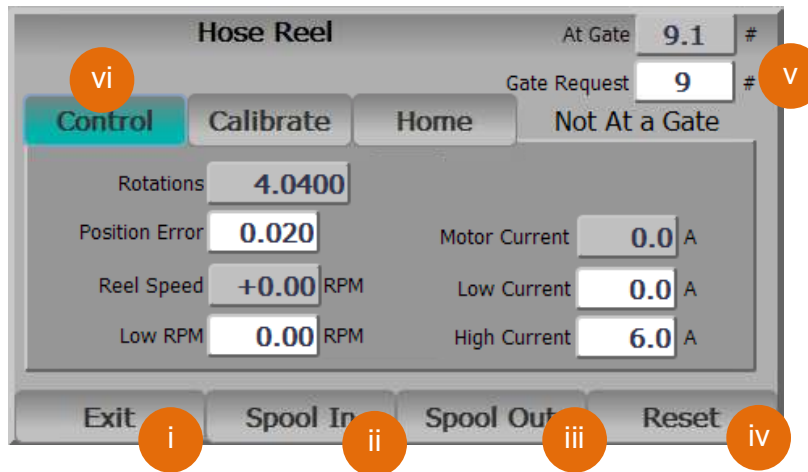
1. **Sampling System Sequencer:** The current state of the sampling system is displayed at this location. The buttons in this section will allow the operator to start and stop the sampling sequence, as well as initiate a manual flush of the sensors. The time remaining in the current sample position along the depth profile is also displayed.
2. **Process Graphical Interface:** This section of the screen displays automated process components along a flow diagram that represents the sample system. Touching each of these components will bring up a pop-up that allows the operator manual control.
 - a. **Pump:** This pop-up allows the operator to start and stop the pump under manual control.

Figure 12 Process Component Pop-Ups



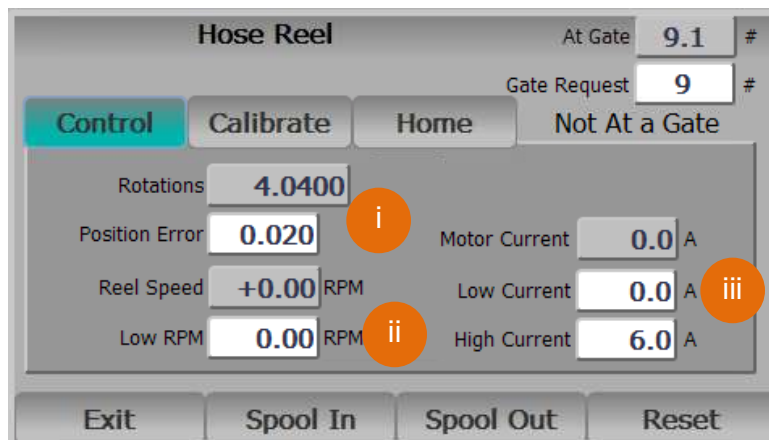
- b. **Valves:** This pop-up allows the operator to open and close valves under manual control.
 - c. **Instruments:** Pop-ups for instruments allow the operator to set high and low alarms for the instrument and allow the operator to simulate and scale instrument values.
3. **Reel System Home Button:** Pressing this button will return the sample screen to the home position. This position should be within inches of the water surface to allow inspection of the screen.
4. **Reel System Status Indicator:** When the reel system is activated and rotating to move the sample screen into position along the depth profile. This will either read "Spooling Out" or "Spooling In" to indicate whether the reel system in letting hose out, or reeling hose in.
5. **Current WQ Parameters Display:** In this section of the screen the current water quality parameters as measured by the sonde are displayed in real time.
6. **Wipe Button/Indicator:** This button will allow the operator to initiate a wipe of the multiparameter sonde's turbidity instrument. It also will indicate when the sensor is being wiped as part of the sample sequence.
7. **Hose Reel Advanced Controls:** Pushing this button labelled "Hose Reel" will bring up a pop-up with more advanced controls for the reel system.
 - a. **Reel System Advanced Control:** This pop-up allows the user to control the reel system parameters, and has 3 sub screens.

Figure 13 Reel System Advanced Control



- i. **Exit Button:** This button closes the Reel System Pop-Up.
 - ii. **Spool In:** This button manually reels in the sample hose.
 - iii. **Spool Out:** This button manually lets out the sample hose.
 - iv. **Reset Button:** Alarms associated with the hose reel system are latched and held until the reset button is pressed.
 - v. **Gate Request:** Pressing on the Gate Request button allows the operator to send the sample screen to a desired gate position along the depth profile.
 - vi. **Reel System Sub-Screen Selection:** This allows the operator to switch between the three reel system control sub screens.
- b. **Reel System Control Sub-Screen:** This sub-screen allows the operator to set reel system motor control settings.

Figure 14 Reel System Control Sub-Screen



- i. **Rotations Display:** This section monitors the rotation of the reel as measured by the encoder in relation to the Home position and displays the position error in relation to gate request.

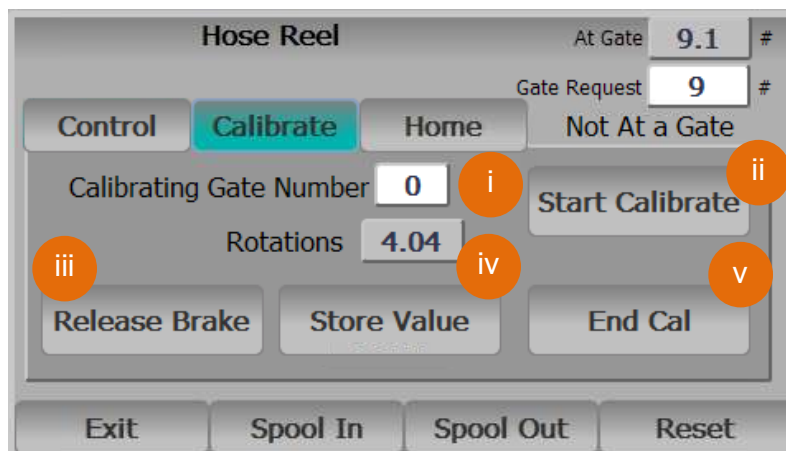
- ii. **Reel Speed:** This section displays the current rotational speed of the reel and allows the input of a low speed alarm.
- iii. **Current Draw:** This section displays current motor amperage and allows the input of high and low current alarms.
- c. **Reel System Calibrate Sub-Screen:** This sub-screen allows the operator to set each of the reel systems corresponding gate positions along the depth profile.
 - i. **Calibrating Gate Number:** This allows the operator to select which gate position along the depth profile to calibrate.
 - ii. **Start Calibrate Button:** Pressing this button begins the calibration process for the gate position selected in (i). After pressing this button, the sample screen can now be moved into position.



NOTE: When calibrating sample screen positions, it is recommended by Ixom that the operator gain assistance from trained divers to allow accurate underwater locating.

- iii. **Release Brake Button:** Pressing this button during a calibration will disable the reel system's brake allowing the screen and hose to be reeled in and out by hand.

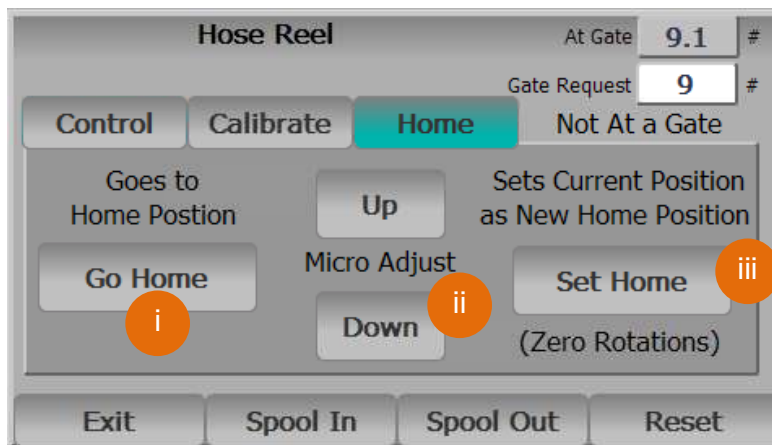
Figure 15 Hose Reel Calibrate Sub-Screen



- iv. **Store Value Button:** During a calibration, once the operator is satisfied with the position of the sample screen, pressing this button will store the current position as the calibrated position corresponding to the selected gate in (i).
- v. **End Cal Button:** Pressing this button ends the calibration sequence for the gate selected in (i).

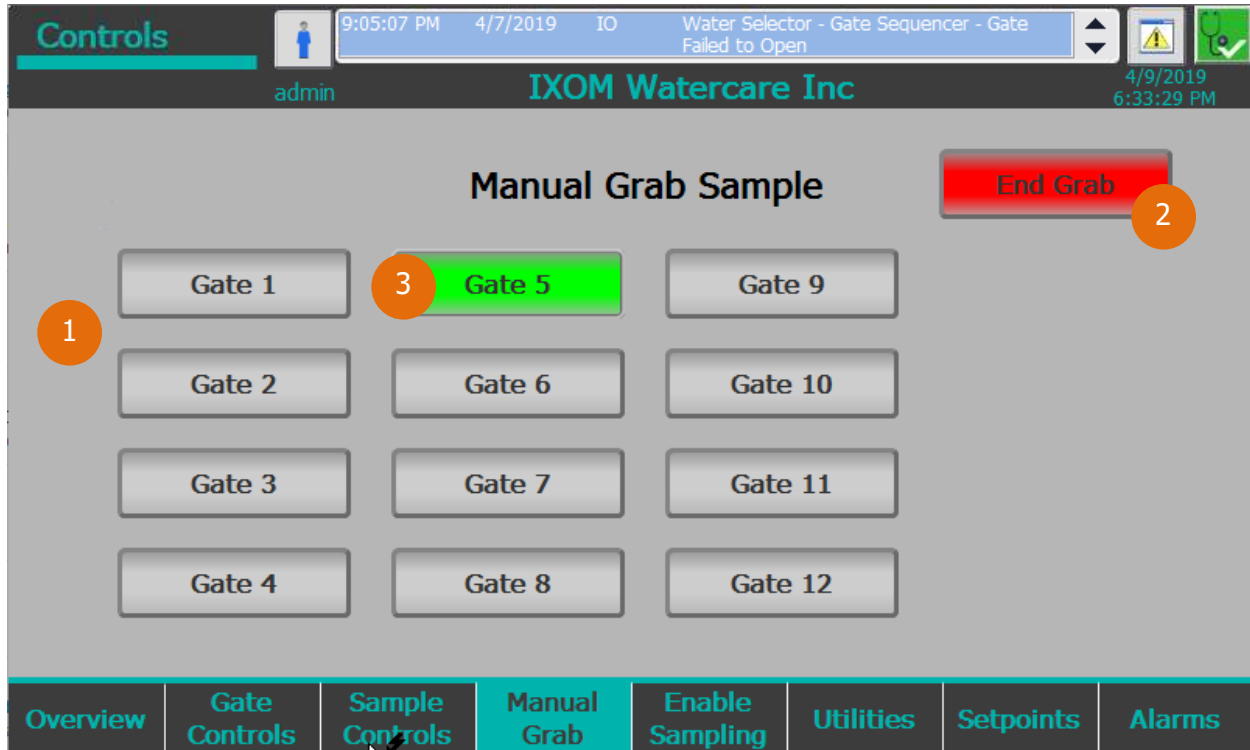
- d. **Reel System Home Sub-Screen:** This sub-screen allows the operator to set the home position for the sample screen.
- i. **Go Home Button:** Pressing this button will return the sample screen to its home position.
 - ii. **Micro Adjust Buttons:** The "Spool Out" and "Spool In" buttons can be used for gross adjustment of the sample screen position. The micro adjust buttons can be pressed to adjust the position ~1" at a time in either direction.
 - iii. **Set Home Button:** Once operators are satisfied with the sample screen's home position this button can be pressed to set a new home position.

Figure 16 Reel System Home Sub-Screen



3.3.1 Manual Grab Screen

Figure 17 Manual Grab Screen

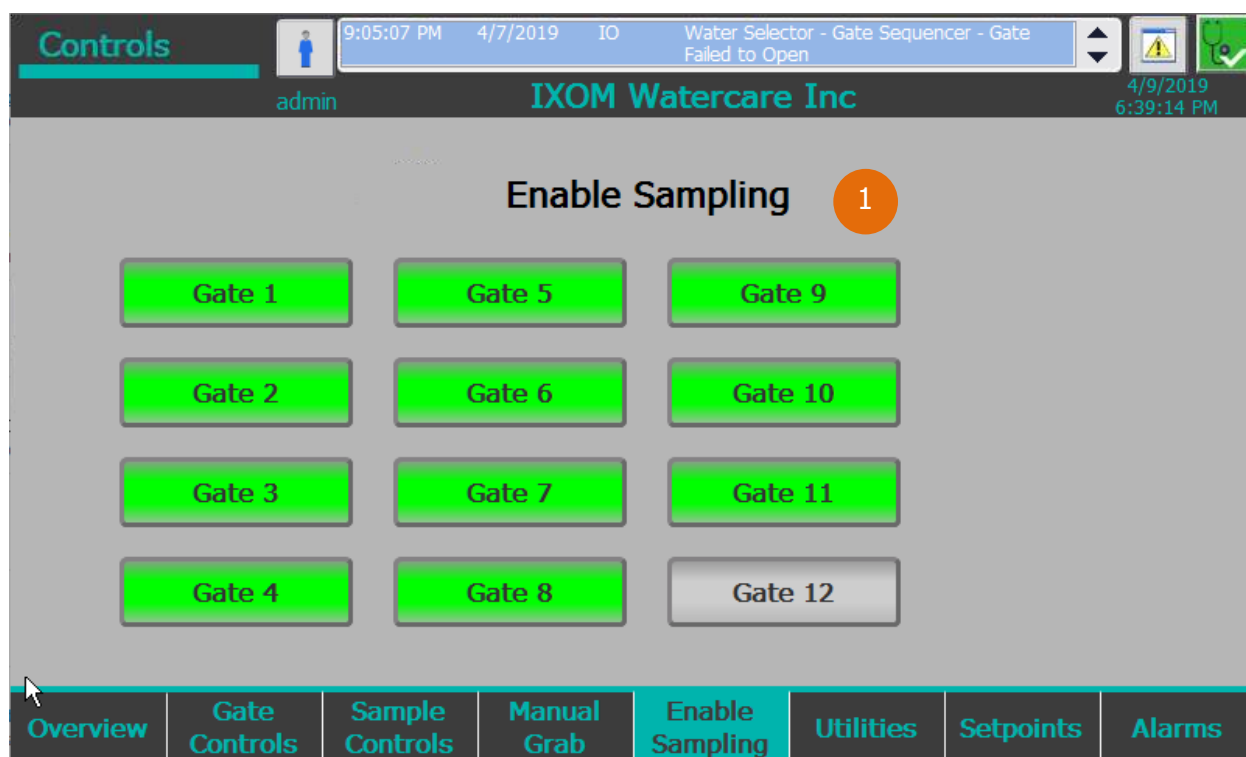


1. **Grab Sample Buttons:** Using these buttons allows operators to send the sample screen to a gate position along the depth profile. The manual sample valves within the control cabinet can then be used to take a sample of water from the selected position.
2. **End Grab Button:** After a manual grab sample is taken this button can be pressed to return the sample system to its previous state.
3. **Active Grab Sample:** The highlighted color indicates that active gate for the Manual grab sample

3.3.2 Enable Sampling Screen

1. **Enable Sampling Buttons:** Operators can de-select any gate position by pressing one of the buttons on this screen. Once de-selected, the sample system will not send the screen to this position along the depth profile during the sample sequence.

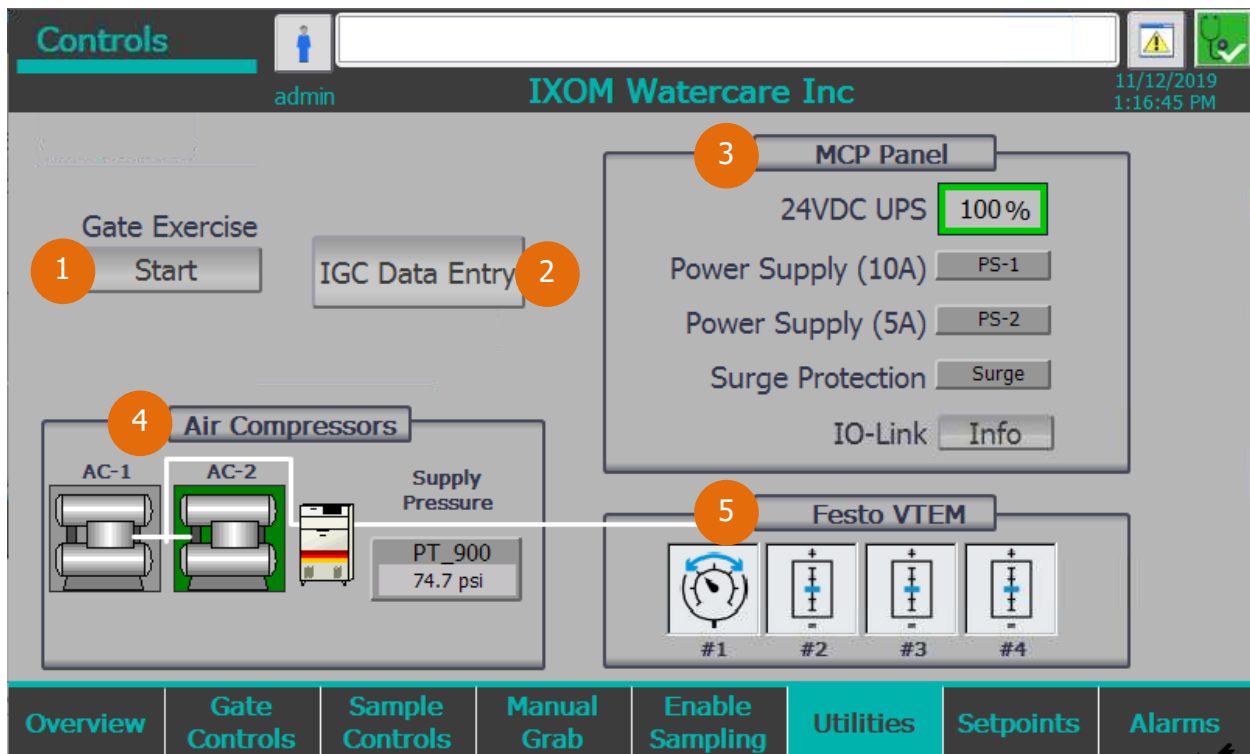
Figure 18 Enable Sampling Screen



3.3.3 Utilities Screen

1. **Gate Exercise:** The start button here starts a sequence that opens one gate at a time checking for gate closed and gate open positions.
2. **IGC Data Entry:** The button accesses the data table for the most recent sample cycles.
3. **MCP Panel:** Status indicators for the control panel are displayed in this section including the UPS battery charge and the power supply, surge protection, and IO-link communication status.
4. **Air Compressors:** This section of the screen displays information pertaining to the air compressors, and details which compressor is currently activated, whether a compressor is in fault, allows the operator to clear faults, and the current system air pressure.
5. **Festo VTEM:** The Festo Motion Terminals are items that control air flow precisely to several Water Selector™ components. This section shows the operating mode of each of the motion terminals. A pop-up that provides further information can be accessed by pressing the "Festo VTEM" button.


Figure 19 Utilities Screen



3.3.4 Setpoints Screens

Figure 20 Setpoints Screens

Controls

 admin

Page 1

Next

11/12/2019
1:20:08 PM

Sample Sets per Day (#)

12.00

SP 001

Distinct Sample Duration (min)

8.00

SP 002

Sond Wipe Buffer (sec)

90.00

SP 003

Grab Sample Timeout (hr)

1.00

SP 004

Sonde Air Scour (min)

1.00

SP 005

Sonde Air Scour Valve (%)

3.00

SP 006

Sonde Air Scour / Flush (min)

2.00

SP 007

Sonde Air Scour / Flush Valve (%)

2.00

SP 008

Sonde Flush (min)

2.00

SP 009

Sample Supply Flush (min)

1.00

SP 010

Gate Detection Air Supply (%)

0.30

SP 011

Gate Detection ROC (ft/min)

1.00

SP 012

Open Gate Air Supply (%)

20.00

SP 013

Buoyancy Chamber Fill (sec)

60.00

SP 014

Pressure Detect Equalize (sec)

15.00

SP 015

Gate Open Tolerance (ft)

0.75

SP 016

Gate Travel DP (ft)

1.80

SP 017

Maintain Gate Open (%)

0.05

SP 018

Allowable Deviations per (day)

0.00

SP 019

Air Compressors Alternate (days)

1.00

SP 020

Overview

Gate Controls

Sample Controls

Manual Grab

Enable Sampling

Utilities

Setpoints

Alarms

Table 2 Setpoints

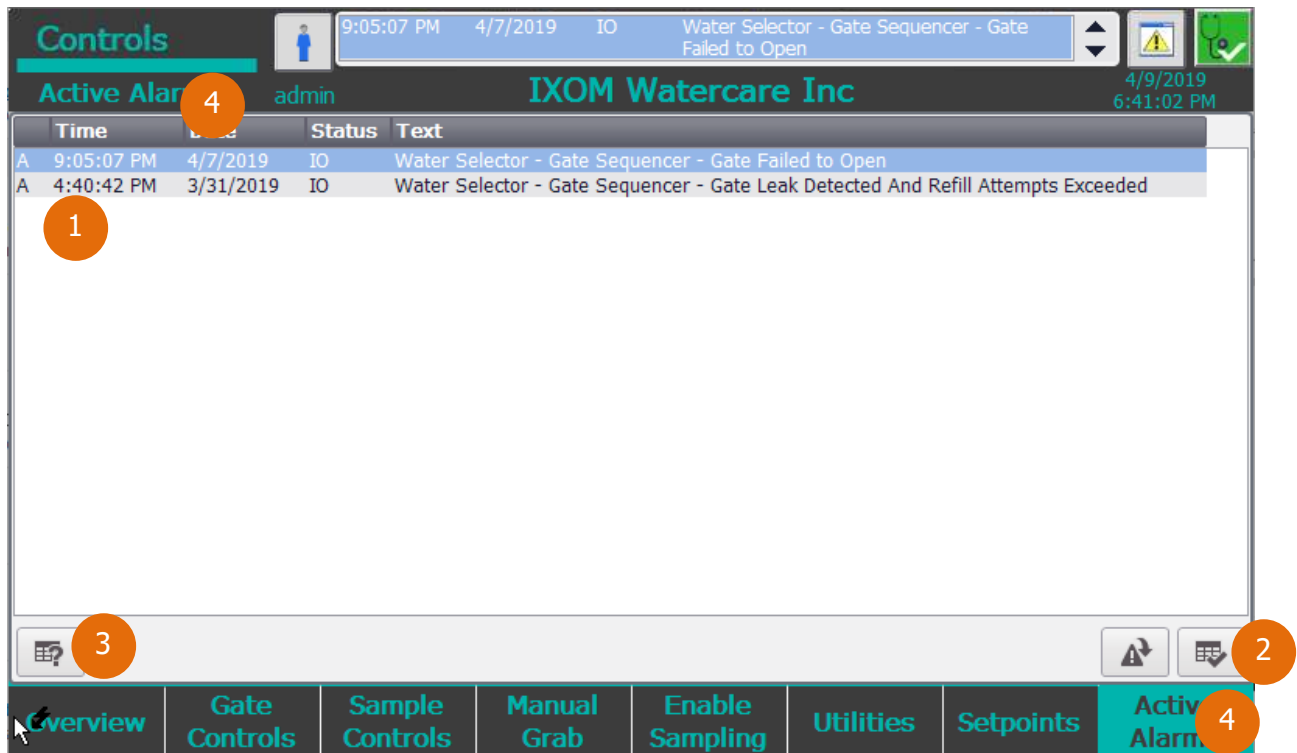
Setpoint / Variable	Description	Allowable Input	Initial Setting	Comments
Sample Sets per Day (#) (SP001)	Total number of times that the sample system will run through the depth profile per day.	0 – 24	12	4 min minimum recommended for automatic gate selection. 16 max any more sample sets will be redundant to accurate gate selection.
Distinct Sample Duration (min) (SP002)	Amount of time the sample screen will remain at one position along the depth profile.	2 – 30	8.0	5min minimum recommended Durations lower than this can produce misrepresentative sampling.
Sonde Wipe Buffer (sec) (SP003)	Before and after a sensor wipe, amount of time recording of values from sensors is disabled.	0 – 120	90	45 sec min. Too small of a buffer can lead to recording of erroneous data. 120 sec max.
Grab Sample Timeout (hr) (SP004)	When a grab sample is initiated, amount of time before system automatically returns to the sample sequence.	0 – 2	1	.0875 min. minimum recommended. Give at least 5 minutes to take your sample. 1 hr max. Timeouts effectively pause gate control for the system so long time periods should be avoided.
Sonde Air Scour (min) (SP005)	Amount of time for sonde flow cell air scour.	0-60	1	Input 0 to disable air scour. 10min Max recommended, further air scouring will prove redundant.
Sonde Air Scour Valve (%) (SP006)	Intensity of Air Scour to sonde flow cell via motion terminal air valve adjustments.	0-6	3.00	Intensity any higher can be detrimental to air scour effectiveness. (Air Scour is now controlled by a manual valve)
Sonde Air Scour / Flush (min) (SP007)	Amount of time for sonde flow cell flush with air scour.	0-60	2.00	Input 0 to disable air Scour / flush. 15min Max recommended, longer periods will prove redundant.
Sonde Air Scour / Flush Valve (%) (SP008)	Intensity of Air Scour / Flush to sonde flow cell via motion terminal air valve adjustments.	0-6	2.00	Intensity any higher can be detrimental to air scour / flush effectiveness. (Air Scour is now controlled by a manual valve)
Sonde Flush (min) (SP009)	Amount of time for potable water flush to sonde flow cell.	0-15	1.00	Input 0 to disable Sonde Flush. 15min Max recommended, longer periods will prove

Setpoint / Variable	Description	Allowable Input	Initial Setting	Comments
				redundant.
Sample Supply Flush (min) (SP010)	Amount of time for potable water flush to sonde flow cell when a manual flush is initiated.	0-60	1.00	15min Max recommended, longer periods will prove redundant.
Gate Detection Air Supply (%) (SP011)	Flowrate of air supply to gate when detecting gate open / closed via motion terminal air valve adjustments.	0-5	0.30	To high of flows cause errors is gate Closed detection logic.
Gate Detection ROC (ft/min) (SP012)	Minimum rise rate measured by motion terminals to detect the gate Closed pressure	0-5	1.00	With instrument error a detection rate to close to zero could prevent the gate closed detection logic from working.
Open Gate Air Supply (%) (SP013)	Flowrate of air supply to gate when opening a gate via motion terminal air valve adjustments.	5-35	20	Higher air flows are not required to open a gate and should be reduced to avoid excessive use of compressed air.
Buoyancy Chamber Fill (sec) (SP014)	Amount of time air is supplied at "Open gate Air Supply (%)" to open a gate.	0-300	60	30 sec minimum recommended. Any lower than this may result in insufficient air to fill gate buoyancy chamber. 90 sec maximum recommended. This should be reduced to avoid excessive use of compressed air.
Pressure Detect Equalize (sec) (SP015)	Amount of time air is supplied at "Gate Detection Air Supply (%)" to determine open/close.	0-60	15	10 sec minimum recommended. Lower than this and system may not successfully detect open / close.
Gate Open Tolerance (ft) (SP016)	Allowable tolerance in gate open detection compared to past recorded values.	0-2	0.75	0.250 ft min recommended. Less than this and system may not successfully detect open / close. 1 ft maximum recommended. Accurate gate open detection is not possible when tolerance set too high.
Gate Travel DP (ft) (SP017)	Expected difference between gate closed detected pressure and gate open detected pressure. Set for physical gate open / close position.	0-2	1.8	Measure gate change in elevation when closed vs. open.
Maintain Gate Open (%) (SP018)	Flowrate of air supply to gate when gate has been detected open via motion terminal air valve adjustments.	0-1	0.05	Higher air flows are not required to keep a gate open and should be reduced to avoid excessive use of compressed air.

Setpoint / Variable	Description	Allowable Input	Initial Setting	Comments
Allowable Deviations per (day) (SP019)	Amount of failures to detect gate opening allowed per day before system will perform an automatic gate refill.	0-3	0	Input of 0 will cause any failure to detect a gate opening to trigger an automatic gate check sequence.
Air Compressors Alternate (days) (SP020)	Amount of time before air compressors switch between duty and standby if there hasn't been a fault detected.	0-31	1	Input of 1 caused compressors to switch each day.
Refill Ballast Time (min) (SP021)	If gate is slowly closing additional refill time may be configured	0-5	0.00	should be less than SP014
Chemical Add Time (min) (SP022)	Amount of time chemical addition pump will run each time it is called.	0-60	0.00	Must be less than SP007
Add Chemical Every (#) Flushes (SP023)	Number of flushes the sample system must finish before chemical will be added on the next flush	0-30	1	This sets the chemical addition frequency. Set higher to add cleaning solution less frequently.

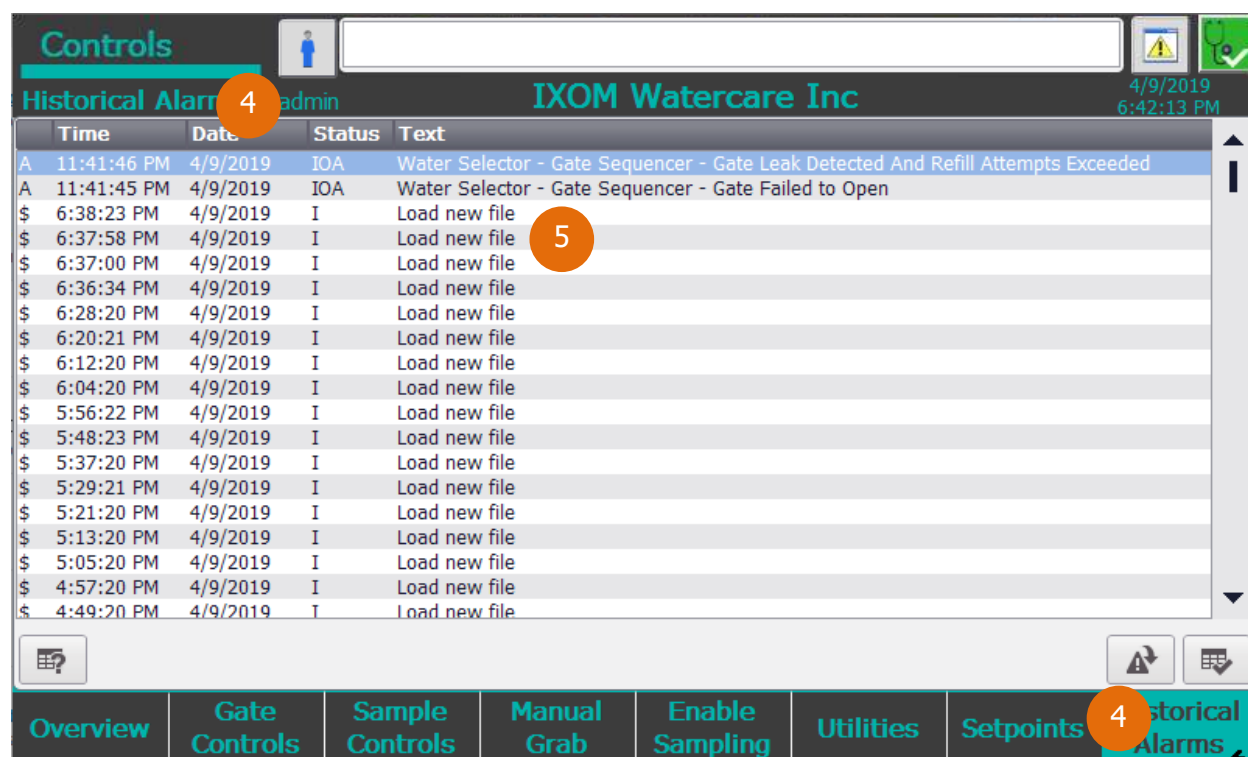
3.3.1 Alarms Screens

Figure 21 Active Alarms Screen



1. **Active Alarms:** Alarms will be displayed with time and date stamps and will flash red when active. When the system falls out of an alarm condition the alarms stay up on the active screen waiting to be acknowledged by operators.
2. **Acknowledge Alarms:** Pressing this button will acknowledge all current alarms on the active screen.
3. **More Info:** Provides help and more information about the highlighted alarm.
4. **Go to Historical Alarms / Active Alarms:** Pressing this text in either location will toggle between Historical and Active Alarms. (see figures 21 and 22)
5. **Historical Alarms:** Historical alarms and events are displayed here.

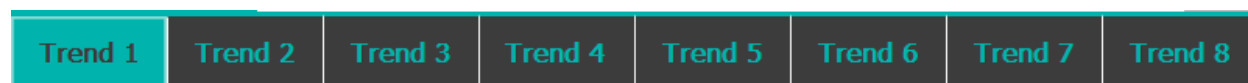
Figure 22 Historical Alarms Screen



3.4 TREND SCREENS

This section of the HMI screens displays historical trended data for water quality parameters measured by the sonde, and other data collected by instruments in the Water Selector™ and PAMS unit.

Figure 23 Trend Screens Navigation

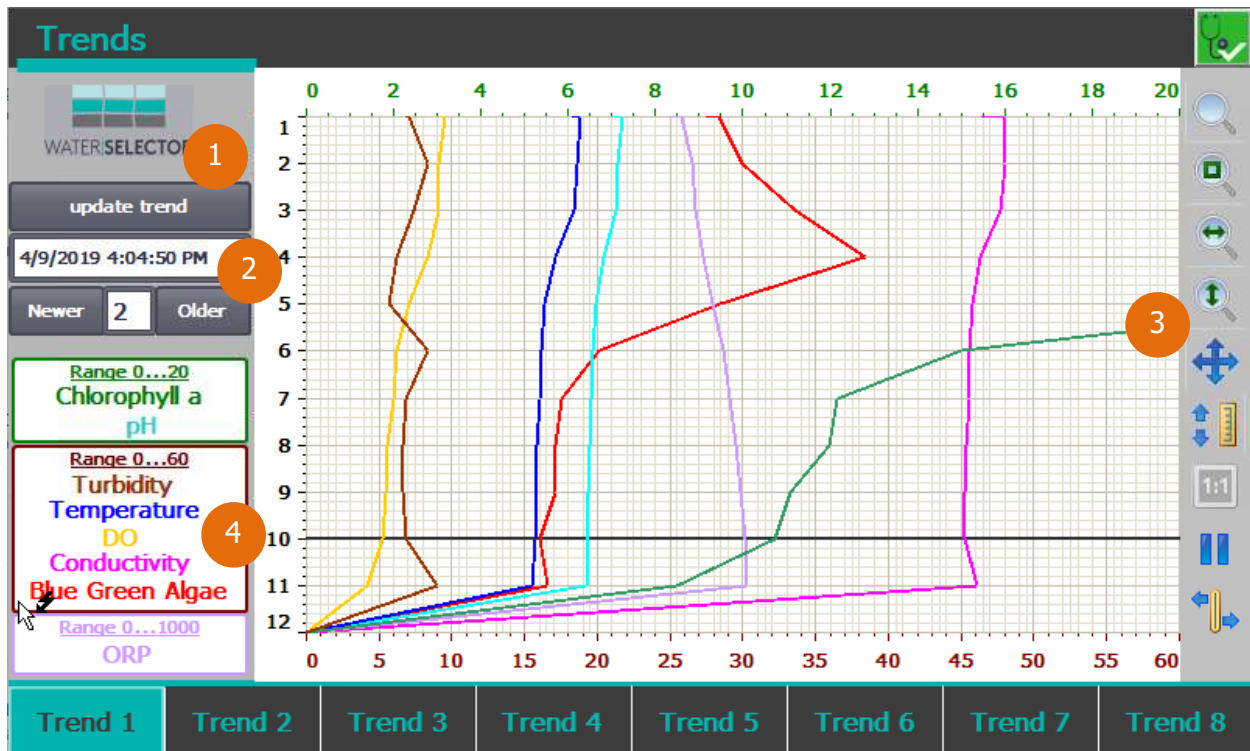


Along the bottom of the interface there are several buttons that navigate the various trend screens which are described below:

- **Trend 1:** This trend shows current and historical lake profiles.
- **Trend 2:** This trend shows historical data for system air pressure and gate operations.
- **Trend 3:** This trend shows historical data for gate sequence, sample position and flow rate.
- **Trend 4:** This trend shows historical data for measured water quality parameters.

3.4.1 Trend 1

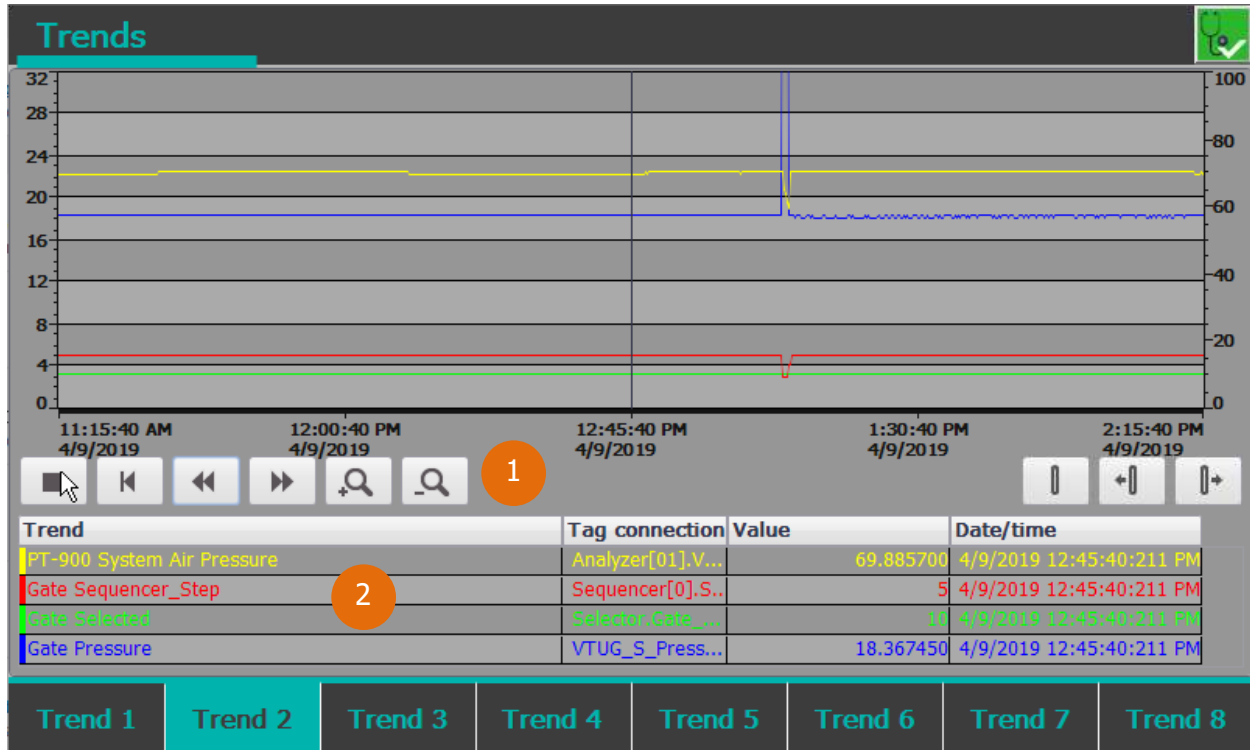
Figure 24 Trend 1 Lake Profiles



1. **Update Trend:** This button updates the screen with current lake profile data being collected from the sonde.
2. **Historical Lake Profiles:** Using the "Newer" and "Older" Buttons will allow operators to browse between completed Lake Profiles. The date and time of the lake profile displayed will be shown here as well. Enter the number of previous lake profiles desired to view the corresponding historical lake profile.
3. **Manipulate View Commands:** The commands in this section will allow the operator to change the view of the trend data displayed. Operators can change the scale of the display, zoom in to sections, pause the recording of lake profiles on the trend screen, and measure differences in data points.
4. **Water Quality Unit Definitions:** This section of the screen defines which water quality parameters correspond to which coloured line in the lake profile and identifies which X (horizontal) axis displays the units for each parameter.

3.4.2 Additional Trend Screens

Figure 25 Additional Trend Screens



1. **Manipulate Trend Commands:** The commands in this section will allow the operator to change the view of the trend data displayed. Operators can browse through historical data, zoom in to sections, and pause or start the recording of trends on the trend screen.
2. **Trended Values Table:** This table defines the values and units being displayed on the current trend screen and gives date and time information.

3.5 DIAGNOSTICS SCREENS

This section of the HMI screens displays diagnostics information for the control panel hardware.

Figure 26 Diagnostics Screens Navigation



Along the bottom of the interface there are several buttons that navigate the various diagnostics screens which are described below:

- **Viewer:** This screen displays an overview of PLC IO and Remote IO Status.

- **Network Status:** The status of network components is displayed here.
- **Network Topology:** A schematic of network connectivity is shown on this screen.
- **Managed Switch:** NA for this System
- **UPS:** UPS battery health and status can be assessed in this section.
- **Watch Table:** NA for this System
- **Pro Diag:** NA for this System
- **PLC View:** NA for this System

3.5.1 `Viewer

Figure 27 Viewer

The screenshot shows the 'Diagnostics' tab in the IXOM Watercare Inc. software. The main display area shows the 'ET 200SP station_3' configuration. Below this, a table lists the hardware components and their statuses. A green checkmark in the 'Status' column indicates that all components are operational. A red circle with the number '1' highlights the 'CM PtP_1' component in the 'Operational' column.

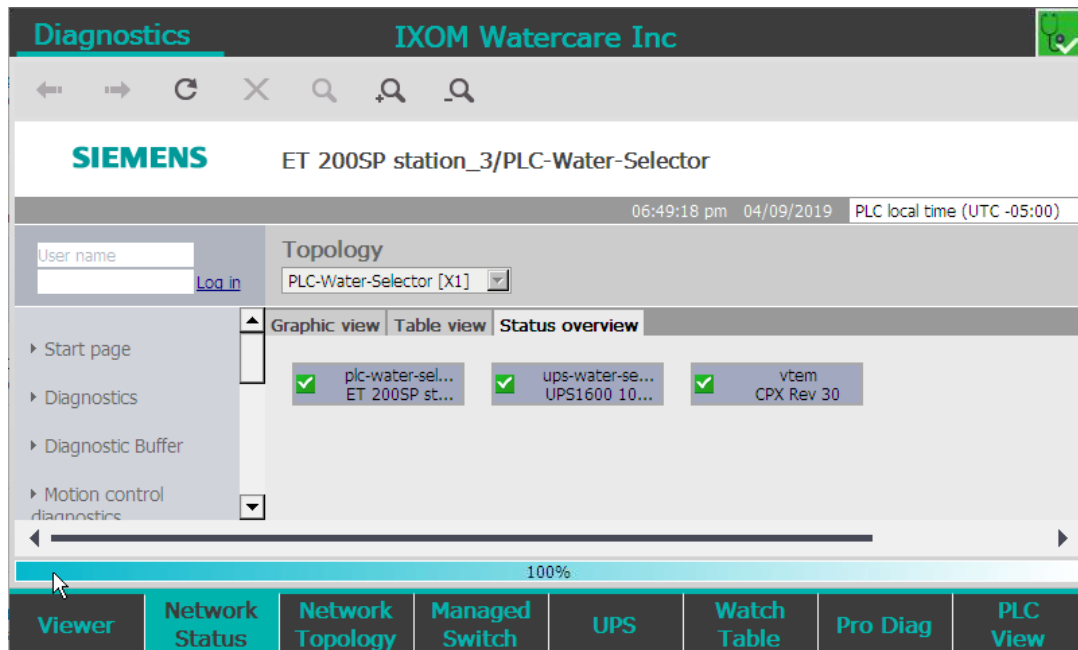
Status	Name	Operational	Slot	Type	Order number	Address
✓	ET 200SP station_3			ET 200SP station		32*
✓	PLC-Water-Selector	✓	1	CPU 1512SP-1 PN	6ES7 512-1DK01-0AB0	49*
✓	PROFINET IO-System					258*
✓	CM PtP_1	1	2	CM PtP	6ES7 137-6AA00-0BA0	281*
✓	CM 4xIO-Link_1		3	CM 4xIO-Link	6ES7 137-6BD00-0BA0	271*
✓	AI 4xI 2-,4-wire ST_1		4	AI 4xI 2-,4-wire ST	6ES7 134-6GD01-0BA1	268*
✓	DI 8x24VDC ST_1		5	DI 8x24VDC ST	6ES7 131-6BF01-0BA0	269*
✓	DQ 8x24VDC/0.5A ST_1		6	DQ 8x24VDC/0.5A ST	6ES7 132-6BF01-0BA0	257*
✓	Server module_1		7	Server module	6ES7 193-6PA00-0AA0	270*

The interface includes a navigation bar at the bottom with buttons for 'Viewer', 'Network Status', 'Network Topology', 'Managed Switch', 'UPS', 'Watch Table', 'Pro Diag', and 'PLC View'. The 'Viewer' button is currently selected.

1. **Hardware components:** This table shows the various listed hardware components and their statuses. A green check mark indicated not problems. Each of the fields can be expanded for further details.

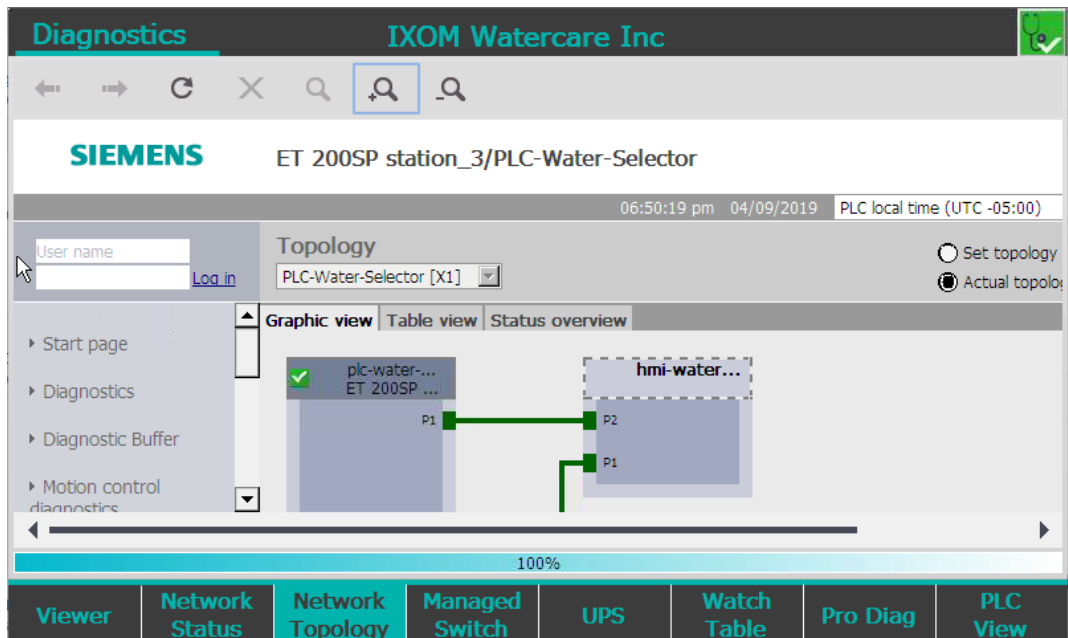
3.5.2 Network Status

Figure 28 Network Status



3.5.1 Network Topology

Figure 29 Network Topology



3.5.1 UPS Screens

Figure 30 UPS Sub-Screen

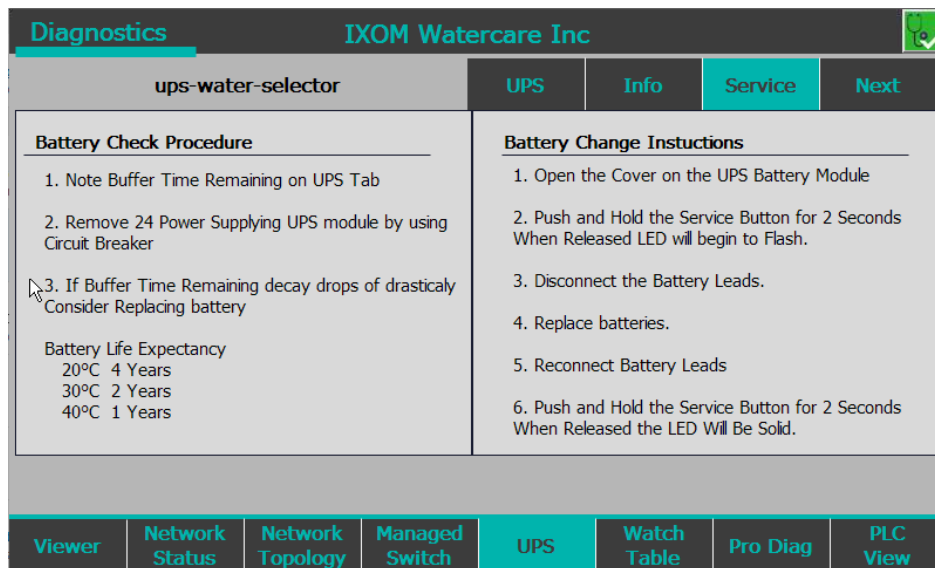
UPS state information		Battery state information	
Status	Buffering	Status	Status
Input Voltage: ■	Runtime Remaining: 16.42 min	Change Battery: ■	Charge Level: 100 %
Buffer Mode: ■	Total Operating Time: 35.2 Days	Charge Sufficient: ■	Capacity: 1.20 Ah
Ready to Buffer: ■		Unknown Battery: ■	Battery Com.: ■
New Alarms: ■			
Input Voltage: 24.20 V	Output Voltage: 24.26 V	End of Charge: 27.30 V	
Input Current: 1.88 A	Output Current: 1.67 A	Battery Voltage: 25.51 V	
	Load Current: 1.68 A	Charge Current: 0.01 A	

1. **Select UPS Sub-Screen:** Switching between the various UPS subscreens can be done using these tabs.
2. **UPS State Information:** All status indicators for the UPS unit are displayed here along with total run time, total buffer time, and current input and output voltage and current.
3. **Battery State Information:** All status indicators for the battery are displayed here along with charge level, charge capacity, and voltage and current.

Figure 31 UPS Info Sub-Screen

Battery Information	
Device name:	ups-water-selector
Order number:	6EP4134-3AB00-2AY0
Serial number:	Q6KOACPWGLC
HW revision:	768
SW revision:	1030

Figure 32 UPS Service Sub-Screen



3.6 APPS SCREENS

This section of the HMI screens displays different application that can be accessed to perform a variety of tasks.

Figure 33 Apps Screens Navigation



Along the bottom of the interface there are several buttons that navigate the various application screens which are described below:

- **Email:** This is where email/text messages address may be configured for notification during a critical alarm scenario.
- **Users:** The various user profiles are recorded in this section of the HMI screens.
- **Set Time:** On this screen time and date for the PLC can be set.
- **HMI:** This screen can access various HMI system applications.
- **USB:** (this screen is empty at this time)
- **PLC:** Configure PLC.
- **Data Exchange:** (this screen is empty at this time)
- **System Commands:** Various control system commands can be initiated from this screen.

Figure 34 Users Screen

Appendix

Apps		Users	Backup 1	Restore 2	admin	
User	Password	Group	Logoff time			
admin	*****	Administ...	60			
Administrator	*****	Administ...	60			
oper	*****	Operators	60			
PLC User	*****	Unautho...	5			
super	*****	Supervis...	60			
view	*****	View Only	60			

1. **Backup:** Pressing this button creates a backup of all users.
2. **Restore:** This button will restore the users directly from that last saved backup.



NOTE: When HMI is reloaded or upgraded it will reset to default users and you must restore or recreate any new users or changed passwords.

3. **Username:** Select blank area to create a new user.
4. **Password:** Select ***** to create a new password for user.
5. **Group:** Select this column to assign user to a group.
6. **Logoff Time:** logoff time is may be changed to a maximum of 60 minutes

3.6.1 Set Time Screen

Figure 35 Set Time Screen

The screenshot shows the 'Setting PLC Time' interface. At the top, there's a header with 'Apps' and 'IXOM Watercare Inc'. The main area contains a form titled 'Setting PLC Time'. It has two rows for time: 'UTC Time' showing '4/9/2019 10:54:48 PM' and 'UTC' showing '-8' and '4/9/2019 6:54:48 PM'. Below these is a 'Time Zone' section with input fields for Year (2019), Hour (18), Month (4), Minute (54), Day (9), Second (44), and Week Day (3). There are also 'Get Time' and 'Set Time' buttons. Three orange circles with numbers 1, 2, and 3 are overlaid on the screen. Circle 1 is on the 'Get Time' button. Circle 2 is on the 'Set Time' button. Circle 3 is on the 'Set' button. At the bottom, there's a navigation bar with buttons for 'Email', 'Users', 'Set Time' (highlighted), 'HMI', 'USB', 'PLC', 'Data Exchange', and 'System Commands'.

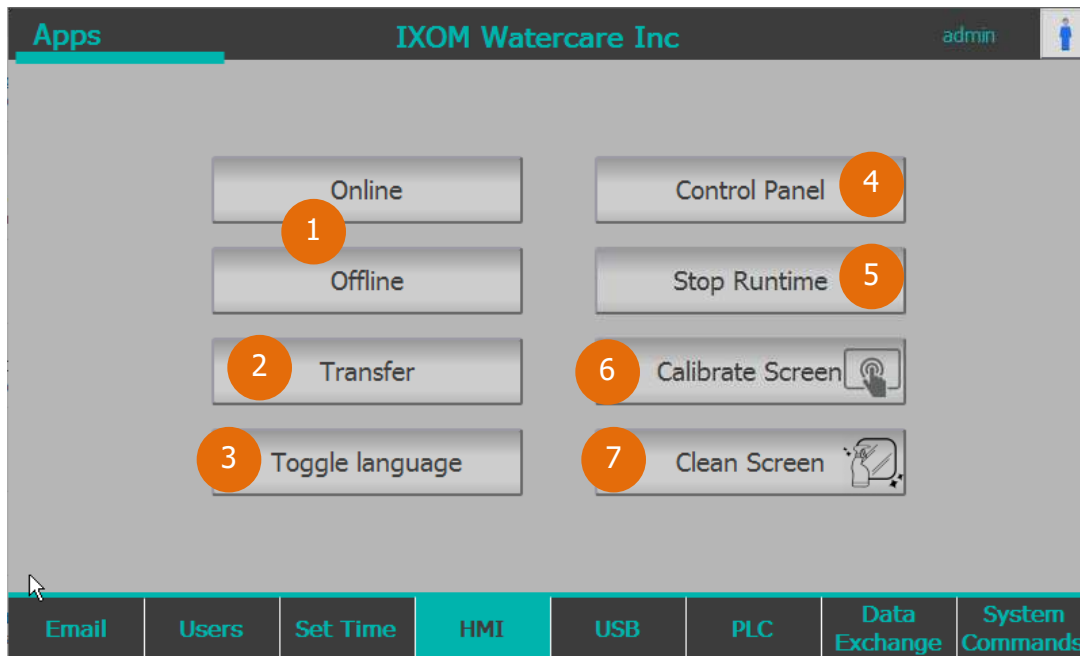


NOTE: If there is an active internet connection the system time is synced from the VPN router and only the time zone is needed.

1. **Get Time:** Copies the Current PLC time in the registers for easy modification.
2. **Time Fields:** Update the Time fields as needed.
3. **Set Time:** moves the time fields to the PLC.

3.6.2 HMI Screen

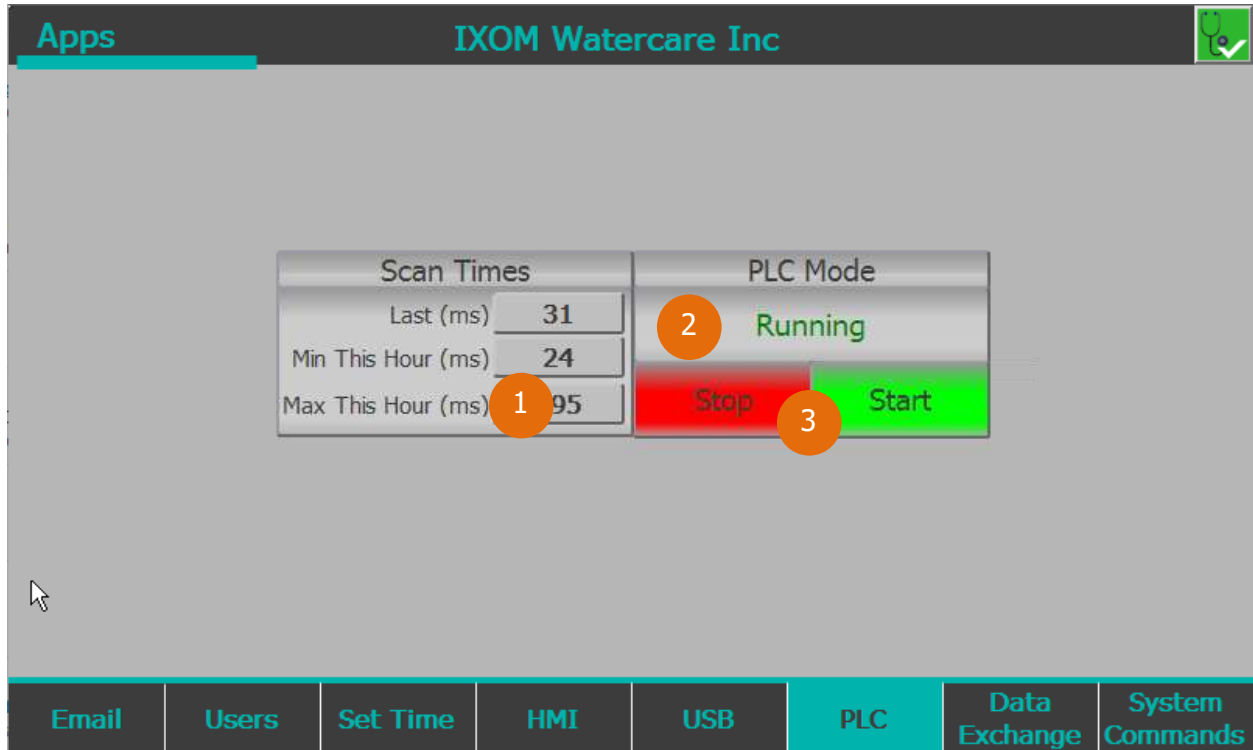
Figure 36 HMI Applications Screen



1. **Online/Offline:** Change the HMI mode to read, or not read PLC tags.
2. **Transfer:** Changes the HMI to transfer mode where the HMI is waiting to receive program.
3. **Toggle Language:** This brings up a tool that allows the operating language to be changed.
4. **Control Panel:** This button brings up the operating systems control panel.
5. **Stop Runtime:** Closes the HMI runtime application and exits to Windows CE
6. **Calibrate Screen:** This button will bring up a window that allows the operator to calibrate touch screen.
7. **Clean Screen:** Pushing this button will disable to touch screen temporarily to allow cleaning of the screen without accidentally activating buttons.

3.6.3 PLC Screen

Figure 37 PLC Screen



1. **Scan Time:** Indication of PLC scan times for diagnostic purposes.
2. **PLC Status:** Indicates the status of the PLC.
3. **Start/Stop:** Allow PLC to be started and stopped from the HMI.

3.6.1 System Commands

1. **System Name and Location:** Enter this information in these locations.

2. **Simulate All:** Using this will put all instruments in simulation mode.

Figure 38 System Commands

The screenshot displays the 'System Commands' interface for IXOM Watercare Inc. At the top, there's a header with 'Apps' and 'IXOM Watercare Inc'. Below this, the 'System Name' is set to 'Water Selector' (labeled 1), and the 'System Location' is empty. The main section contains 11 numbered callouts pointing to various system command buttons: 2. Simulate All, 3. Manual ALL, 4. Reset Required, 5. Save Setpoints, 6. Download Mode, 7. UnSimulate All, 8. Auto ALL, 9. Reset Not Req, 10. Restore Setpoints, and 11. Reset Alarms. Each button has a 'No' status indicator. The bottom navigation bar includes 'Email', 'Users', 'Set Time', 'HMI', 'USB', 'PLC', 'Data Exchange', and 'System Commands'.

3. **Manual All:** Using this will put all equipment, valves, and instruments in manual mode.
4. **Reset Required:** Changes all instrument alarms to require a manual reset to clear alarm.
5. **Save Setpoints:** Saves current list of setpoints.
6. **Download Mode:** Changes state of all devices in the system to be safe to perform a PLC download.
7. **UnSimulate All:** Takes all instruments out of simulate mode.
8. **Auto All:** Using this will put all equipment, valves, and instruments in auto mode.
9. **Reset Not Required:** Changes all instruments alarms to not require a manual reset to clear alarm
10. **Restore Setpoints:** Restores system setpoints to last saved values.
11. **Reset Alarms:** Reset multiple latched alarms at one time.

SECTION 4: ROUTINE MAINTENANCE AND CALIBRATION

4.1 INTRODUCTION

This section of the manual will provide information on procedures for the maintenance of the Water Selector, and PAMS unit equipment, as well as calibration information for the sensors contained in the multi-parameter sonde.

4.2 TOWER BASED WATER SELECTOR™ MAINTENANCE

A tower-based Water Selector™ will sit mostly submerged and for this reason most maintenance operations should be conducted by a trained and certified diver. The below table contains a breakdown of equipment maintenance, and schedule:

Table 3 Tower Based Water Selector™ Maintenance

Equipment Item	Description	Frequency
Barrier Exterior	<ul style="list-style-type: none">Inspect exterior surfaces. Look for bio-growth (remove if possible), signs of corrosion, and any damaged surfaces. If any heavily corroded, or damaged areas appear to allow water to flow through an area larger than ~1" diameter this will interfere with the operation of the selector and plans must be made to repair the breach.Inspect barrier rubber seal along perimeter of contact with intake structure. Check that no sections of the seal have broken contact with the structure or barrier.	Yearly; inspection by trained divers only.
Barrier Interior	<ul style="list-style-type: none">Remove barrier grating and inspect interior. Look for bio-growth or debris (remove if possible), signs of corrosion, and any damaged surfaces. Inspect floor of barrier for excessive buildup of debris (>1ft deep), remove if present.Inspect air tubing to gates for tidiness, and for any tangling with selector gates, bio-growth, or debris; remove if present. With assistance, open a gate and observe if any air bubbles release from air tubing, or at the bulk head connections near top of barrier. Replace air tubing or bulk head connector if required.	Yearly; inspection by trained divers only.
Gate Operation	With assistance, observe the opening and closing of each of the Water Selector™ gates. Ensure that each gate opens promptly when air is applied, and that each close firmly against its opening, with its gasket fully sealing. Note quality of gasket, and attachment to gate perimeter. Contact Ixom Watercare if gasket has become detached or worn.	Yearly; inspection by trained divers only.
Interior Inspection of	<ul style="list-style-type: none">Inspect gates for tidiness, and for any interference with bio-growth, or debris; remove if present. With assistance,	Yearly; inspection by trained divers

Equipment Item	Description	Frequency
Gates	<p>open a gate and observe if any air bubbles release from air tubing connection at gate. Replace air connection fitting if required.</p> <ul style="list-style-type: none"> Inspect the gate buoyancy chambers for any bio growth or debris, ensure that buoyancy chambers are clear of any debris as this can affect operation of gates. Observe connection with gate door for tightness; re tighten buoyancy chamber if needed. 	only.
Control System gate exercise routine	<ul style="list-style-type: none"> From the control system, trigger the Gate exercise routine and verify the Close gate pressure, and Open gate position feed backs of each or the gates in the system 	Monthly

4.3 REEL SYSTEM MAINTENANCE

The reel system will sit on a work platform above the body of water and is likely installed outdoors. The system should be observed running on a routine basis to confirm normal operation. The below table contains a breakdown of equipment maintenance, and schedule:

Table 4 Reel System Maintenance

Equipment Item	Description	Frequency
Drum and Hose	<ul style="list-style-type: none"> With assistance, observe the rotation of the reel, and wrapping of the hose on the drum by the guide (ENSURE SAMPLE SYSTEM IS PAUSED WHEN EVALUATING HOSE REEL OPERATION FOR MAINTENANCE). This will require peering under or removing the sun shade (HOSE REEL GUIDE MUST BE PARTIALLY REASSEMBLED AFTER REMOVING SUN SHADE). If hose wraps along the drum in an uneven or crossing pattern, reel sample screen out until hose is unwrapped completely from drum (TAKE CARE NOT TO REEL OUT PAST THE FINAL DRUM NOZZLE POSITION AND KINK THE HOSE). Reel sample screen back in to home position; ensure even wrapping of hose. Hose will be marked at the point where it passes through the platform reel system is installed on; observe location of home marking and adjust using the Hose Reel Advanced Controls 3.3.2.7 	Monthly
Sample Screen	<ul style="list-style-type: none"> Reel sample screen back in to home position; ensure even wrapping of hose. Pull hose up through platform penetration till screen sits on deck. Observe screen and remove buildup of debris and material using clean water, and rag. Lower sample screen back into water and resume the sample process. 	Monthly

Equipment Item	Description	Frequency
Chain Drive system	<ul style="list-style-type: none"> Check the tension and wear on the chain drive system Lubricate to help prevent corrosion 	Monthly
Motor and Brake	<ul style="list-style-type: none"> Inspect reel system motor and brake for signs of corrosion and damage. Check motor and brake mounting for tightness. Tighten any loose connections found. 	Twice Per Year
Encoder	Inspect encoder for tightness of connection to reel shaft. With assistance, observe the encoder while the system reels in and out, and ensure that the reel shaft does not slip against the encoder's annulus. Tighten set screws if needed.	Twice Per Year
Hose to Sample System	Inspect hose and PVC conduit run for damage, debris, and presence of wildlife; remove if present. Observe while sample system is running and ensure that no leaks are present. Tighten hose connections or replace hose if leaks found.	Twice Per Year

4.4 RIO PANEL MAINTENANCE

The RIO Panel will likely be mounted outdoors local to the selector barrier. This panel should be checked periodically for condition and operation. The below table contains a breakdown of equipment maintenance, and schedule:

Table 5 RIO Panel Maintenance

Equipment Item	Description	Frequency
RIO Panel	<ul style="list-style-type: none"> Check panel for any damage or corrosion. Open panel and inspect for water intrusion, and for presence of any wildlife, remove if present. Inspect air solenoid valve manifold exhaust silencers for evidence of water. Look for stains on the silencer or on the panel surfaces local to it. Replace any damaged exhaust silencers. 	Monthly

4.5 COMPRESSED AIR EQUIPMENT MAINTENANCE

Compressed air equipment will be installed local to the PAMS control cabinet. The below table contains a breakdown of equipment maintenance, and schedule:

Table 6 Compressed Air Equipment Maintenance

Equipment Item	Description	Frequency
----------------	-------------	-----------

Equipment Item	Description	Frequency
Air Compressors	<ul style="list-style-type: none"> On each compressor, test the auto-drain valves and note any excess water being expelled from the receiver tanks. Adjust timing of auto-drain valves to operate more frequently if excess water is observed. Remove the air filter from each compressor and open the lid. Clean off air filter element. If clogged, replace with a new air filter. Refer to the air compressor manual for routine and repair maintenance. 	Monthly
Air Dryer	Test the auto-drain valves and note any excess water being expelled from the dryer. Adjust timing of auto-drain valve to operate more frequently if excess water is observed. (reference air dryer manual for instructions)	Monthly
Air Filters	<ul style="list-style-type: none"> Observe differential pressure on air filter gauges. Clean or replace element if dial indicates differential pressure is in the "red" zone. Test auto-drain valves and not if any excess water is expelled. Clean out any debris that has collected in the filter element cup. 	Monthly

4.6 PAMS CONTROL CABINET EQUIPMENT MAINTENANCE

The main items requiring maintenance will be the sonde sensors and flow cell. The below table contains a breakdown of equipment maintenance, and schedule:

Table 7 PAMS Control Cabinet Equipment Maintenance

Equipment Item	Description	Frequency
Process Piping and Cabinet Interior	<ul style="list-style-type: none"> Observe the process piping within the cabinet during sample system operation. Note any leaking fittings or piping. Tighten, repair, or replace any piping or tubing that has developed any leaks. Inspect the cabinet interior for build up of any debris or material, clean and remove if present. 	Monthly
Sonde Flow Cell	<ul style="list-style-type: none"> Inspect flow cell for excessive build up of debris and material; remove if present, and clean flow cell to maintain proper flows and cell transparency. 	Monthly

4.7 CONTROL PANEL MAINTENANCE

The main items requiring maintenance will be the sonde sensors and flow cell. The below table contains a breakdown

Table 8 Control Panel Maintenance

Equipment Item	Description	Frequency
UPS Battery	<ul style="list-style-type: none"> Perform a Power cycle with disconnect switch and observe battery performance and runtime. Replace battery every 2-5 years or as needed according to power cycle test. 	Years
Surge Protection Device	Ensure that none of the Surge protection devices have been tripped. Replace damage surge protection device and needed	Monthly

4.8 SONDE SENSORS CALIBRATION AND MAINTENANCE

The below table contains a breakdown of sensor maintenance, and calibration. Each sensor will need to be calibrated and cleaned on a quarterly basis. Refer to [section 4.8.1](#) for instructions on removing the sonde flow cell and attaching the calibration cup. Use the following link to access the [user manual for the Hydrolab HL7 Sonde's Sensors](#) containing all instructions for calibration and maintenance, PDF document has links to each of the sensor pages from page 3 of the document:

Table 9 Sonde Sensors Calibration and Maintenance

Sensor	Link	Frequency ¹
Blue-Green Algae Fresh Water Sensor	Refer to page 5 of Hydrolab HL7 – OTT HL Series Sensors User Manual	Quarterly
Chlorophyll Sensor	Refer to page 12 of Hydrolab HL7 – OTT HL Series Sensors User Manual	Quarterly
Conductivity Sensor	Refer to page 14 of Hydrolab HL7 – OTT HL Series Sensors User Manual	Quarterly
Temperature Sensor	Refer to page 29 of Hydrolab HL7 – OTT HL Series Sensors User Manual	Quarterly
Depth Sensor	Refer to page 16 of Hydrolab HL7 – OTT HL Series Sensors User Manual	Quarterly
PH/ORP Sensor	Refer to page 23 of Hydrolab HL7 – OTT HL Series Sensors User Manual	Monthly

Sensor	Link	Frequency ¹
LDO Sensor	Refer to page 18 of Hydrolab HL7 – OTT HL Series Sensors User Manual	Monthly
Turbidity sensor	Refer to page 33 of hydrolab hl7 – ott hl series sensors user manual	Monthly

1. Or in accordance with the plant's standard instrument calibration program/procedures

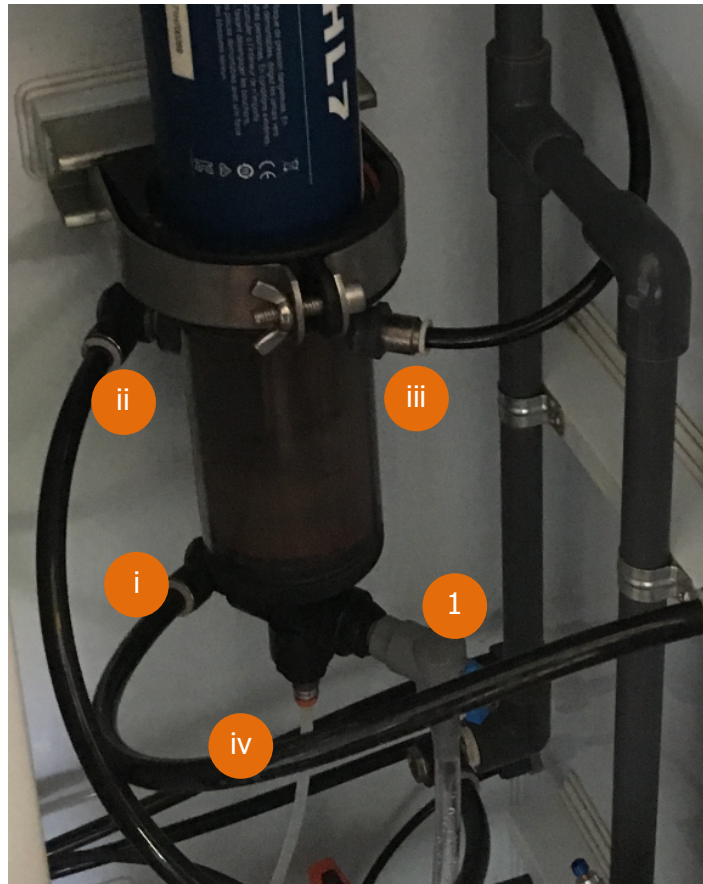
4.8.1 Handling of Sonde Flow Cell

In order to perform routine maintenance and calibration on the sonde flow cell and sensors instructions for removal and re-assembly of the flow cell and/or calibration cup should be followed in order to avoid damaging equipment, and causing loss of containment:

Flow Cell Removal

1. Pause the sample sequence, and wait for the pump to stop.
2. Open the sample cell drain valve, and allow the contents of the flow cell to drain into the base of the cabinet.
3. Remove the following tube connections from the flow cell:
 - i. 1/2" Sample Flow Inlet
 - ii. 1/2" Sample Flow Outlet
 - iii. Air Vent
 - iv. 1/4" Air Scout Inlet

Figure 39 Sample Flow Cell Connections



4. With all connections removed and the sample cup free from obstructions, spin the sample cup counter clockwise to loosen it from the sonde's threads.
5. Carefully remove the cup past the sonde's sensors. Take care not to contact the sensors or catch on the wiper while removing.

Calibration Cup or Flow Cell Attachment

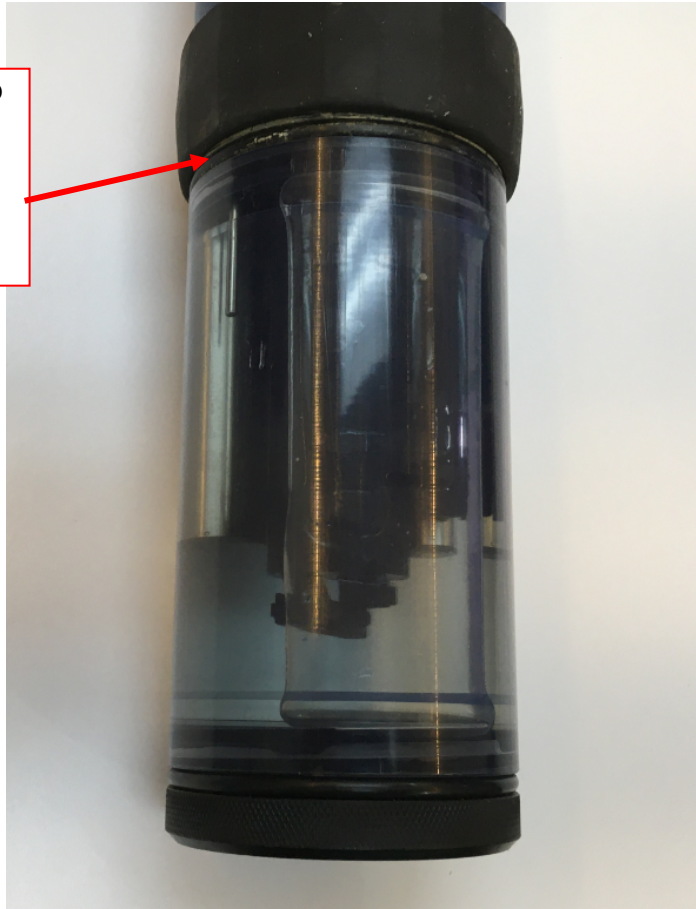
1. To fit either the flow cell or calibration cup onto the sonde, carefully place the open threaded end over the sonde sensors taking care not to contact the sensors or catch on the wiper.
2. Spin clockwise to tighten onto the sonde's threads.



NOTE: DO NOT OVERTIGHTEN. Only tighten until the cup or cell sits against the O-ring and does not compress it or seal will be broken.

Figure 40 Sonde Calibration Cup fit onto Sonde

Take care not to compress O-Ring when tightening onto Sonde



4.9 GENERAL HOSE AND TUBE INSPECTION/REPLACEMENT

The system contains several runs of water hose, and various runs of tubing for compressed air. These will be subject to wear and deterioration over time. Refer to the table below for information on inspection and replacement of water hose, and air tubing:

Table 10 Hose and Tube Inspection/Replacement

Equipment Item	Description	Frequency
Water Hosing Inspection	<ul style="list-style-type: none">• Inspect all hose runs including the sample reel hose.• Take special notice of the ends of hose runs, note any fraying, or signs that the material has become damaged due to bending.• Look for signs that the circular cross section of the hose has collapsed, or has become permanently deformed.• Check for punctures and leaks.	Quarterly

Equipment Item	Description	Frequency
Water Hosing Replacement	<ul style="list-style-type: none"> • If a puncture is present, or excessive wear or deformation of the hose is observed, replace hose immediately. • Hoses should be replaced every 5 years under normal operation. 	5 years
Air Tubing Inspection	<ul style="list-style-type: none"> • Check all air tubing connections for tightness. • Check air tubing runs, check for nicks, and cuts, and discoloration. • Where possible handle the air tubing, and note any sections that have become ridged, and have lost their original flexibility. • Note any punctures or breaks. 	Quarterly
Air Tubing Replacement	<ul style="list-style-type: none"> • Any punctured, broken or deteriorated tubing should be replaced immediately. • All tubing should be replaced every 5 years under normal operation. 	5 years

4.10 LAKE LEVEL CALIBRATION

From the help screen, select the lake level calibration option, and follow the steps displayed to calibrate the lake level bubbler.

Figure 41 Lake Level Calibration 1 of 3

The screenshot shows the 'Lake Level Calibration' screen, Step 1 of 3. The interface has a dark grey header with 'Help' and 'IXOM Watercare Inc' on the left, and a green checkmark icon on the right. Below the header is a navigation bar with 'Measure & Air Trickle', 'Lake Level Calibration' (selected), 'Step 1', 'Step 2', and 'Step 3'. The main content area is divided into two columns. The left column is titled 'Calibrating Trickle' and 'Active'. It contains instructions: 'Press Start Calibrate' with a 'Start Calibration' button, 'Disconnect the Lake level Bubble Tube from the panel bulkhead and replace with a short short piece of tube with one end in a bucket of water', 'Set "Valve Position" to 2%. When bubbling occurs in bucket change Decrease valve percentage to "Trickle Postion Setpoint". Adjust Percentage up or down until reaching one bulble ever 3-5 seconds', 'Valve Position' set to 0.05 %, 'Step 3: Change "Trickle Position Setpoint" to Match "Valve Position"', and 'Step 4: Reconnect Lake Level Bubbler Tube'. The right column is titled 'Adjust the Following Setpoints For Puge and Trick Postion and Time'. It contains four setpoint fields: 'Purge Position Setpoint' (10.00 %), 'Purge Position Setpoint' (15 sec), 'Trickle Position Setpoint' (0.05 %), and 'Trickle Position Setpoint' (10 min). At the bottom right of the main content area is an 'Accept Values' button. The footer has a navigation bar with 'Contact Us', 'About', 'Service Intervals', 'Lake Level Calibration' (selected), 'Hose Reel Calibration', 'Gate Calibration', and 'Basic Controls'.

Help		IXOM Watercare Inc					
Measure & Air Trickle		Lake Level Calibration		Step 1	Step 2	Step 3	
Calibrating Trickle		Active					
Press Start Calibrate		Start Calibration		Adjust the Following Setpoints For Puge and Trick Postion and Time			
Disconnect the Lake level Bubble Tube from the panel bulkhead and replace with a short short piece of tube with one end in a bucket of water				Purge Position Setpoint 10.00 %			
				Purge Position Setpoint 15 sec			
Set "Valve Position" to 2%. When bubbling occurs in bucket change Decrease valve percentage to "Trickle Postion Setpoint". Adjust Percentage up or down until reaching one bulble ever 3-5 seconds				Trickle Position Setpoint 0.05 %			
				Trickle Position Setpoint 10 min			
Valve Position 0.05 %							
Step 3: Change "Trickle Position Setpoint" to Match "Valve Position"				When happy with values Accept			
Step 4: Reconnect Lake Level Bubbler Tube				Accept Values			

Contact Us	About	Service Intervals	Lake Level Calibration	Hose Reel Calibration	Gate Calibration	Basic Controls
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Figure 42 Lake Level Calibration 2 of 3

[Help](#)
IXOM Watercare Inc

Measure & Air Trickle

Lake Level Calibration

Step 1

Step 2

Step 3

Calibration Data

E1: Elevation from Sea Level to the Top of the Hose Reel Platform

780 feet

E2: Elevation from the Top of the Hose Reel platform to the Lake Water Level

80 inches

E3: Elevation from top of hose reel Platform to Highest Sample Postion

65 inches

E4: Distance Between Sample Postions

24 inches

Number of Sample Postions

12 #

Only Save Calibration when in "Input Calibration Data" Step

Save Calibration Data

Calibration Mode Active

** Note

Adjust E2 and E3 for fine calibration of pressure Sensor

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Hose Reel Calibration

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Figure 43 Lake Level Calibration 3 of 3

[Help](#)
IXOM Watercare Inc

Measure & Air Trickle

Lake Level Calibration

Step 1

Step 2

Step 3

Confirmation

Wait for System to enter "Measure & Air Trickle" Step and Verify Lake Level and Gate Feedback

Lake Level

773.4 ft

Gate Open Feedback

3.975 #

Current Selected Gate

4

Minor adjustments to Elevation calibrations may be needed to decrease margin of error.

If values look acurate do a "Purge and Verify"

If value are not in tolerance select "Unacceptable Error"

Unacceptable Error

Purge and Verify

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4.11 HOSE REEL CALIBRATION

From the help screen, select the Hose Reel calibration option, and follow the steps displayed to calibrate the hose reel. Assistance from Divers will be required for this calibration to confirm location of sample system's screen relative to gate positions.

Figure 44 Hose Reel Calibration 1 of 4

Help **IXOM Watercare Inc**

Hose Reel Calibration **Step 1** **Step 2** **Step 3** **Step 4**

Hose Reel Controls

Spool In At Gate 4.0 # Up
Large Adjustment (Push and Hold) Gate Request 4 # Micro Adjust (Push Once)
Spool Out Down

Setting the Home Position

Distance from the top of the Decking to the Top of the Sample screen

Step 1: Press "Go Home" Button and Hose reel will move to home position

Go Home

Step 2: Use the Hose Reel Controls to Adjust In/Up our Out/Down until the measured distance matches the Configured Distance

Step 3: When Configured Distance Matches Measured Distance Press "Set Home"

Set Home

65 Inches

Contact Us About Service Intervals Lake Level Calibration **Hose Reel Calibration** Gate Calibration Basic Controls

Figure 45 Hose Reel Calibration 2 of 4

[Help](#)
IXOM Watercare Inc

Hose Reel Calibration

Step 1

Step 2

Step 3

Step 4

Hose Reel Controls

Spool In

Large Adjustment (Push and Hold)

Spool Out

At Gate

4.0

#

Gate Request

4

#

Up

Micro Adjust (Push Once)

Down

84Inches D2

Set Top Gate

Step 2: Use the Hose Reel Controls to move the center of the sample screen to the Center of the Top/First Gate Location. D2 is assigned in the owners and my be used for Reference. Once the hose reel and sample screen are at this elevation Press "Store the Top Gate"

Store Top Gate

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Gate Calibration

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Figure 46 Hose Reel Calibration 3 of 4

[Help](#)
IXOM Watercare Inc

Hose Reel Calibration

Step 1

Step 2

Step 3

Step 4

Hose Reel Controls

Spool In

Large Adjustment (Push and Hold)

Spool Out

At Gate

4.0

#

Gate Request

4

#

Up

Micro Adjust (Push Once)

Down

372Inches D3

Set Bottom Gate

Step 2: Use the Hose Reel Controls to move the center of the sample screen to the Center of the Bottom/Last Gate Location. D3 is assigned in the owners and my be used for Reference. Once the hose reel and sample screen are at this elevation And the Gate Count is accurate Press "Store the Top Gate"

12 Gate Count

Store Bottom Gate

Caution !
This Will Calculate all Gate Postions

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Hose Reel Calibration


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Figure 47 Hose Reel Calibration 4 of 4

[Help](#)

IXOM Watercare Inc

# Hose Reel Calibration

Step 1

Step 2

Step 3

Step 4

Hose Reel Controls

Spool In

Large Adjustment
(Push and Hold)

At Gate

4.0

#

Up

Micro Adjust
(Push Once)

Spool Out

Gate Request

4

#

Down

Verify Postions

Press "Go Home" and while reel is moving note the Motor running Current and Speed

Go Home

Values

Reel Speed

+0.00

RPM

Motor Current

0.0

A

Trip Points

Low RPM

1.00

RPM

Low Current

0.2

A

High Current

2.0

A

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4.12 GATE CALIBRATION (NOT COMPLETE)

From the help screen, select the Gate Calibration and follow the steps displayed to calibrate the gates.

Figure 48 Gate Calibration 1 of 3

The screenshot shows the 'Gate Calibration' screen for IXOM Watercare Inc. The interface includes a top navigation bar with 'Help' and 'IXOM Watercare Inc' logos. Below this is a step indicator showing 'Step Number 7 #'. The main content area is titled 'Calibrating Gate Maintain Trickle' and contains four steps: Step 1: Disconnect the 10mm 'VTUG Supply Tube' from the panel bulkhead and replace with a short short piece of tube with one end in a bucket of water; Step 2: Set valve Position to 2 percent and when bubbling occurs in bucket change Decrease valve percentage to Maintain Gate Open %. adjust Valve postiton percentage to one bulble ever 3-5 seconds; Step 3: Change Maintain Gate Open (%) to Match Valve Position; Step 4: Reconnect the 'VTUG Supply Tube'. Input fields for 'Valve Position' (0.05 %) and 'Maintain Gate Open (%)' (0.05) are present. A 'Start Calibration' button is located on the left side of the screen. The bottom navigation bar includes links for 'Contact Us', 'About', 'Service Intervals', 'Lake Level Calibration', 'Hose Reel Calibration', 'Gate Calibration', and 'Basic Controls'.

Help IXOM Watercare Inc

Step Number 7 # Gate Calibration Step 1 Step 2 Step 3

Start Calibration

The Start Calibration Button must be pressed before Changing any changing any values and Ended when before Leaving !!!

Start Calibration

Calibrating Gate Maintain Trickle

Step 1: Disconnect the 10mm "VTUG Supply Tube" from the panel bulkhead and replace with a short short piece of tube with one end in a bucket of water

Step 2: Set valve Position to 2 percent and when bubbling occurs in bucket change Decrease valve percentage to Maintain Gate Open %. adjust Valve postiton percentage to one bulble ever 3-5 seconds

Valve Position 0.05 %

Step 3: Change Maintain Gate Open (%) to Match Valve Position

Maintain Gate Open (%) 0.05 SP 018

Step 4: Reconnect the "VTUG Supply Tube."

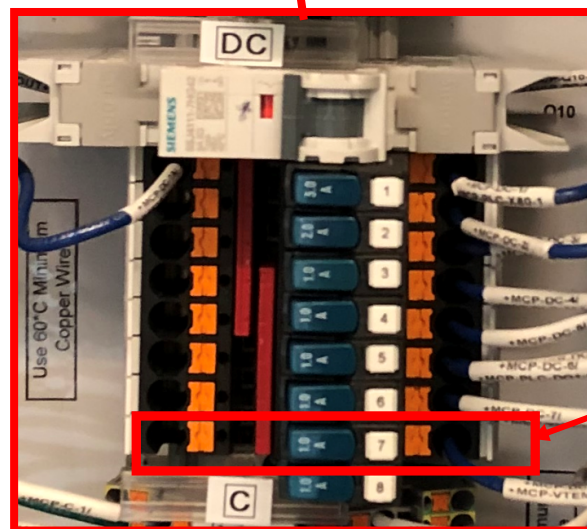
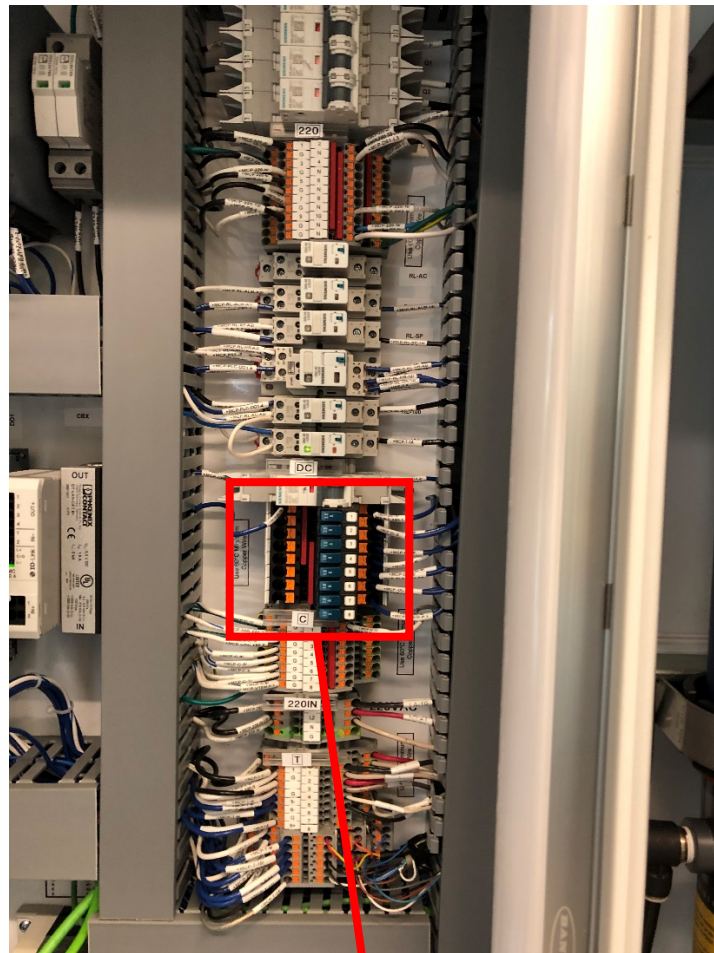
Contact Us About Service Intervals Lake Level Calibration Hose Reel Calibration Gate Calibration Basic Controls

4.13 SAMPLE DATA COLLECTION SYSTEM FAULT

Occasionally the sample system's data collection will experience a fault where all recorded water quality parameters read **Zero Value** or **non-changing** values. If it is observed that the IGC system is not changing the selected gate when enabled, the ["IGC Data Entry"](#) button on the "Utilities" screen can be pressed to observe all recent collected data. If all data is observed to be of zero value, or the same value then the data collection system must be reset. This can be done by accessing the control panel, and performing a power cycle. Follow the instructions below to reset:

1. Open the control panel door, and locate the circuit breaker for the multi parameter sonde and IO-Link card. Refer to the figure below for reference.

Figure 49 Data Collection Power Cycle



DC7 Circuit
Breaker for Sonde
and IO Card.

2. Depress the green/blue button labeled with the current rating until it clicks.

3. Wait 10 seconds.
4. Depress this button once again.

After performing the power cycle return to the [“IGC Data Entry”](#) button on the “Utilities” screen and observe until normal data entry has returned.

4.14 CLEANING EQUIPMENT OPERATION AND MAINTENANCE

The control cabinet has a cleaning solution pump and container that is set to add solution to the sample flow cell on an intermittent basis during operation. The type and containment of the solution is to be managed by operators, but the following types of cleaning solution are recommended:

- Iron Out Powdered Products (Sodium Bisulfate)
- CLR (combination stain remover)



NOTE: Do not use any products that are not recommended for iron or rust stain removal, or that can be corrosive to stainless steel, brass, PVC, PE, PP or acrylics.

Cleaning Frequency and Duration

Depending on site conditions and water quality, cleaning frequency and duration will need to be determined by operators through observation of the interval over which the flow cell becomes fouled. The system is set to add cleaning solution during the air scour and flush step of the sample system’s normal flush cycle. The amount of cleaning solution added for each clean cycle and the frequency of addition can be adjusted by operators using two setpoints accessible from the setpoints screen.

Table 11 Cleaning Setpoints

Setpoint / Variable	Description	Allowable Input	Initial Setting	Comments
Chemical Add Time (min) (SP022)	Amount of time chemical addition pump will run each time it is called.	0-60	0.00	Must be less than SP007
Add Chemical Every (#) Flushes (SP023)	Number of flushes the sample system must finish before chemical will be added on the next flush	0-30	1	This sets the chemical addition frequency. Set higher to add cleaning solution less frequently.

The cleaning solution pump provides flow at **7 GPH**. In order to estimate the amount of cleaning solution that will be used operators can use the following calculation:

$$\begin{aligned}
 & \text{[1440 minutes/day]} \\
 & \quad / \\
 & \text{[Distinct Sample Duration (min) (SP002)] x [Number of Gates Being Sampled*]} \\
 & \quad / \\
 & \text{[Add Chemical Every (#) Flushes (SP023)]} \\
 & \quad \times \\
 & \text{7 GPH x [1/60 (mins/hr)] x [Chemical Add Time (min) (SP022)]} \\
 & \quad = \\
 & \text{Estimated Gallons of Chemical Added Per Day}
 \end{aligned}$$

***Inspect Enable Sampling Screen to Determine.**

As a worked example, system is set for 8-minute distinct sample duration (SP002), is sampling from 10 gates, with chemical added every 3 flushes (SP023), and a chemical add time (SP022) of 0.25 mins:

$$\begin{aligned}
 & \text{[1440 minutes/day]} \\
 & \quad / \\
 & \text{[8 (min) (SP002)] x [10 gates sampled]} \\
 & \quad / \\
 & \text{[3 (#) (SP023)]} \\
 & \quad \times \\
 & \text{7 GPH x [1/60 (mins/hr)] x [0.25 (min) (SP022)]} \\
 & \quad = \\
 & \text{Estimated 0.175 Gallons Per Day Chemical Added}
 \end{aligned}$$

After arriving at an acceptable use rate to meet the cleaning needs of the system, use this to estimate size of needed containment, and frequency of cleaning solution refill.

SECTION 5: PROCESS PAUSE REASONS

5.1 GENERAL

In this section of the manual, process pause reasons will be described for the gate control sequence and the sample control sequence, as well as descriptions of hose reel faults. These will be accompanied by suggested measures to take when troubleshooting.

5.2 GATE CONTROL SEQUENCE PAUSES

Refer to the below table for information on pause reasons associated with the gate control sequence, prompts for troubleshooting these pauses will also be included. Each pause reason is assigned a number:

Table 12 Gate Control Pause Reasons

Gate Control			
ID #	Pause Reason	Description	Items to Check
1	Via Operator	Operator pressed PAUSE	Operator pressed PAUSE button; press RESUME to continue.
2	VTEM Motion Terminal	VTEM Motion terminals has a fault, an alarm, or is not ready.	One off fault. Check VTEM motion terminal on the utilities screen. The various motion terminal units can be browsed through. If faulted press reset button.
3	VTUG Gate Manifold Failure	Gate manifold has a fault or is not in communication.	One off trip / fault. Electrical wiring fault (i.e. loose wire). Inspect RIO panel. Open panel and note if water has intruded on VTUG manifold. Check for moisture at exhaust silencers.
4	Gate Leak – Refill Attempts	Gate has exceeded the set amount of refill attempts while maintaining open, pressure detected exceeds gate open pressure after attempts.	One off Fault. Resume gate control sequence. Observe water above selector barrier, after initial slug of air is observed, watch for slow flow of air bubbles from buoyancy chamber which may indicate a leak.

Gate Control			
ID #	Pause Reason	Description	Items to Check
			Check for evidence of air tubing detaching from gate buoyancy chamber.
5	Gate Leak – Low Pressure	Measured pressure detected is less than gate open pressure, while maintaining open.	<p>One off Fault. Resume gate control sequence.</p> <p>Observe water above selector barrier, after initial slug of air is observed, watch for slow flow of air bubbles from buoyancy chamber which may indicate a leak.</p> <p>Check for evidence of air tubing detaching from gate buoyancy chamber.</p>
6	Gate Open Fail	When system is detecting open gate, detected pressure exceeds gate open pressure.	<p>One off Fault. Resume gate control sequence.</p> <p>If persistent try different gates to rule single gate failure. If multiple gate fail consider recalibrating the lake level bubbler.</p>
7	Air Pressure	System air pressure low alarm is active	<p>Check air compressor(s) running (not both faulted).</p> <p>Check for no major air leaks.</p> <p>Check alarm settings.</p> <p>Close air compressor receiver outlet valves, and allow compressors to load, open valves once compressor/s has stopped loading.</p>
8	Power Failure	UPS has detected that control power is low.	<p>Loss of main 220V power to control panel. Check main power supply, breakers, voltages etc.</p> <p>Loss of power to UPS (inside control panel). Check UPS input / output 120 voltage.</p> <p>Bad / faulted UPS output relay card which provide 'power failure' alarm.</p>

5.3 SAMPLE CONTROL SEQUENCE PAUSES

Refer to the below table for information on pause reasons associated with the sample control sequence, prompts for troubleshooting these pauses will also be included. Each pause reason is assigned a number:

Table 13 Sample Control Pause Reasons

Sample Control			
ID #	Pause Reason	Description	Items to Check
1	Via Operator	Operator pressed PAUSE	Operator pressed PAUSE button; press RESUME to continue.
2	OTT HL7 Failure	Communication failure to multiparameter sonde.	Check for loose wiring to sonde. Check I/O link connection in control panel. Remove instrument cable from sonde and reconnect.
3	Electronic Circuit Breaker	Electronic circuit breaker fault or communication failure.	This is the voltage and current control for the hose reel. Perform power cycle and recheck status.
4	Hose Reel Encoder	Hose reel encoder fault or communication failure.	Check wiring connections and control panel (PLC I/O Link), and at instrument end. Check wire integrity for any kinks / nicks or breaks. Disconnect instrument, connect to a 4-20mA signal generator. Check correct reading at PLC I/O Link. Instrument is faulty, been damaged and does not work correct. Device may need to be replaced.
5	Hose Reel Failure	Hose reel fault or loss of communication detected.	One off Fault. Manual reset is required for this fault. This can be reset from the hose reel sub screen. NOTE: Sequencer will automatically resume after hose reel reset. Attempt to control hose reel from sub screen.

Sample Control			
ID #	Pause Reason	Description	Items to Check
6	High Sample Pump Flow	Detected sample flow higher than alarm setpoint.	<p>Check in control cabinet for any leaks of loose fittings downstream of pump.</p> <p>Check high flow setting in parameters page.</p>
7	Low Sample Pump Flow	<p>Detected sample pump flow lower than alarm setpoint.</p> <p>NOTE: System will attempt an auto resume if this failure is detected.</p>	<p>Run sample system flush.</p> <p>Check sampled water outlet hose from control cabinet for air lock.</p> <p>A flush of the piping using cleaning solution injection may be required.</p> <p>Check sample hosing for clogs, remove if present.</p>
8	Flow Meter Failure	<p>Bad Transmitter detected.</p> <p>NOTE: System will attempt an auto resume if this failure is detected.</p>	<p>Check wiring connections and control panel (PLC I/O Link), and at instrument end. Check wire integrity for any kinks / nicks or breaks.</p> <p>Check instrument operation. For displayed error codes on instrument unit – check instrument manual for meaning and other possible faults.</p> <p>Disconnect instrument, connect to a 4-20mA signal generator. Check correct reading at PLC I/O link, and/or displayed on screens.</p> <p>Instrument is faulty, been damaged and does not work correct. Device may need to be replaced.</p>
9	Power Failure	<p>UPS has detected that control power is low.</p> <p>NOTE: System will attempt an auto resume if this failure is detected.</p>	<p>Loss of main 220V power to control panel. Check main power supply, breakers, voltages etc.</p> <p>Loss of power to UPS (inside control panel). Check UPS input / output 120 voltage.</p> <p>Bad / faulted UPS output relay card which provide 'power failure' alarm.</p>
10	Air Pressure	System air pressure low alarm is active	Check air compressor(s) running (not both faulted).

Sample Control			
ID #	Pause Reason	Description	Items to Check
		NOTE: System will attempt an auto resume if this failure is detected.	<p>Check for no major air leaks.</p> <p>Check alarm settings.</p> <p>Close air compressor receiver outlet valves, and allow compressors to load, open valves once compressor/s has stopped loading.</p>
11	Suction Above Water	<p>Suction of pump may be at an elevation above water, sample is disabled to protect equipment.</p> <p>NOTE: System will attempt an auto resume if this failure is detected.</p>	<p>Check sample hose to see if screen is above water.</p> <p>Remove sunscreen from hose reel to observe if sample hose is evenly wound around the drum. Ensure hose has not wrapped over itself.</p> <p>Send Screen to home position, ensure this position is consistent with previous setting.</p>

5.4 HOSE REEL FAULTS

Refer to the below table for information on faults associated with the hose reel, prompts for troubleshooting these faults will also be included. Each fault is assigned a number:

Table 14 Hose Reel Faults

Hose Reel			
ID #	Pause Reason	Description	Items to Check
1	Spool in Fail	Based on encoder feedback, reel is not spooling in when commanded.	<p>Pause system and attempt to manually spool in the reel.</p> <p>Observe reel when spooling in, check encoder annulus is tightened around reel system shaft.</p>
1	Spool Out Fail	Based on encoder feedback, reel is not spooling out when commanded.	<p>Pause system and attempt to manually spool out the reel.</p> <p>Observe reel when spooling out, check encoder annulus is tightened around reel system shaft.</p>

Hose Reel			
ID #	Pause Reason	Description	Items to Check
3	High Current Trip	High current detected to hose reel motor.	<p>Approach reel system and pull on the sample hose to ensure sample screen moves freely. High current can be caused by increased resistance on hose.</p> <p>Check alarm settings.</p>
4	Low Current Trip	Low current detected to hose reel motor.	<p>Bring sample screen to home position. Ensure that sample screen has not become detached from sample hose. Reduced resistance on hose can cause low current.</p> <p>Check alarm settings.</p>
5	Brake Release	Minimum Current for brake release has not been reached.	Remove hose reel sunshade. Check for voltage at terminals and possible open circuit
6	Position Slip	Encoder position change has been detected while brake is engaged.	Remove hose reel sunshade. Check that motor brake pads are contacting the hose reel drum.

SECTION 6: APPENDICES

Appendix 1	Supplier - Multi-Parameter Sonde Sensors OM Manual (Hydrolab HL7 - OTT)
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