6.5.3.1 MBR Basins – Automatic Operation

The MBR basins receive flow from the MBR aeration basins and separate the solids from the MLSS to produce a high quality effluent. There are two MBR basins each with two process trains. Each train has an ADWF capacity of 1.0-mgd and a peak flow capacity of 2.5-mgd. The MBR basins are plug flow basins with space for up to 10 cassettes of hollow fiber media. There are 9 cassettes installed in each basin. GE Zenon provided the membrane system.

MBR Process Control Screens

The MBR system is controlled through a dedicated PLC located in the MBR building. The MBR controls are accessed through the main SCADA screen for the membrane system is shown on ***Figure 6.5.1-1***. The screen is accessed by clicking on the **MBR** button **<1>** on the top of the screen. The control screen for each of the MBR basins is accessed by clicking on the **MBR Basin** button **<2>**.

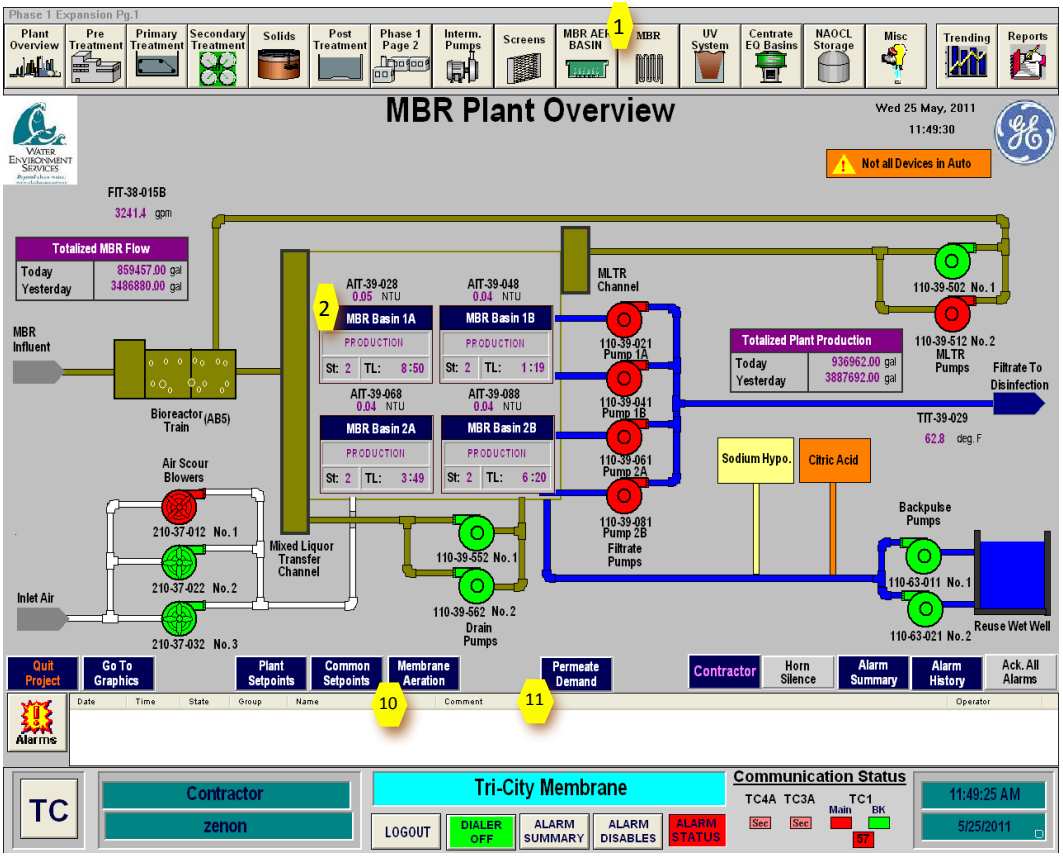

Figure 6.5.3-1 – Membrane System Control Screen

Membrane Basin Controls

The basins are controlled through the MBR basin control screen as shown in ***Figure 6.5.3-2***. The MBR basin controls and each of the lower level screens are discussed in the following sections. A summary of the controls is also provided in the GE Process Controls Descriptions manual provided in Section 6.5.2.1.

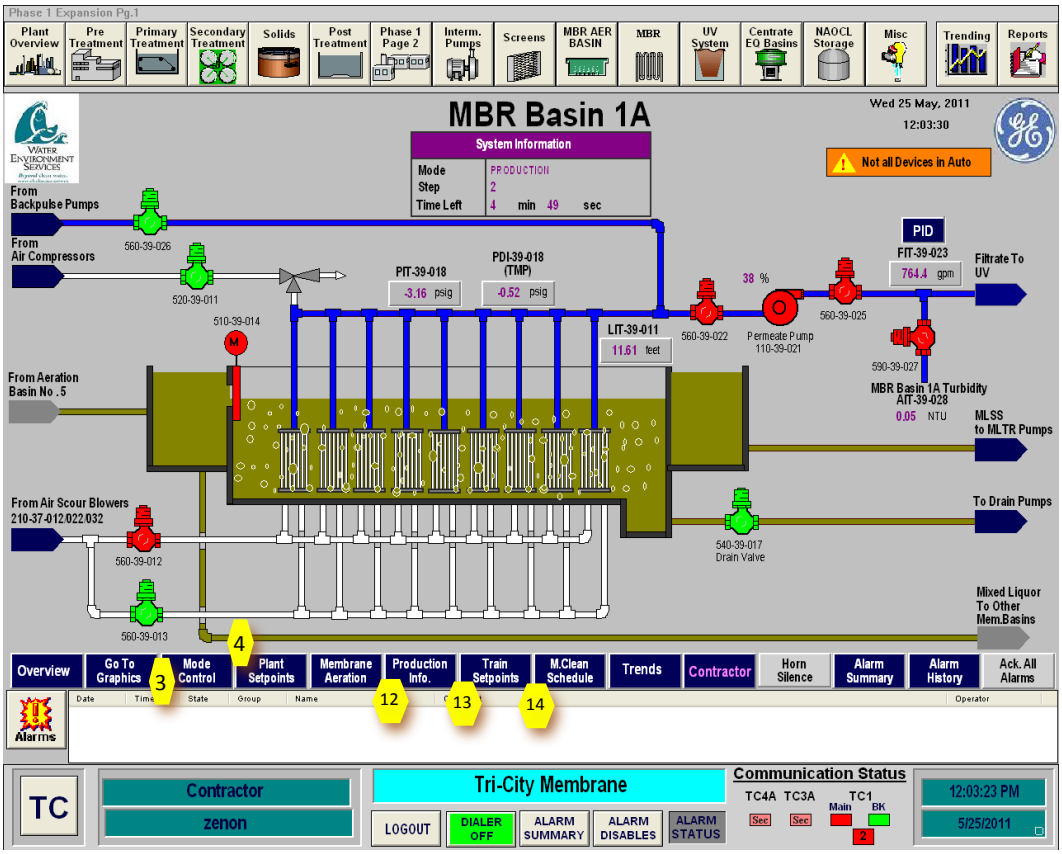

Figure 6.5.3.1-2 – MBR Basin Control Screen

MBR Basin Automatic Startup

The MBR basins are placed in service through the SCADA system. The basins can only be operated in Automatic mode. To start the basin, all equipment associated with the basin must be in AUTO. This includes the filtrate pump, each of the valve, the influent gate, the air scour blowers, the MLTR pumps, the air compressors and the backpulse pumps, if being used.

To place a MBR basin in service go to the MBR basin control screen for the desired basin. Once on that screen, go to the select the **Mode Control button <3>** as shown in ***Figure 6.5.3.1-2***. This will bring up the basin Modes of Control popup box ***(Figure 6.5.3.1-3).*** On this control box, select the **ON button <4>** to place the MBR basin in service. When this button is selected, the basin will go through an automatic startup sequence and being processing flow.

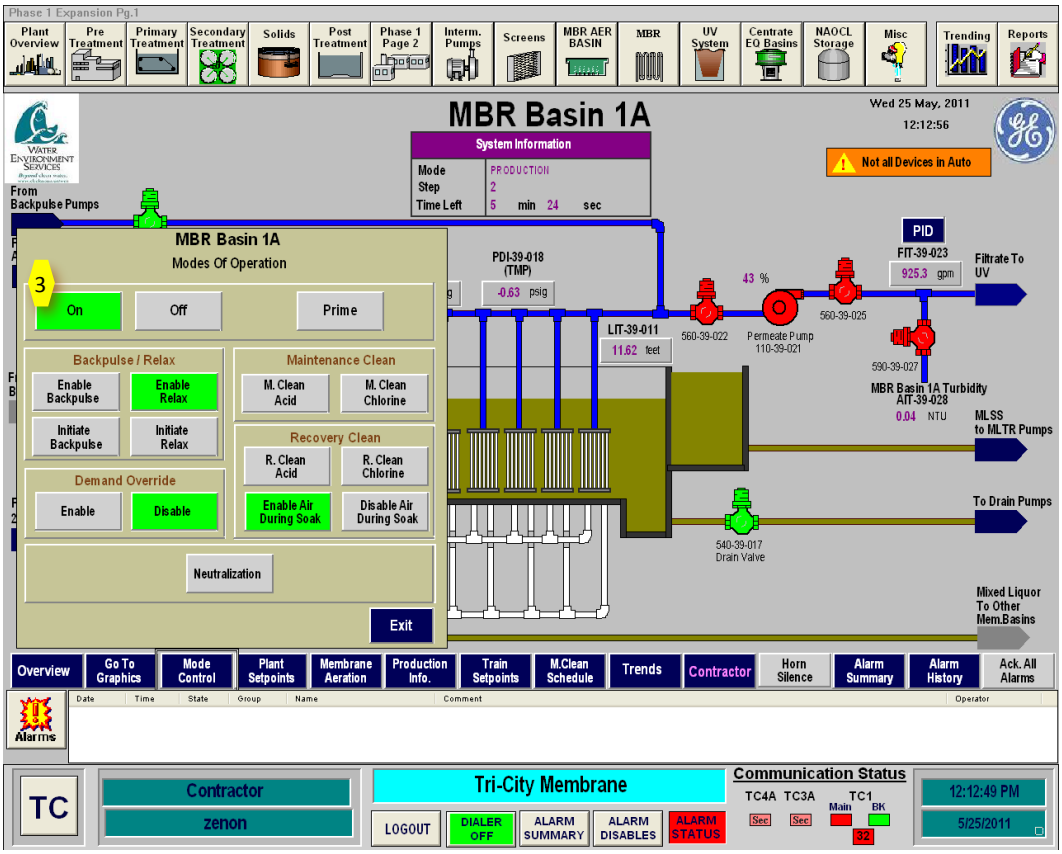

Figure 6.5.3.1-3 – MBR Basin Modes of Operation Popup Box

MBR Basin Plant Setpoints

The plant setpoints menu is accessed from the MBR system main screen or any of the four MBR basin screens by clicking on the **Plant Setpoints button <3>** as shown in ***Figure 6.5.3.1-2***. provides five input screen options as shown on the popup box for the screen shown in ***Figure 6.5.3.1-4***. These options are:

- Plant Setpoints
- Maintenance Clean Setpoints
- Neutralization Setpoints
- Recovery Clean Setpoints
- Flow Demand Triggers

Clicking on each of these buttons puts up an input box to input the variables for each of these functions. Each of the input boxes is restricted to a specific range of values to ensure the values that are entered are appropriate.

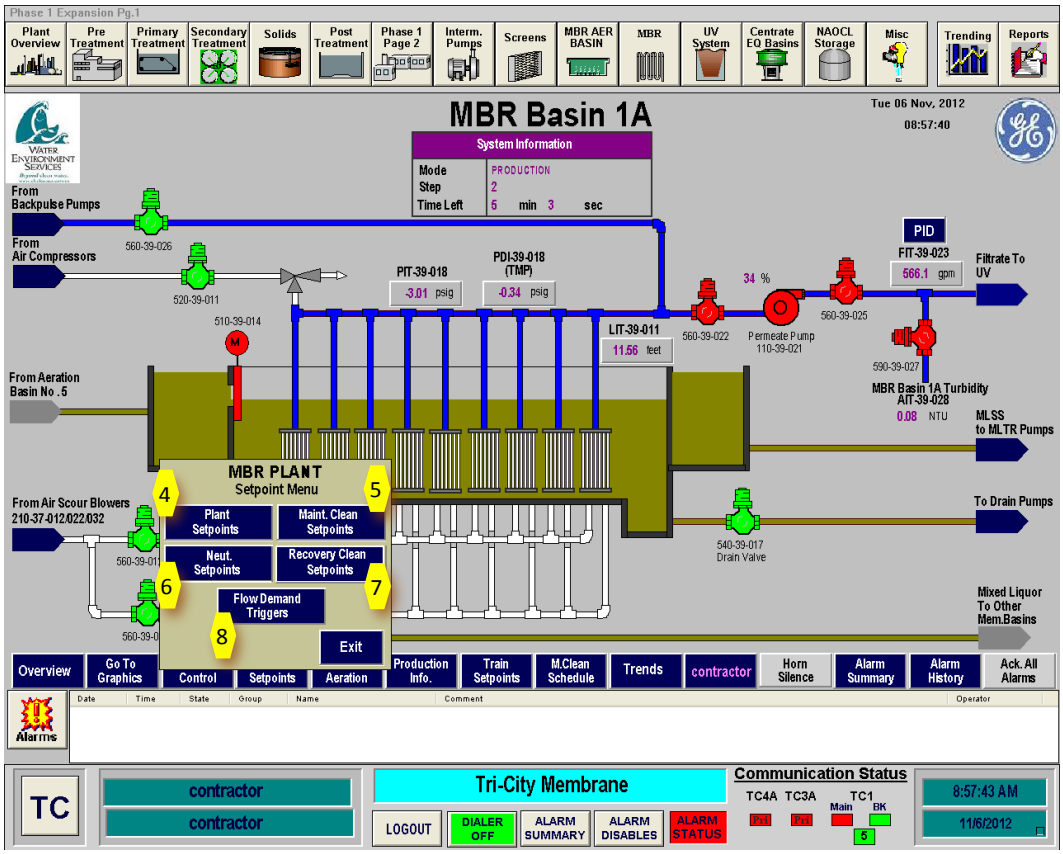

Figure 6.5.3.1-4 – MBR Plant Setpoint Menu

Plant Setpoints

Clicking on the **Plant Setpoints button <4>** gives the MBR Plant Setpoint popup box shown in ***Figure 6.5.3.1-5***. Clicking on the highlighted box will give a popup keyboard for input of the setpoint. These setpoints are common to all of the MBR basins. These setpoints set the timers for the production cycle and the timers before a turbidity alarm occurs at the various turbidity alarm levels. A description of each of these setpoints is provided in the provided in the GE Process Controls Descriptions manual provided in Section 6.5.2.1.

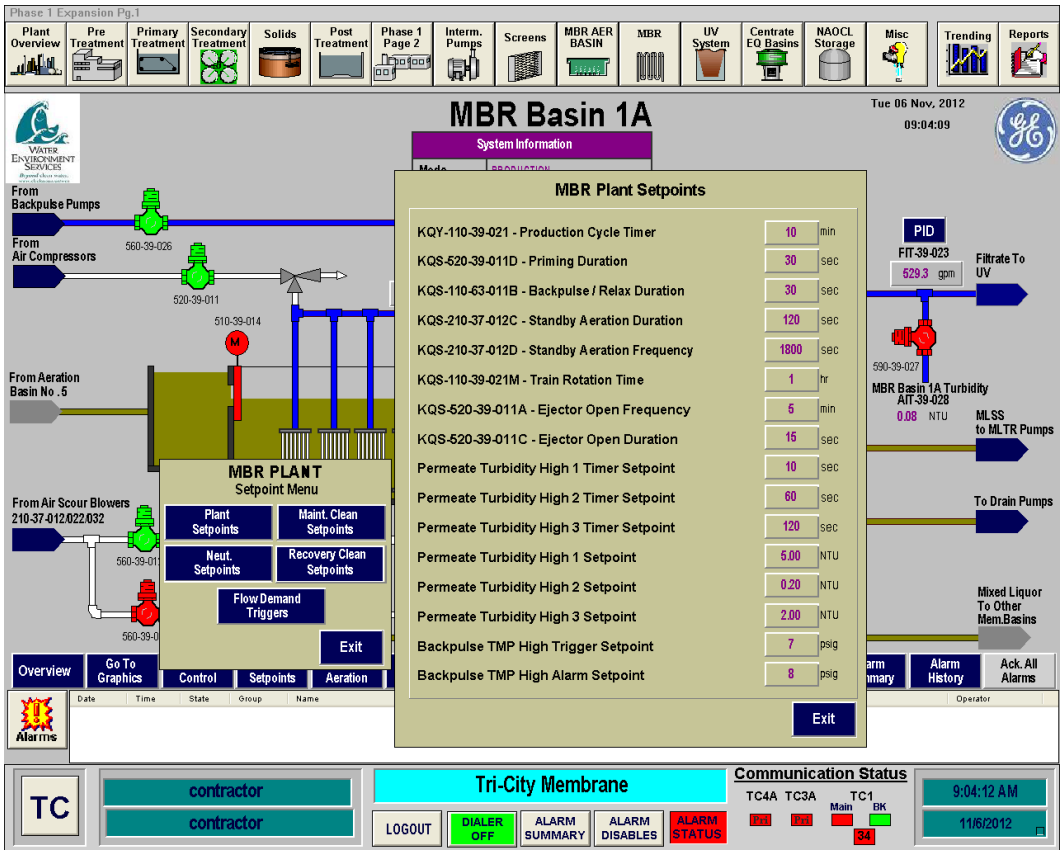

Figure 6.5.3.1-5 – MBR Plant Setpoint Input Box

Maintenance Clean Setpoints

Clicking on the **Maint. Clean Setpoints button <5>** gives the Maintenance Clean Setpoint popup box shown in ***Figure 6.5.3.1-6***. Clicking on the highlighted box will give a popup keyboard for input of the setpoint. These setpoints are common to all of the MBR basins. These timers determine the duration for each of the cleaning steps during maintenance clean. A description of each of these setpoints is provided in the provided in the GE Process Controls Descriptions manual provided in Section 6.5.2.1.

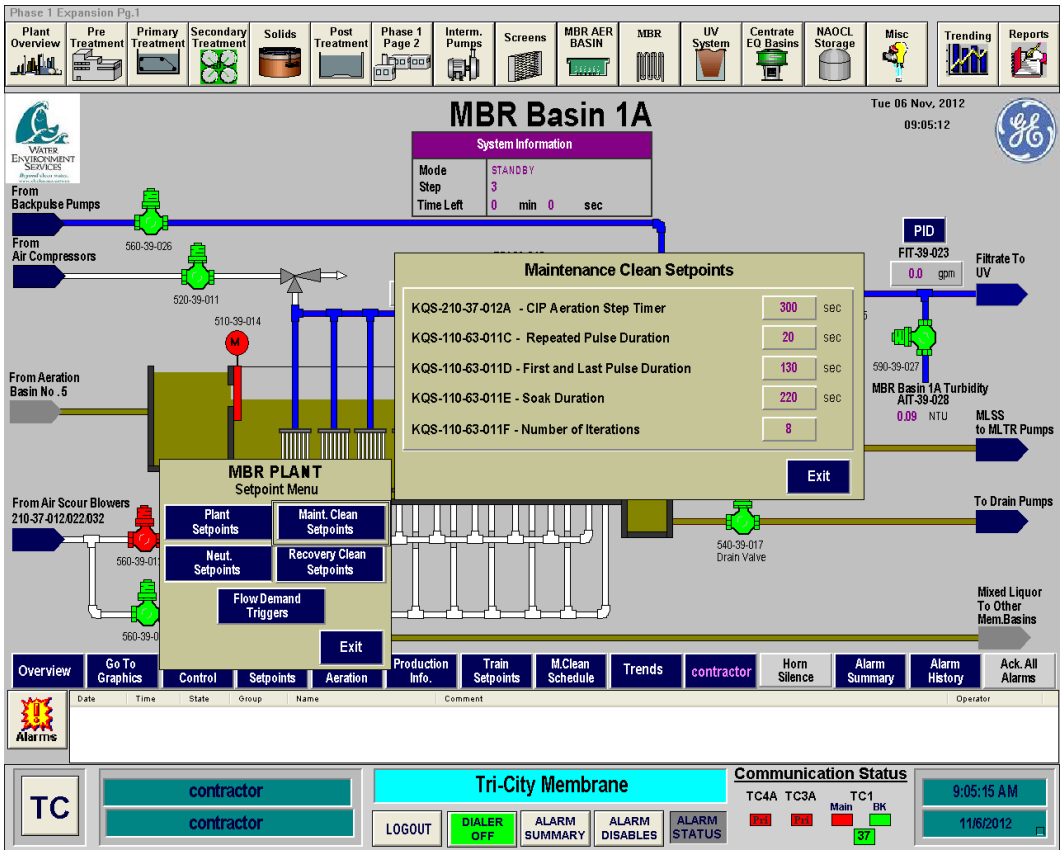

Figure 6.5.3.1-6 – Maintenance Clean Setpoints Input Box

Neutralization Setpoints

Clicking on the **Neut. Setpoints button <6>** gives the Neutralization Setpoint popup box shown in ***Figure 6.5.3.1-7***. Clicking on the highlighted box will give a popup keyboard for input of the setpoint. These setpoints are common to all of the MBR basins. These timers determine the duration for neutralization step of the recovery clean. A description of each of these setpoints is provided in the provided in the GE Process Controls Descriptions manual provided in Section 6.5.2.1.

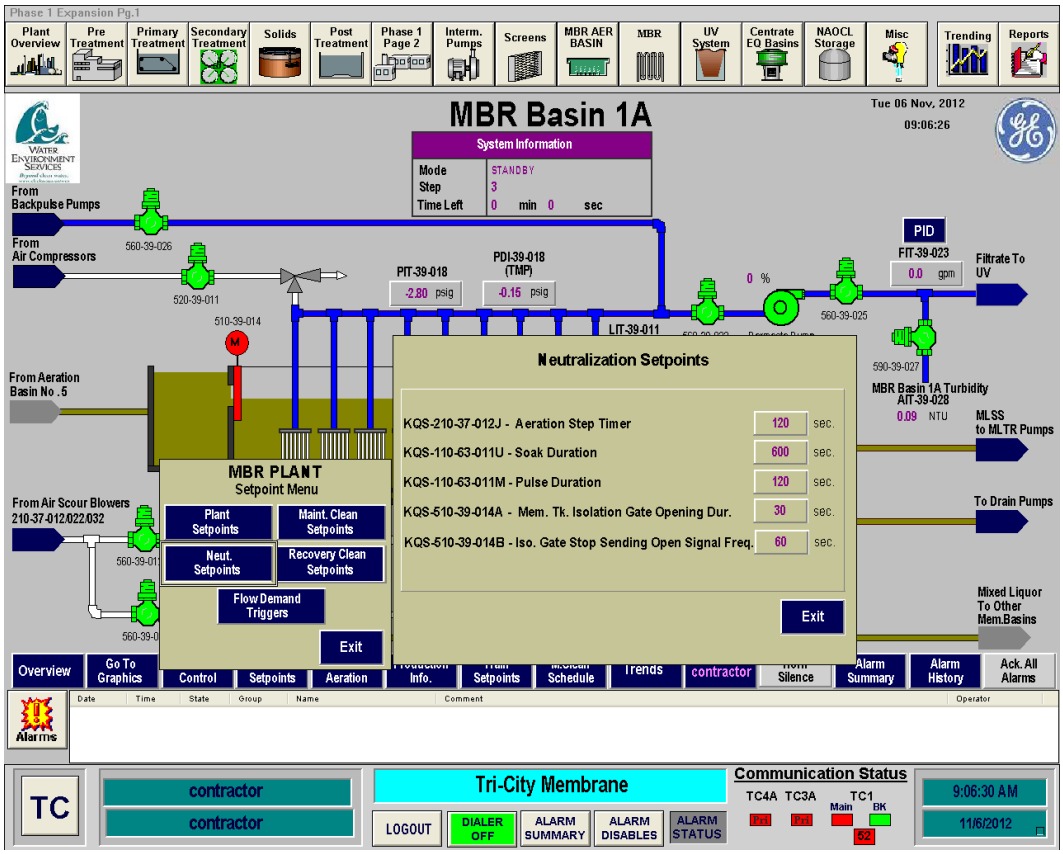

Figure 6.5.3.1-7– Neutralization Setpoints Input Box

Recovery Clean Setpoints

Clicking on the **Recovery Clean Setpoints button <7>** gives the Recovery Clean Setpoint popup box shown in ***Figure 6.5.3.1-8***. Clicking on the highlighted box will give a popup keyboard for input of the setpoint. These setpoints are common to all of the MBR basins. These timers determine the duration for each step of the recovery clean. A description of each of these setpoints is provided in the provided in the GE Process Controls Descriptions manual provided in Section 6.5.2.1.

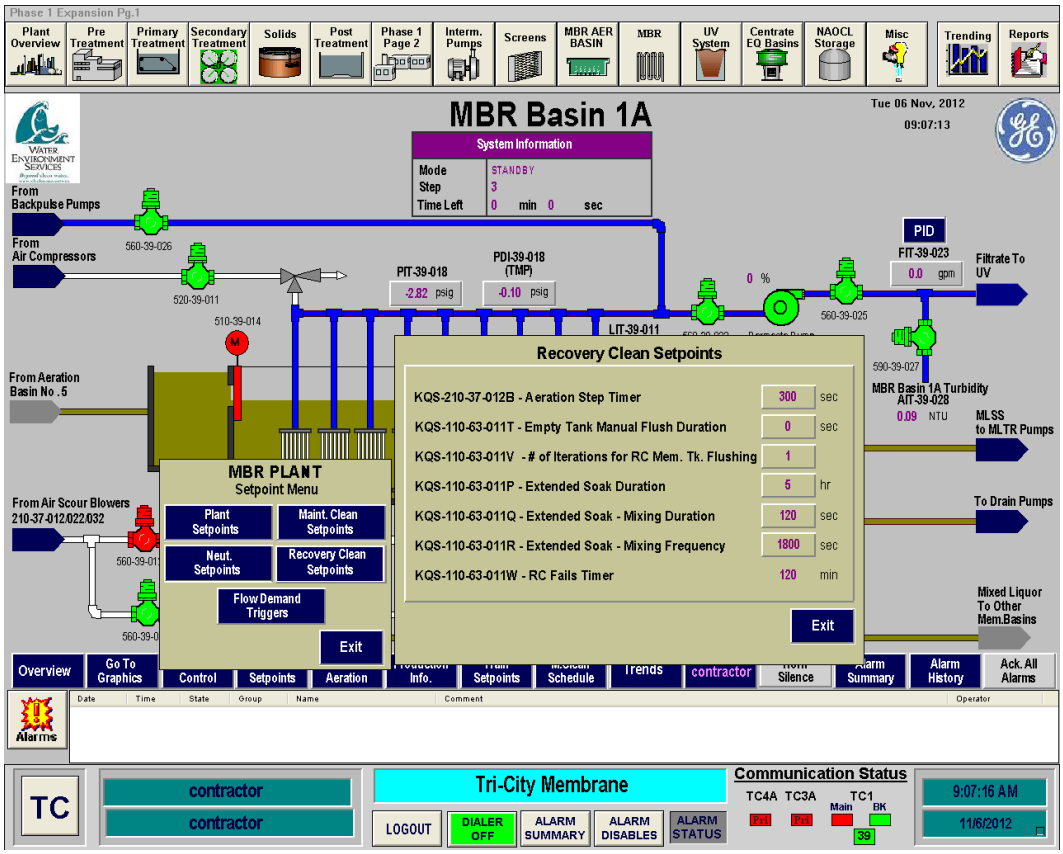

Figure 6.5.3.1-8 – Recovery Clean Setpoints Input Box

Flow Demand Triggers

Clicking on the **Flow Demand Triggers Setpoints button <7>** gives the Flow Demand Triggers popup box shown in ***Figure 6.5.3.1-9***. Clicking on the highlighted box will give a popup keyboard for input of the setpoint. These determine the flow rates that determine the number of basins that are operating. As the flow the MBR system varies, MBR basins will go on standby if the flow is not high enough for all of the operating basins to operate efficiently. A description of each of these setpoints is provided in the provided in the GE Process Controls Descriptions manual provided in Section 6.5.2.1.

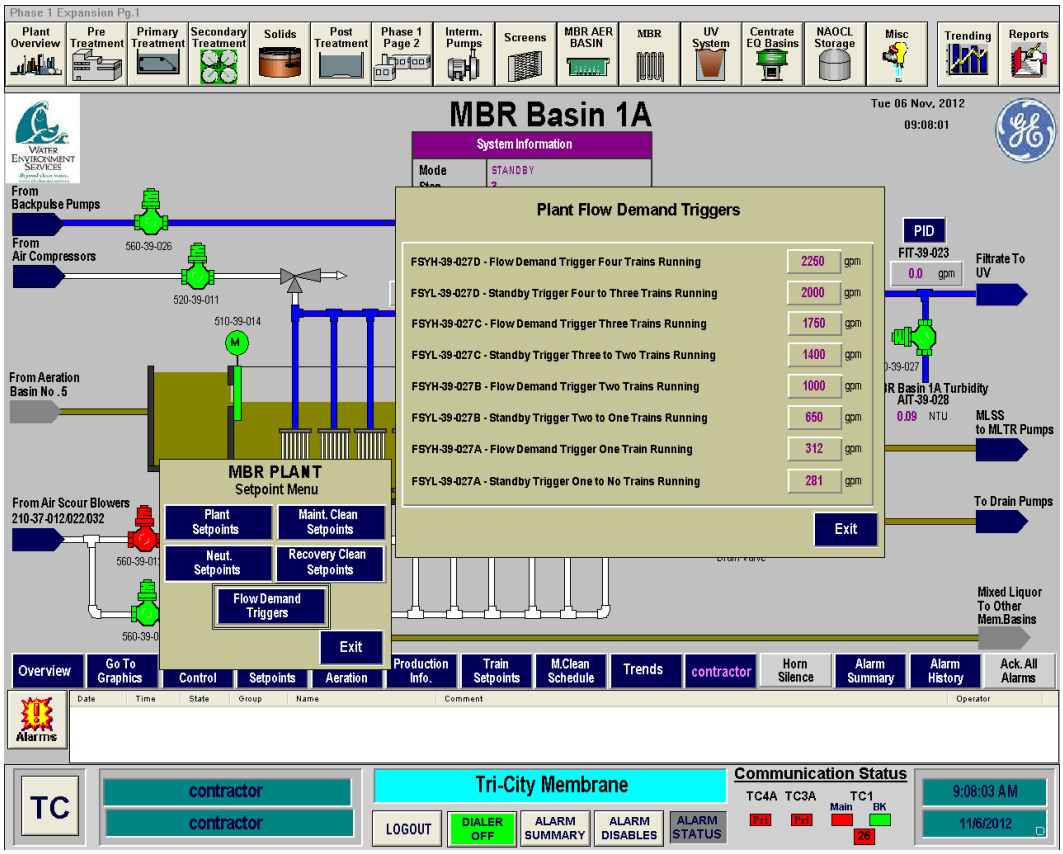

Figure 6.5.3.1-9– Flow Demand Triggers Input Box

Common Setpoints

Clicking on the **Common Setpoints button <8>** gives the Common Equipment Setpoints popup box shown in ***Figure 6.5.3.1-10***. Clicking on the highlighted box will give a popup keyboard for input of the setpoint. These setpoints determine the recirulation rate of the MLTR pumps and the timers for alternating the MLTR pumps, air scour blowrers and backpulse pumps. A description of each of these setpoints is provided in the provided in the GE Process Controls Descriptions manual provided in Section 6.5.2.1.

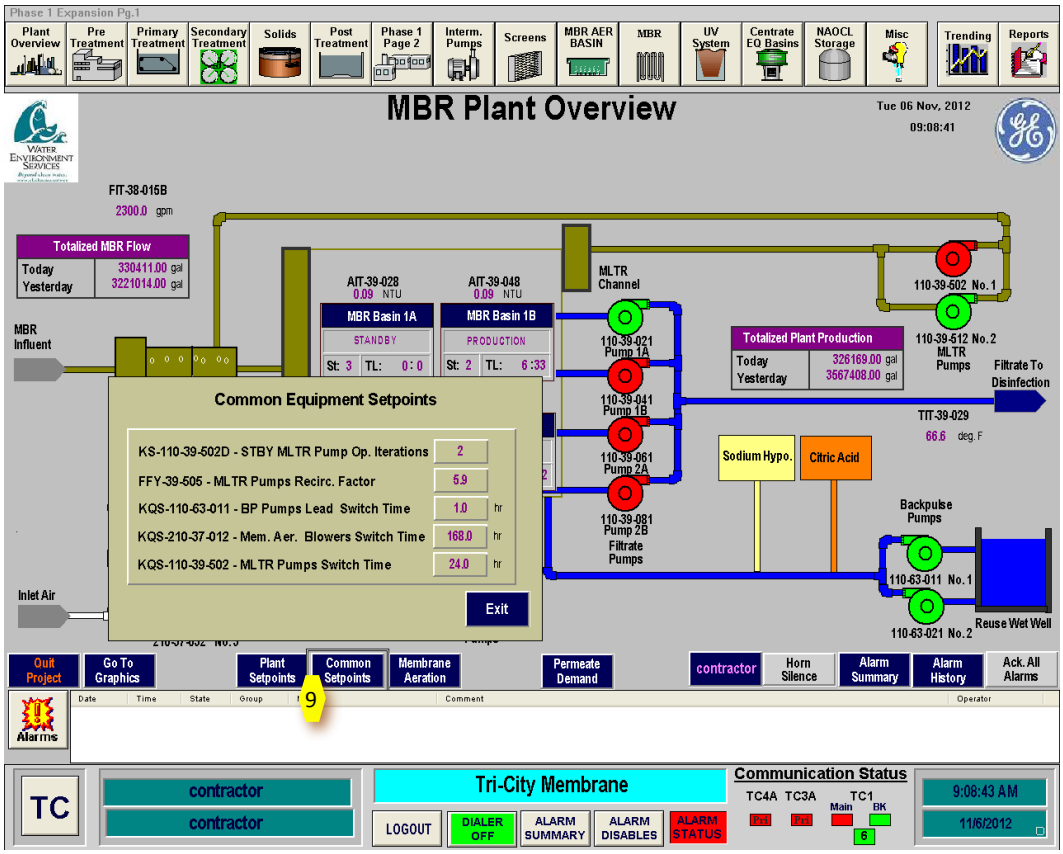

Figure 6.5.3.1-10 – Common Setpoints Input Box

Membrane Aeration

There are three membrane blowers. Two of the blowers are designated as duty blowers with the third as a standby. These blowers supply air to the membrane basins for scouring of the membranes. An air valve on each air header controls the basin air. There are three types of aeration: constant aeration, 10/10 aeration and 10/30 aeration. The type of aeration that is used will optimize power use while still meeting the scouring requirements.

Clicking on the **Membrane Aeration button <10>** located on the bottom of the MBR Plant Overview screen (**Figure 6.5.3.1-1)** and each of the MBR Basin screens goes to the MBR Air Scour Controller screen shown in ***Figure 6.5.3.1-11***. This screen provides status and control for the MBR air scour blowers.

The operating blowers and open valves are highlighted in red. The closed valves and blowers that are not on are shown in green. If a blower is failed, it will be shown as yellow.

There are a number of air scour control variables that are displayed on this screen for each of the basins. These are:

- **10/30 Aeration** – The operator can enable or disable the 10/30 aeration mode for a specific basin by selecting the 10/30 aeration button. The mode is shown with the button as a green color.
- **ADF Criteria** – The ADF criteria is based on the average daily flow setpoint shown on the purple bar above the 10/30 Aeration Information. If the flow to a

basin exceeds this flow rate, the 10/30 aeration mode will become invalid and the basin will go to constant aeration.

- **Ri & RC Calc Result** – This is a calculation of the rate the TMP changes during a production cycle. If this rate is too high, it signifies that the membranes are plugging and the result will change to invalid with the basin going to constant aeration.
- **10/30 Aeration Status** – This value will show Yes when all of the variables are appropriate for 10/30 aeration.
- **Actual Aeration** – This box shows that actual mode of aeration that the basin is operating.
- **Order No** – This box shows the order in which the basin is in within the production cycle.
- **Mode** – This box shows the operating mode of the basin. The modes can be production, relax, off, recovery clean or maintenance clean.
- **Step** – This box shows the step of the production cycle, recovery clean or maintenance clean that the basin is in.
- **Time Left** – This box shows the time left in the step the basin is in.

The Standby Aeration Information box shows the setpoints of the timers for aerating a basin when it is on standby. A basin that is on standby is not aerated. The MLSS in the basin then goes without air and can go septic. The standby aeration will aerate the basin to ensure that the MLSS stays fresh.

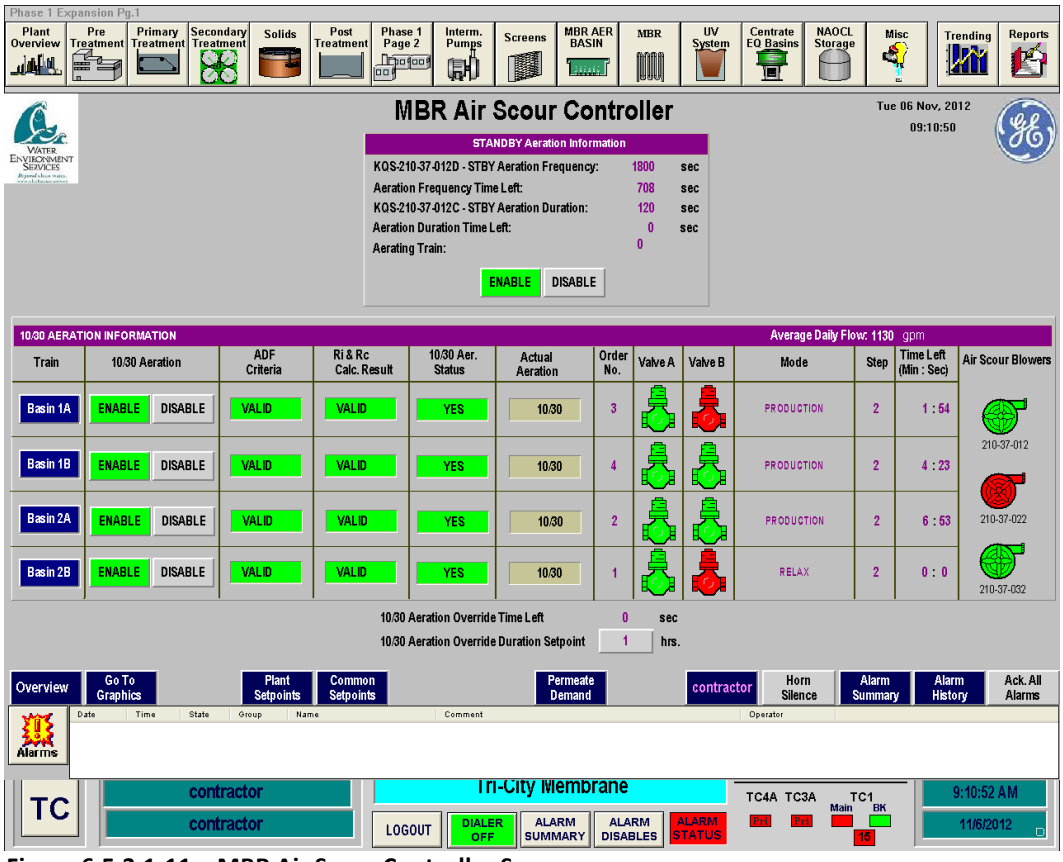

Figure 6.5.3.1-11 – MBR Air Scour Controller Screen

Permeate Demand

Clicking on the **Permeate Demand button <11>** located on the bottom of the MBR Plant Overview screen (**Figure 6.5.3.1-1)** and each of the MBR Basin screens goes to the MBR

Plant Permeate Flow Demand screen shown in ***Figure 6.5.3.1-12***. This screen provides control for the MBR filtrate pumps.

The MBR process is a closed system. Flow into the system must be pumped out of the system so the basin levels remain constant. This presents a fairly complicated control as each membrane basin goes through its production cycle the flow rates out of the system vary. In addition, the flow is added back to the system with the backpulse pumps and additional flow is periodically removed from the system with the WAS pumps. Therefore, the MBR plant permeate flow demand control strategy maintains the system in balance.

The general control strategy is for the filtrate pumps to take the MBR plant influent flow, divide it by the number of basins operating and apply a correction factor for the time the basins are in relax mode and to compensate for the backpulse water added to the system. This strategy sets the base flow for each filtrate pump. The system then monitors the level of the MLTR channel and applies a "Trim Factor" that maintains the system in balance. The Plant Permeate Flow Demand screen provides for monitoring and control of this system.

There are a number of variables that are displayed on this screen for each of the basins. These are:

- **Demand Override** – The operator can enable or disable the automatic flow control of the filtrate pumps with the demand override button. If the button is shows disable, the filtrate pump flow will be controlled by the permeate demand. If the button shows enable, the pump will maintain a constant flow rate at the instantaneous flow setpoint. The mode is shown with the button as a green color.
- **Net Flow Setpoint** – The net flow setpoint is the plant flow divided by the number of basins in operation.
- **Net Flow Mode** – The net flow mode provides the operator the ability to input a flow manually. If the net flow mode is set to auto, the filtrate pump flow will be determined by the control system. If the net flow mode is set to Supervisor, the net flow setpoint can be manually entered by the operator.
- **Correction Factor** – This is the correction factor that the control system has calculated to compensate for the relax period and backpulse water flow.
- **Instantaneous Flow Setpoint** – This is the actual flow sepoint for the filtrate pump following the addition of the correction factor and the Trim Factor.
- **Mode** – This box shows the operating mode of the basin. The modes can be production, relax, off, recovery clean or maintenance clean.
- **Step** – This box shows the step of the production cycle, recovery clean or maintenance clean that the basin is in.
- **Time Left** – This box shows the time left in the step the basin is in.
- **Flow** – This is the actual flow being produced by the filtrate pump for that basin.
- **TMP** – This is the Trans Membrane Pressure. This is the pressure drop across the membrane. This value shows the condition of the membrane and if it needs to be cleaned or not.

The box at the top of the screen labeled MLTR Channel Level Indicating Proportional Controller shows the current variables that are being used to calculate the trim factor. These values were set to optimize the system and should not be changed without authorization from the Plant Supervisor or GE Zenon Service Personnel.

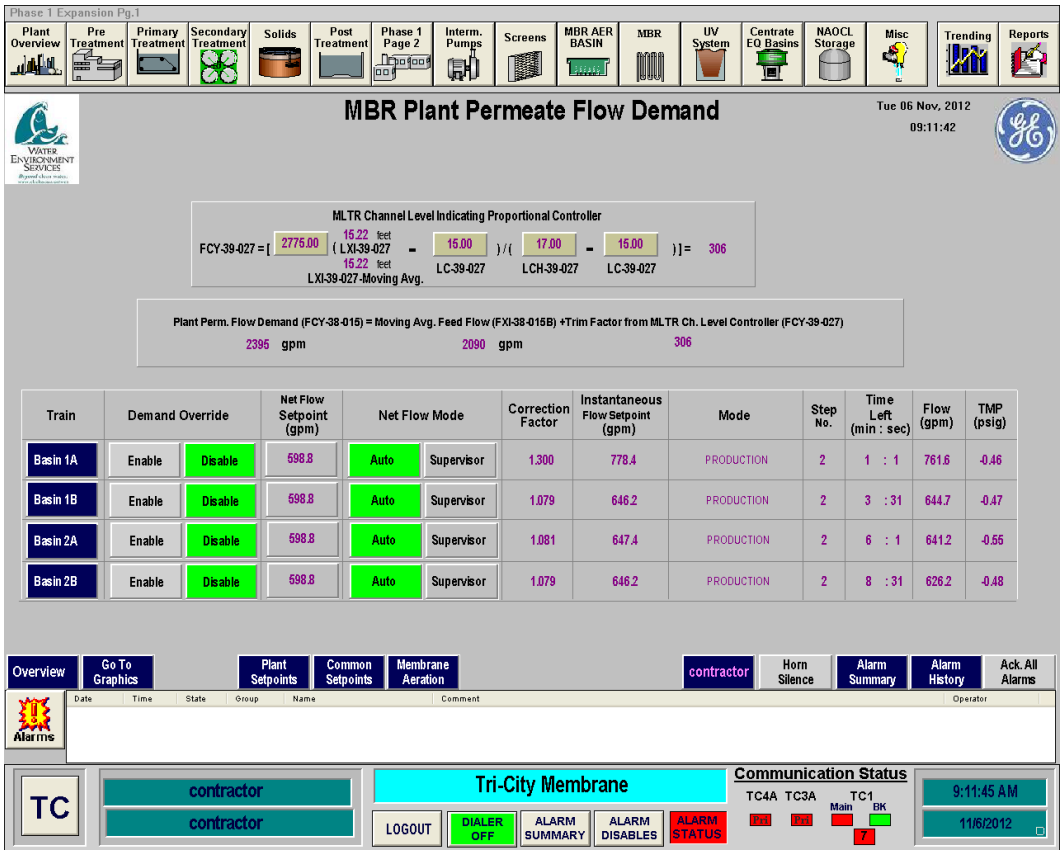

Figure 6.5.3.1-12 – MBR Plant Permeate Flow Demand Screen

Production Information

Clicking on the **Production Information button <12>** located on the bottom of the MBR Basin screen (**Figure 6.5.3.1-2)** gives the Production Information popup box shown in ***Figure 6.5.3.1-13***. This box is specific to each basin. This screen provides production data and operating data for the basin.

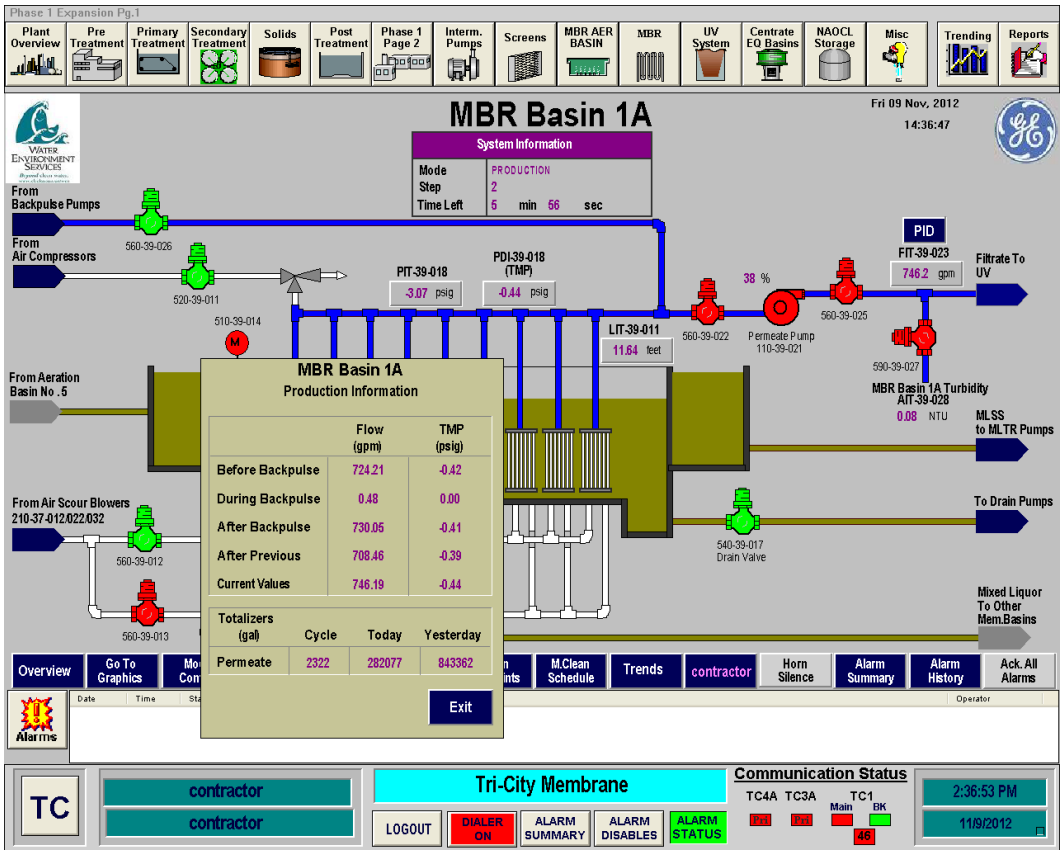

Figure 6.5.3.1-13 – Production Information Screen

MBR Basin Train Setpoints

Clicking on the **Train Setpoints button <13>** located on the bottom of the MBR Basin screen (**Figure 6.5.3.1-2)** gives the Train Setpoints popup box shown in ***Figure 6.5.3.1-14***. This box is specific to each basin. This screen provides for the input of maximum and minimum flow setpoints for the basin.

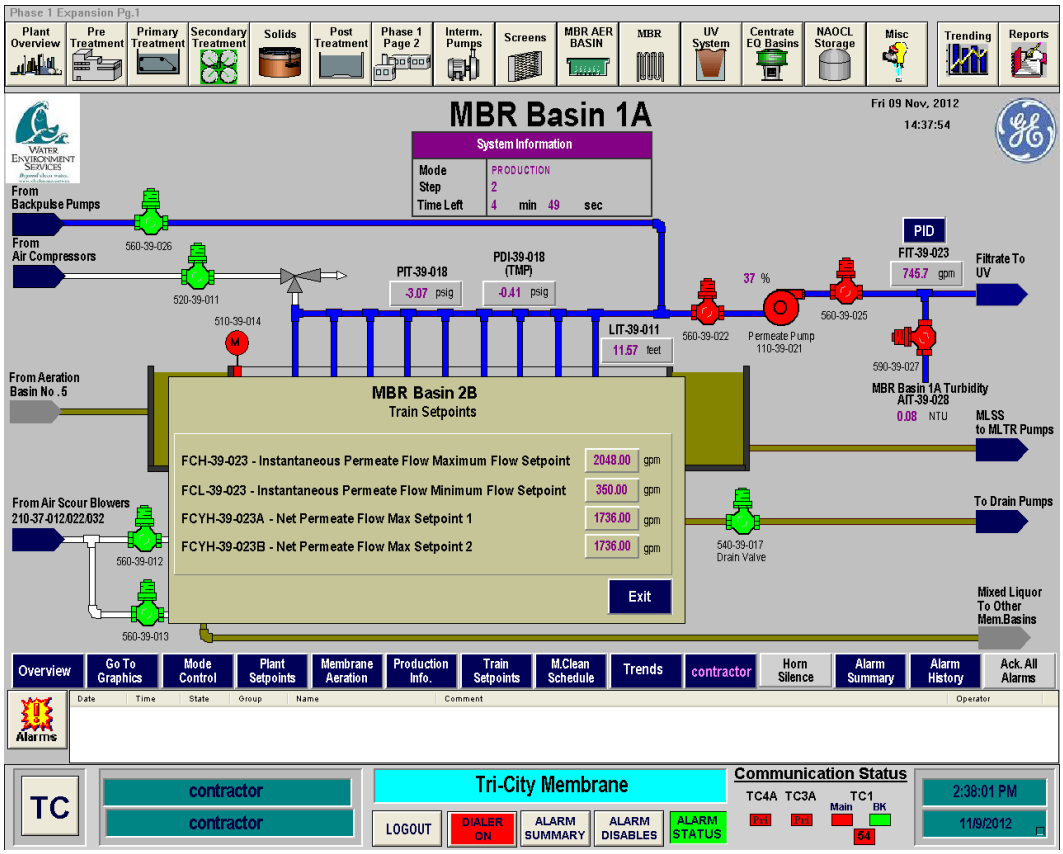

Figure 6.5.3.1-14 **– Train Setpoints Screen**

Maintenance Clean Schedule Setpoints

Clicking on the **M.Clean Schedule button <14>** located on the bottom of the MBR Basin screen (**Figure 6.5.3.1-2)** gives the Maintenance Clean Schedule popup box shown in ***Figure 6.5.3.1-15***. This box is specific to each basin. This box provides for inputting the maintenance clean schedule for the basin. The maintenance clean scheduling provides for the operator to input the day of the week, time of day, the chemical to be used and the ability to enable or disable the specific day. On the screen shown in Figure 6.5.3.1-15, Basin 1A is scheduled for a hypochlorite maintenance clean on every Monday at 9:30 AM.

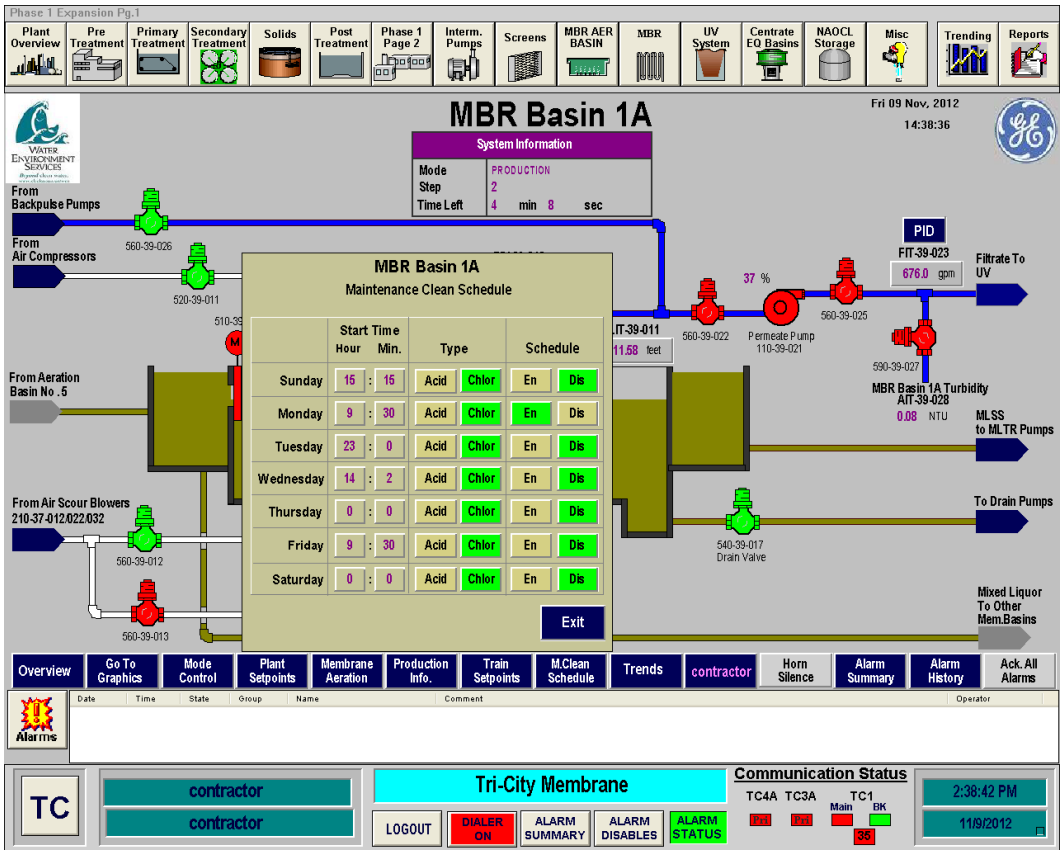

Figure 6.5.3.1-15 – Maintenance Clean Schedule Screen

Membrane Tank Level Transmitter Setpoints

When on the membrane tank screen, clicking on the **Level Transmitter button <15>** located on the the MBR Basin screen (**Figure 6.5.3.1-16)** gives the Membrane Tank Level Transmitter popup box shown in ***Figure 6.5.3.1-16***. This box is specific to each basin. This box allows for input of the high and low basin setpoint alarms and the level setpoints used by the system during a recovery clean.

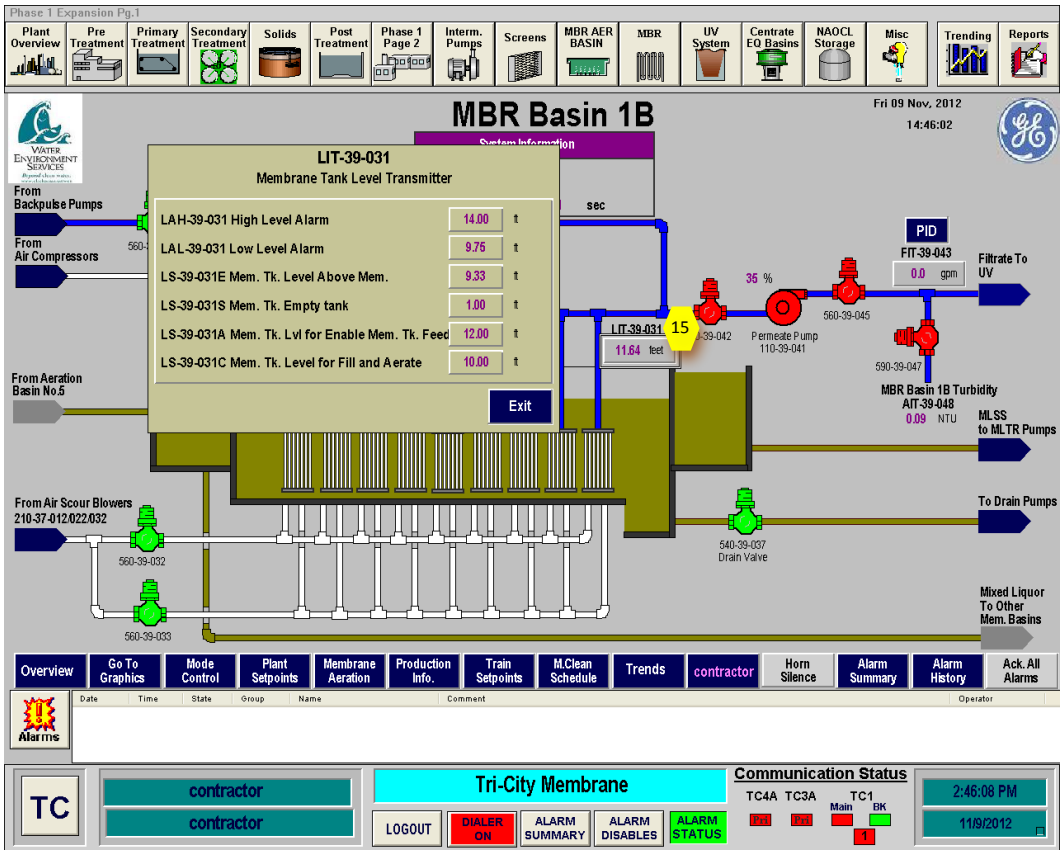

Figure 6.5.3.1-16 – Membrane Level Transmitter Alarm Setpoint Screen