CAMP LEJEUNE

WATER TREATMENT SYSTEM

PROCESS DESCRIPTION

AND

CONTROL PHILOSOPHY

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1.0 INTRODUCTION

This document supplements the drawings and specifications previously supplied by OHM Remediation Services Corp., for Delivery Order 15, Soil and Groundwater Remediation, MCB Camp LeJeune Operable Unit No. 2. This document should be used in conjunction with Piping and Instrument Diagrams P-3 through P-6, Control Loop Drawings (Drawing Numbers E-20 through E-32), Instrument Installation Details, (Drawing Numbers I-1 through I-2), PLC System Specification, and Instrument Installation Specification to define the scope of work and material supply. This Process Description and Control Philosophy is intended to provide the basis for the systems integrator to design the PLC, procure the proper instrumentation, and write the required software programming for the plant control system. It will be included in the plant operations and maintenance (O&M) manual.

The Process Description and Control Philosophy provides stream flow rates, equipment sizes, and other process information. This document provides a description of Instrumentation and Control (I&C) for each part of the system. This I&C description includes the measured variable and by what instrument it is measured; the logic needed by the Programmable Logic Controller (PLC) software to interpret the measured variable; the control action the PLC must provide to the final control element; and the type of alarm required based on the measurement of process parameters (i.e., horn, light, PLC display, or communications signal).

The items referred to in the process description and on drawings P-3 through P-6 as indicated, controlled, or alarmed in the PLC, refer to the PLC interface display (monitor) and computer system. The field-mounted indicating instruments, which indicate the measured parameter at or near their field location, are referred to as local instruments or displays.

2.0 SYSTEM OVERVIEW

2.1 Process Design

Groundwater found in the upper water bearing zone underlying MCB Camp LeJeune Operable Unit 2 is at a low pH and contains a significant quantity of iron and other inorganic compounds that would, over time, foul treatment equipment if these compounds were not removed. In addition, the groundwater in this zone as well as the deeper Castle Hayne Aquifer contains Volatile Organic Constituents (VOCs) at concentrations above the limits that the North Carolina Department of Environmental and Health Regulation will allow to be discharged to Wallace Creek. This treatment plant is designed to removed the VOCs below those limits and to remove the compounds that would foul the VOC removal equipment.

Groundwater from the upper zone is pumped by pneumatic, controllerless pumps from wells that are drilled to 35 feet below land surface (BLS) to a packaged iron removal system. This system consists of neutralization/aeration, followed by flocculation, gravity separation and sludge dewatering.

The partially treated water from the upper zone is combined in a collection tank with groundwater that is pumped from wells drilled to 110 feet BLS into the Castle Hayne Aquifer by electric pumps. The Castle Hayne Aquifer is a limestone aquifer that contains a high concentration of calcium carbonate and is at a higher pH than the shallow groundwater (8.5 to 10). The pH of the combined groundwaters is reduced in the collection tank in order to inhibit calcium carbonate scaling of the downstream piping and equipment.

The combined water is pumped through a packed bed air stripper where the VOCs are removed. Water is then pumped through cartridge filters and Granular Activated Carbon (GAC) adsorbers prior to discharge to Wallace Creek.

2.2 Instrumentation and Control System Design

The basis of the Instrumentation and Control System (I&C) is a Programmable Logic Controller (PLC) located in a central control station. Simple feedback pH control and cascade shut down of process operations based on tank levels are the main control features. The PLC maintains the

treatment process at a steady state and compensates for step changes that may be introduced to the system. The PLC station is not continually manned, but is connected via telephone modem to a continuously manned remote monitoring location. The PLC uses password entry codes for different levels of access. There is an operator level password, a supervisor level password, and a programmer level password. Operators are allowed to start and stop pumps and reset alarms and interlocks. Only supervisors will be allowed to change flow rates, pH, pressure, and other process setpoints. Changes in PLC programming can only be made by specialized programmers.

All functions and equipment are designed to fail in a safe position. Manual restart of the entire system is required after power outages.

2.2 Instrumentation and Control System Equipment

The computer interface with the PLC includes a 486/33 MHz computer with 4 MB RAM and 210 MB hard drive, 256 color SVGA monitor, 24 pin dot matrix printer, mouse, modem, extended keyboard, and appropriate user-friendly graphical interface. This PLC station, located in the GTB control room inside the office, provides a central location from which the process can be monitored, controlled, and modified when necessary. Also included at this station are the appropriate audible and visual alarms to alert the operators to changes in process parameters that are considered "critical." These "critical" alarms are also transmitted via modem and telephone lines to the remote monitoring location. Transmitting these signals to the remote monitoring location enables operators stationed there to immediately respond to "critical" treatment system alarms. The PLC programmer and the electrical contractor will provide the appropriate phone lines and interface with the remote monitoring location. All alarms, not specified herein as "critical," register and flash on the treatment system PLC monitor and must be addressed during the daily operation of the treatment system. The treatment system control station has the ability to log alarms and measured process parameters (e.g., flow rates, pressures, pH, etc.), as specified in this document. Reports of these parameters, as well as the date and time recorded, are printed as scheduled in the O&M Manual [to be completed later].

3.0 GROUNDWATER EXTRACTION SYSTEMS

3.1 Shallow Groundwater Extraction System (DWG P-3)

3.1.1 Equipment

Groundwater is extracted from wells drilled to 35 feet below land surface (BLS) in the shallow, relatively low permeability zone and is pumped to the initial compartment or reactor of a packaged iron removal system, Item X-130 (See Section 4.0). The groundwater is pumped by three (3) controllerless, pneumatic pumps, P-100, P-102, and P-104. The three pumps have a combined capacity of 30 gpm. These pumps are used because the maximum sustained yield from a well in this zone may be lower than the rate at which a centrifugal well pump may be able to operate continuously. Each pump will pump at the recharge rate of the well. This will yield maximum drawdown and capture zone. Internal controls open an internal compressed air valve when the pump body is full of water. The compressed air forces the water into the discharge line. When the pump is empty, the internal compressed air supply valve closes.

Each extraction well discharge pipe is equipped with a check valve and a flow switch. Each pump is powered by a dedicated, single stage tank mounted oilless air compressor, Items X-100, X-102, and X-104. Each air compressor is rated at 15 cfm at 100 psig and is powered by a 5-hp, 230/3/60 TEFC motor. Each check valve and flow switch is located above ground inside a prefabricated, heated and ventilated building. The groundwater from the shallow well pumps discharges into a single 2 inch diameter HDPE header pipe that is connected to a nozzle on the initial compartment or reactor of the packaged iron removal system, Item X-130 (See Section 4.0). The discharge piping after the flow switch is installed below the ground surface. At X-130, the pipelines are aboveground and inside the groundwater treatment building (GTB).

3.1.2 Instrumentation and Controls

Each discharge line and pump compressed air supply line contains identical instrumentation and valving. For brevity, this discussion uses pump P-100 as an example. The pressure gauge, PI-100, is used for measuring the discharge pressure from the extraction well pump. A paddle type flow switch, FS-100, is used to indicate the operating status of the pump. The switch sends a digital input to the PLC that indicates the operating status via position indicator XI-100. The status is displayed on the PLC monitor. A time delay will be programmed into each input that may vary because the

individual well flow rates may be different. A time delay is necessary as there is no flow from the well during the time when the pump is filling.

P-100 is equipped with a Hand-Off-Auto (HOA) Switch, HS-100, that controls a solenoid valve, SV-100, (installed in the pump compressed air supply line) which in turn controls the pump operation. This switch allows the pump operation mode to be set to manual (hand), off (switched off to override any other inputs), or automatic (controlled by the PLC). The pump normally operates in the automatic mode. The manual position is used during system start-up and after pump maintenance to determine if the pump operates to its design parameters. The off position is set during maintenance or repair operations to isolate the pump from the system PLC and as a secondary safety in case the compressed air line supply valve is not closed.

Each pump is supplied by the manufacturer with a 0 to 100 psig constant pressure regulator, PCV-100, and a mechanical compressed air pulse counter, FIQ-100. PCV-100 is adjusted to maintain the optimum pump rate. In general, the minimum pressure setting is 40 psig. Higher settings may be used to increase the pumping rate as may be appropriate. FIQ-100 is a local instrument with a digital display. Each count represents one pump volume. The cumulative volume pumped can be determined after each pump is calibrated during the start up phase.

The shallow extraction well pumps are also controlled by the water level in Groundwater Storage Tank T-110 (see DWG P-5). If the water level in T-110 rises above the height of high level switch, LSH-110, LSH-110 sends a digital input to the PLC, which displays high level alarm, LAH-110. LAH-110 trips interlock output I-151 in the PLC software. The PLC then sends digital output signals to HS-100, HS-102, and HS-104 closing the solenoid valves which effectively stops pumps P-100, P-102, and P-104. If the water level in T-110 drops below the level of LSH-110, interlock in the PLC software will automatically reset, the solenoid valves will open and the pumps will resume operation. In the event that a total system shut down has occurred, or groundwater flow from this bank of pumps needs to be stopped, HIS-103 may be accessed by operators through the PLC interface to start or stop them.

The shallow extraction well pumps are also controlled by the water level in the iron removal system Reaction Tank, X-130 . If the water level in X-130 rises above the height of high level switch, LSH-130, LSH-130 sends a digital input from the system manufacturer PLC to the master PLC through a dry contact, which displays high level alarm, LA-130. LA-130 trips interlock output I-130 in the PLC software. The PLC then sends digital output signals to HS-100, HS-102, and HS-104 closing the solenoid valves which effectively stops pumps P-100, P-102, and P-104. If the water level in X-130 drops below the level of LSH-130, interlock in the PLC software will automatically reset, the solenoid valves will open and the pumps will resume operation.

The groundwater from the shallow well pumps discharges into a single pipe header that is connected to a nozzle in X-130. The flow through the shallow extraction well header is measured by turbine meter FE-106 and displayed locally and transmitted to the PLC by flow indicating transmitter FIT-106. The flow rate is displayed on the PLC monitor by software module FI-106. The PLC also records the flow rate and displays the instantaneous and total volume of groundwater to date in software modules FI-106 and FIQ-106, respectively.

The air compressors that power the shallow groundwater extraction pumps are equipped with self contained instrumentation for their independent operation. The air compressors are not interfaced with the plant PLC. Compressors will start when the pressure in the receiver drops to 50 psig and will stop when the pressure reaches 100 psig. The receiver is equipped with a pressure relief valve, a 0-150 psig pressure gauge, and an automatic condensate drain valve.

3.2 Castle Hayne Aquifer (Deep) Groundwater Extraction System (DWG P-4)

3.2.1 Equipment

Groundwater is withdrawn from the Castle Hayne (deep) Aquifer from wells drilled to 110 feet BLS and pumped to the Groundwater Storage Tank T-110. The groundwater is pumped from the extraction wells by centrifugal well pumps P-101, P-103, and P-105. The three (3) well pumps have a total pumping capacity of 600 gpm. Each extraction well discharge pipe is equipped with a flowmeter and manual butterfly valve for adjusting the groundwater flow to the desired flow rate. Each meter and globe valve is located aboveground inside a prefabricated, heated and ventilated building. The groundwater from the extraction well pumps discharge into a single 8 inch diameter

HDPE pipe header that is connected to a nozzle in T-110. The piping after the butterfly valve is installed below the ground surface. At T-110, the pipeline is aboveground and insulated (flow and pressure transmitters are located at this point).

3.2.2 Instrumentation and Control

Each well and discharge line contains identical instrumentation and valving. For brevity, this discussion uses pump P-101 as an example. The pressure gauge, PI-101, is used for measuring the discharge pressure from the extraction well pump to monitor if the pump is functioning according to its design parameters. A turbine flowmeter , FE-101 provides instantaneous and total flow measurements from P-101, displayed locally and represented by FIQ-101. This allows operators to adjust the flow rate with the manual butterfly valve. Instrumentation is connected to the appropriate valving to provide maintenance access. This same configuration is provided for each of the wells.

The same control scheme is designed for each extraction well pump. P-101 is equipped with a Hand-Off-Auto (HOA) Switch (HS-101) that controls the pump operation. This switch allows the pump operation mode to be set to manual (hand), off (switched off to override any other inputs), or automatic (controlled by the PLC). The pump normally operates in the automatic mode. The manual position is used during system start-up and after pump maintenance to determine if the pump operates to its design parameters. The off position is set during maintenance or repair operations to isolate the pump from the system PLC. HS-101 sends a digital input to the PLC that indicates if the pump is "on" or "off" via the position indicator XI-101, displayed on the PLC monitor.

In the automatic mode, operation of all extraction well pumps are controlled by the water level in the well via low level switches LSL-101 and high level switch LSH-101 and by the water level in the Groundwater Storage Tank, T-110 via high-high level switch LSHH-110. When the water level in the extraction well drops below the low level setpoint of LE-101, LSL-101 sends a digital input to the PLC which displays low level alarm LAL-101 on the monitor. LAL-101 then trips interlock output I-101 in the PLC software and sends a digital output signal back to HS-101 that stops the pump. When the extraction well water level rises above the low level setpoint, LSL-101 is reset and LAL-101 is no longer displayed on the PLC monitor. When the extraction well recharges further and the water level rises to the high level setpoint of LE-101, high level switch LSH-101 provides

a digital input to the PLC, which then displays high level alarm LAH-101 on the PLC monitor. LAH-101 then resets I-101 in the PLC software. After resetting I-101, the PLC then sends a digital output to HS-101 that restarts P-101. When the extraction well water level falls below the high level setpoint, LSH-101 is reset and LAH-101 is no longer displayed in the PLC.

If the level in T-110 continues to rise after the shallow groundwater pumps (P-100, P-102, and P-104) are stopped and the water level exceeds the height of high-high level switch, LSHH-110, then LSHH-110 provides a digital input to the PLC which displays high-high level alarm LAHH-110. This high-high alarm is also sent to the remote monitoring location via telephone lines and activates the "common" alarm signal light in the treatment system control room. LAHH-110 also trips interlock output I-150 in the PLC software. The PLC then sends a digital output signal back to HS-101, HS-103, and HS-105 that stops all of them. When LAH-110 and LAHH-110 have been tripped the extraction system is shut down. If either of these alarms (LAH or LAHH) is tripped, then this pump bank must be reset through start/stop hand indicator switch HIS-100. HIS-100 is accessed by the operators through the PLC interface.

The groundwater from the deep well pumps discharges into a single pipe header that is connected to a nozzle in T-110. The flow through the deep extraction well header is measured by turbine meter FE-107 and displayed locally and transmitted to the PLC by flow indicating transmitter FIT-107. The flow rate is displayed on the PLC monitor by software module FI-107. The PLC also records the flow rate and displays the instantaneous and total volume of groundwater to date in software modules FI-107 and FIQ-107, respectively. The pressure in this header is also measured and transmitted to the PLC by pressure indicating transmitter PIT-108. The pressure is displayed on the PLC monitor by software module PIA-108. PIA-108 also provides a low pressure alarm, that is displayed on the PLC monitor.

4.0 PACKAGED IRON REMOVAL SYSTEM

The Iron Removal System is a packaged, pre-piped, pre- wired system that removes the iron and other inorganic compounds from the shallow groundwater through oxidation/precipitation, flocculation, and gravity solids/liquid separation. It consists of several equipment items that are procured from a single systems manufacturer. All internal functions of the iron removal system are controlled by a PLC provided by the systems manufacturer. Critical operating parameters requiring interface with other plant equipment will be passed to the master plant PLC through dry contacts.

4.1 Reaction Tank

4.1.1 Equipment

The Reaction Tank, Item X-130, is a rectangular, coal tar epoxy lined, carbon steel tank containing baffles that separate the tank into three equal sized chambers that are designed to yield 10 minutes hydraulic detention time at the design flow rate of 30 gpm. The entire tank is covered, gasketed and vented through the roof. Aeration, neutralization, de-aeration and flocculation occur in this vessel.

Water extracted from the shallow saturated zone enters the first chamber of the iron removal system reaction tank through a 2 inch diameter drop pipe. The first chamber is agitated and aerated by compressed air that is introduced at the bottom through fine bubble diffusers. The air flow rate is manually adjusted by a pressure regulator, PCV-130. The pH is adjusted between 8.5 and 9.0 with 50 percent by weight sodium hydroxide, NaOH. The sodium hydroxide is pumped from a 300 gallon polyethylene storage container by an adjustable speed .25-hp, diaphragm metering pump, Item P-121. The pump is equipped with a Hand-Off-Auto (HOA) Hand Switch HS-121 that sends and receives digital signals from the PLC. The flow from this pump is controlled by PLC adjustment of the speed controller SC-121. At this pH, the iron that is in the ferrous (Fe^{++}) state is oxidized to the ferric (Fe^{+++}) state and will precipitate as ferric hydroxide, $Fe(OH)_3$.

Water flows over a baffle into a stilling chamber where any fine bubbles adhering to particles and remaining in the liquid are released. De-aerated water flows under a baffle into the third chamber where a dilute polymer solution is added. The polymer is added at a constant, manually adjustable rate and is prepared by an automatic system, Item X-132, that draws concentrated polymer from a polymer storage drum and mixes it with fully treated water that is pumped from the Treated Effluent Holding Tank, Item T-240 (see DWG P-5) by the Reuse Water Pump, Item P-245. This chamber

is stirred by a slow, manually adjustable speed, Type 304 stainless steel agitator, Item A-130. The polymer assists the agglomeration of the fine particulates and the agitator creates enough movement to distribute the polymer and create a dense flocculate that will settle out rapidly in down stream equipment. The water with precipitated and flocculated solids flows by gravity into a high rate, lamella clarifier, Item X-131.

4.1.2 Instrumentation and Controls

The Reaction Tank drains by gravity and has a constant level. It is equipped with a high level switch, LSH-130 and high-high level switch, LSHH-130 (not currently shown). If the level in X-130 rises above the set point of LSH-130, the signal will be transmitted from the vendor panel to the master PLC. Interlock I-130 will be tripped. As previously described in Section 3.1.2, the I-130 sends a digital output to the shallow well pump (P-100, P-102, P-104) hand switches (HS-100, HS-102, HS-104) to close their respective solenoid valves (SV-100, SV-102, SV-104). The high level is displayed as Level Alarm LA-130 in the plant master PLC. A local audible alarm is supplied by the system manufacturer. I-130 also sends a digital output from HIS-243 (see DWG P-5) to close a solenoid valve, SV-243, in the reuse water line. If the selected system supplier uses a pump to withdraw concentrated polymer from the storage drum, I-130 will also cause this pump to stop through the plant master PLC. I-130 also initiates a digital output to stop and lock out the Spent Backwash Water Pump, Item P-205 (see DWG P-5) through the hand switch, HS-205. LSHH-130 performs the same functions and serves as a backup in case LSH-130 fails. When the water level in X-130 drops below the high level, I-130 resets automatically and all functions that have been stopped are resumed.

Compressed air flow to the initial chamber is manually controlled using pressure regulator, PCV-130. The rate is established and adjusted by operating experience.

Programming that will send a signal to the remote station when I-130 is tripped more than three times in any one hour period should be incorporated.

The pH in X-130 is to be maintained between 8.5 and 9.0. The pH is measured in the initial chamber by pH sensor AE-130 and transmitted to the PLC by pH indicating transmitter AIT-130. The pH is displayed on the master PLC monitor by software module AIA-130. Software

module AIA-130 receives the pH measurement, displays the current pH, and controls the flow of the 50 percent NaOH solution to X-130. The system manufacturer PLC controls the caustic flow by sending an analog signal to the speed controller SC-121 of P-121. AIA-130 also displays high and low pH alarms when the pH reaches the alarm setpoints. When the low pH alarm setpoint is reached, the plant master PLC displays the alarm, sends the alarm signal to the remote monitoring location via telephone lines, and lights the "common" alarm light. The high pH alarm condition is not relayed to the remote monitoring location. The alarm is displayed on the PLC monitor. Both of these alarms are reset only when the pH of the groundwater returns within the setpoint range.

The speed controller of A-130 sends a signal through a contact closure to the plant master PLC. A-130 operating status is displayed on the PLC monitor as XI-130.

4.2 Clarifier

4.2.1 Equipment

The flocculated water flows by gravity from X-130 to the Clarifier, Item X-131. The clarifier is an epoxy coated, carbon steel vessel with internals that allow gravity separation of the solids from the bulk of the water to take place in a relatively small area. The clarifier is designed to yield less than 3 milligrams per liter (mg/L) suspended solids at a flow rate of 30 gpm. X-131 has a bolted and gasketed top and is vented through the roof. Water flows out of the clarifier by gravity. Solids accumulate in a chamber at the bottom of the device and reach a concentration of one to two percent by weight. This sludge is continuously removed from the clarifier at a manually adjustable rate between 1 and 5 gpm by a cast iron, air operated, double Buna N diaphragm Sludge Pump, Item P-143. Sludge is recycled to the first chamber of the Reaction Tank, X-130. Periodically, a manually set timer will activate a three way valve in the recycle line. This will direct sludge to the Sludge Thickener, Item T-140.

4.2.2 Instrumentation and Controls

The Clarifier operation is not affected by low level, therefore low level control is not provided. The height of the Clarifier sidewall will be above the high level set point in the reaction tank, therefore high level control is not provided.

Sludge level detectors have not proven to be sufficiently reliable to be included in this system.

A pressure regulator and needle valve (not shown) are used to manually adjust the speed (and thus flow rate) of the Sludge Pump, P-143.

A three way valve located in the sludge recycle line is electrically operated by timers that adjust both span between operation and duration of position.

4.3 Sludge Thickener

4.3.1 Equipment

The sludge Thickener, Item T-140, is a vertical, cylindrical Fiberglass Reinforced Polyester (FRP) resin tank that is 4 feet in diameter and six feet tall with a 30 degree sloped bottom and a flat, covered and gasketed top that is vented through the roof. This vessel is used to allow the sludge to further thicken to 5 to 10 percent by weight solids prior to dewatering in the Sludge Dewatering Press, Item X-140. It is anticipated that sludge will be withdrawn and dewatered at a frequency equal to the blow down from the clarifier. Should the water level increase beyond the capacity of the tank, it will overflow by gravity to the aeration chamber of X-130.

4.3.2 Instrumentation and Controls

The Sludge Thickener is not equipped with controls because it overflows by gravity and it is designed to manually emptied once every two to three days.

4.4 Sludge Dewatering Press

4.4.1 Equipment

The Sludge Dewatering Press, Item X-140, is a device used to reduce the volume and water content of the sludge produced by the iron removal system. It consists of a set of square glass filled polyethylene plates that have an embossed filtration surface recessed on either side and covered with filter cloth. The set of plates is compressed between a stationary and movable heavy metal heads. Ports allow the sludge to be pumped by an air operated, double diaphragm Filter Press Feed Pump, Item P-141, into the middle of each plate where the solids are retained on the filter cloth. The water that passes through the filter cloth is discharged to the Head Tank, Item T-145. The pump continues to run until solids completely fill the chamber and can no longer be compressed. Compressed air

is used to blow the core back to the Sludge Thickener Tank (T-140) and to force the residual water remaining in the sludge cake after the pump stalls into the Head Tank, T-145. The filter press is then opened, the solids are dropped into a collection hopper, and the press is closed to await the next cycle.

4.4.2 Instrumentation and Controls

The Sludge Dewatering Press and feed pump are supplied complete with all controls necessary to operate them. The operation is batchwise and manual. Therefore, there is no requirement to interface the operation with the plant master PLC.

4.5 Head Tank

4.5.1 Equipment

The Head Tank, Item T-145, is a 500 gallon, closed top polyethylene tank that is provided with a vent that extends above the roof. Clarified water overflows by gravity from the Clarifier, X-131, and is pumped by a ductile iron , horizontal centrifugal Supernatant Transfer Pump, Item P-145, rated at 30 gpm and 30 feet TDH to the Groundwater Collection Tank, Item T-110 (see DWG P-4). A pneumatically operated gate valve, FV-145, controls water flow into the Head Tank. Water discharges from the Supernatant Transfer Pump to a 2 inch diameter, SCH 80 carbon steel line that is equipped with a check valve and manual ball valve. The ball valve is used to adjust the flow from the Supernatant Transfer Pump.

4.5.2 Instrumentation and Controls

The Head Tank is equipped with three discreet level switches, LSL-145, LSH-145 and LSHH-145. Low Level Switch, LSL-145, stops P-145. High Level Switch, LSH-145, starts P-145. High-High Level Switch, LSHH-145 closes the pneumatically controlled valve, FV-145. Dry contacts are provided to communicate and display the position of FV-145 and the operating status of P-145 [not currently shown].

4.6 Chemical Storage

4.6.1 Equipment

The 50 percent NaOH used to neutralize the shallow groundwater is stored in 300 gallon polyethylene containers. Two containers are in service. The two in service are stacked and

equipped with piping that allows the Caustic Supply Pump, P-121, to withdraw caustic from the lower container and allows the upper container to drain into the lower container as caustic is used. This allows the upper container to drain completely before it is changed. Using this arrangement, it is unlikely that the caustic supply will be depleted during vacation or holiday periods when operators may not be available to replenish the supply.

Polymer solution is supplied and stored in 55 gallon polyethylene drums. A polymer addition system is supplied that mixes the concentrated polymer with reuse water and delivers the diluted solution to the third compartment of the Reaction Tank, X-130.

4.6.2 Instrumentation and Controls

The NaOH storage containers are mounted on a weigh scale, WE-121. Weigh transmitter WT-121 transmits an analog input to the plant master PLC. When the weight reaches a preset level, the weight and an alarm is displayed on the PLC monitor as software module WIA-121.

The polymer storage drum is mounted on a weigh scale, WE-131. Weigh transmitter WT-131 transmits an analog input to the plant master PLC. When the weight reaches a preset level, the weight and an alarm is displayed on the PLC monitor as software module WIA-131.

5.0 GROUNDWATER STORAGE AND FEED SYSTEM

5.1 Groundwater Storage Tank and Feed Equipment

Groundwater Storage Tank T-110 is a vertical, cylindrical, glass fused steel tank with a grouted, sloped bottom and conical top. It is 14 feet in diameter and 20 feet high. (All heights given for tanks are straight side heights). The tank is located outside the water treatment system building. It has a design pressure of atmospheric at 150°F, and has a maximum capacity of approximately 22,000 gallons. The tank provides surge capacity for the treatment system, equalization of the influent groundwater and pH adjustment. Groundwater from the deep well and the partially treated shallow well is pumped into the tank through the conical top via separate dip pipes. Sulfuric acid used to adjust the pH is pumped from a polyethylene storage container by a diaphragm metering 93% $H_2 SO_4$ (Acid) feed pump, P-211, to T-110 though a separate dip pipe. T-110 also receives water through separate lines from the two building sumps T-115 and T-025. The Acid Pump is equipped with Hand-Off-Auto (HOA) Hand Switch, HS-211, that is used to control pump start/stop operation.

Agitation of T-110 is provided by a ductile iron jet mixing pump, Item P-120, that circulates 1200 gpm of water through high velocity jets mounted on the floor of T-110. The jet mixing pump is powered by a 10-hp motor.

Groundwater is pumped to the Air Stripper, Item C-200 (DWG P-5), from T-110 by Air Stripper Feed Pumps P-110A/B. P-110A/B are ANSI standard, horizontal centrifugal, ductile iron pumps with Type 316 stainless steel impellers capable of pumping 540 gpm of water at 90 feet TDH using a 20-hp, TEFC motor. The pumps are also equipped with Hand-Off-Auto (HOA) Hand Switches, HS-110A and HS-110B, that are used to control the pump operation. P-110A is the primary pump and P-110B serves as an installed spare to be used during maintenance or repair of P-110A. The flow from these pumps is controlled by flow control valve FCV-110. A continuous recycle of 40 gpm at design conditions is provided for these pumps. The recycle flow is returned to T-110 and is regulated by Restricting Orifice, RO-110.

5.2 Groundwater Storage and Feed System Instrumentation and Control

As mentioned in Section 3.2 of this document, LSH-110 and LSHH-110 provide alarms and appropriate interlocks to the groundwater extraction systems for high levels in T-110. T-110 is also

equipped with differential pressure type level indicating transmitter LIT-110. LIT-110 measures and transmits the fluid level in the tank to the PLC where it is displayed by software module level indicator controller alarm LICA-110. This software module receives the level measurement, provides a software setpoint to the flow indicating controller alarm FICA-110, displays the current tank level, and displays low tank level alarm when the level reaches the low alarm setpoint.

LICA-110 also provides a display and an alarm for low-low tank level when this setpoint is reached. When this alarm is tripped, the software provides interlock output signal I-110 to HS-110A or HS-110B and HS-120 stopping the pumps that are operating. The PLC software recognizes which pump is running by first analyzing the status of the software position indicators XI-120, XI-110A and XI-110B. If I-110 is tripped, then the pump must be reset using the appropriate start/stop hand indicator switches, HIS-120, HIS-110A or HIS-110B. HIS-120, HIS-110A and HIS-110B are accessed by the operators through the PLC interface. The PLC also sends the low-low alarm for T-110 to the remote monitoring location via telephone lines and activates the "common" alarm signal light in the treatment system control room. Pumps 110A/B are also controlled by High-high Level in the Stripper Effluent Holding Tank, Item T-220 (see DWG P-5). Intelock I-221 is tripped upon reaching a high level set point which stops P-110A/B. Pumps 110A/B are also controlled by the Low Pressure switch in the air supply duct to Air Stripper, C-200 (see DWG P-5). Low air pressure trips interlock I-200 which stops P-110A/B.

T-110 is equipped with a local thermometer, TI-110, to monitor the tank liquid temperature.

The flow of groundwater from P-110A/B is measured by turbine flowmeter FE-110 and transmitted by flow indicating transmitter FIT-110 to the PLC where it is displayed by software module FICA-110. FICA-110 represents a flow indicator controller alarm. This software module receives the flow measurement and provides an analog output to FCV-110 to actuate the valve to meet the setpoint provided by LICA-110. FICA-110 also displays the current flow rate and a high and low flow alarm in the PLC at the respective alarm setpoints.

Pressure gauges PI-110A and PI-110B are provided in the discharge line directly after each pump so that the pressure in the line can be measured in the field during operation of the pump. Pressure gauge PI-110 is provided in line directly following FCV-110 to verify that the valve is performing

as specified. Readings from this gauge also are used to determine when maintenance or repair of the valve is needed.

The pH in T-110 is to be maintained between 7.5 and 8.0. The pH is measured in the continuous recycle line by pH sensors AE-200A/B and transmitted to the PLC by pH indicating transmitters AIT-200A/B. The pH measurement is displayed by software module AICA-200. The PLC also provides software selector switch HIS-200C. HIS-200C allows the operators to switch between pH sensors AE-200A and AE-200B. Since pH sensors tend to be high maintenance items, this allows a sensor to be taken out of service without shutting down the process. This software module receives the pH measurement, displays the current pH, and controls the flow of the 93 percent sulfuric acid to T-110. AICA-200 controls the acid flow by sending an analog signal to the speed controller SC-211 on P-211. AICA-200 also displays high and low pH alarms when the pH reaches these respective alarm setpoints. When the low pH alarm setpoint is reached, the PLC displays the alarm, sends the alarm signal to the remote monitoring location via telephone lines, and activates the "common" alarm light. Interlock I-201 is tripped when the pH reaches 6.5 which stops the acid feed pump. Interlock I-201 resets when pH rises above 6.5 and P-211 restarts. The high alarm condition is not transmitted to the remote monitoring location, but is only displayed in the control panel and activates the "common" alarm light. Both of these alarms are reset only when the pH of the groundwater returns within the setpoint range.

Position Indicator XI-211 is an interface signal that informs the treatment system PLC of the on/off status of P-211. HIS-211 allows operators to start and stop P-211 through the PLC interface. Interlock I-211 is tripped when both P-110A/B are off. This interlock will stop P-211. When P-110A/B start, I-211 is reset and P-211 restarts. A local pressure gauge, PI-211, is provided with a diaphragm chemical seal to monitor the P-211 discharge pressure and assist in diagnosis of problems and calibration.

5.3 Chemical Storage

The 93 percent sulfuric acid used to neutralize the combined groundwater is stored in 300 gallon polyethylene containers. Two containers are in service. The two in service are stacked and equipped with piping that allows the Acid Pump, P-221, to withdraw acid from the lower container

and allows the upper container to drain into the lower container as acid is used. This allows the upper container to drain completely before it is changed. Using this arrangement, it is unlikely that the acid supply will be depleted during vacation or holiday periods when operators may not be available to replenish the supply.

The acid storage containers are mounted on a weigh scale, WE-211. Weigh transmitter WT-211 transmits an analog input to the plant master PLC. When the weight reaches a preset level, the weight and an alarm is displayed on the PLC monitor as software module WIA-211.

6.0 AIR STRIPPING SYSTEM

6.1 Air Stripper Column and Equipment

Groundwater flows from the Air Stripper Feed Pump, P-110 A/B to the top of Air Stripper Column C-200 where it discharges to atmospheric pressure and flows onto the tower packing. The air stripper system removes VOCs from the groundwater by mass transfer to the air stream that runs counter current (upward) to the downward water flow. The air stream is then discharged to atmosphere. C-200 is a counter-current column that is approximately 5 feet in diameter and 55 feet high along the straight sides. It contains approximately 47 feet of packing and has a design wind load of 100 mph. The stripper is sized to remove all volatile groundwater contaminants to below their discharge requirements. C-200 is constructed of FRP and contains a random packing. The air stripper is located outside the water treatment building.

Stripping air is provided to C-200 by Air Stripping Column Fan K-200. K-200 is a centrifugal fan designed to provide approximately 5,000 cfm of air at 8 inches w.c. using a 5.0-hp, TEFC motor. The fan is constructed of Fiberglass Reinforced Plastic (FRP) and is provided with the air stripper.

After groundwater reaches the bottom of the column packing and has been stripped by the air, it is collected in Stripper Effluent Holding Tank T-220. T-220 is a vertical, cylindrical, FRP tank with a flat bottom and flat top. It is approximately 8 feet in diameter and 5 feet high. The tank is located outside the treatment system building underneath C-200. T-220 supports C-200 and acts as the collection sump for the air stripper column. T-220 has a design pressure of atmospheric at 150°F and a total capacity of approximately 1,900 gallons.

Groundwater is pumped from T-220 by GAC Adsorber Feed Pumps P-220A/B. P-220A/B are horizontal centrifugal, ductile iron pumps with type 316 stainless steel impellers capable of pumping 540 gpm of water at 90 feet TDH using a 20-hp, TEFC motor. The pumps are also equipped with Hand-Off-Auto (HOA) Hand Switch HS-220A and HS-220B that control the pump operation. P-220A is the primary pump and P-220B serves as an installed spare to be used during maintenance or repair of P-220A. The groundwater is fed from these pumps to the Liquid GAC Adsorption System X-220A/B. This flow is controlled by flow control valve FCV-220. A continuous recycle of 40 gpm at design conditions is provided for these pumps. The recycle flows back to T-220 and is regulated by Restricting Orifice, RO-220.

6.2 Air Stripper System Instrumentation and Control

C-200 is a static piece of process equipment that requires only monitoring of the air pressure in the column. Air pressure is measured in the duct connecting the fan outlet to the Air Stripper column. Hand Indicator Switch HIS-200D allows K-200 to be started, stopped, or reset from the treatment system PLC, while Position Indicator XI-200 is an interface signal that informs the treatment system PLC of the on/off status of K-200. The treatment system PLC also provides digital input signals to the air stripper control system from interlocks I-200 and I-221. I-220 shuts down K-200 after a one hour shut down of GAC Feed Pumps P-220A/B, based on low-low level in T-220. I-221 also shuts down K-200 one hour after shut down of P-110A/B, based on high level in tank T-220. After either I-220 or I-221 has been tripped K-200 must be reset using HIS-200D, which is accessed through the PLC interface.

A diaphragm pressure switch measures the air pressure in the duct. At the low pressure setting, the switch will send a digital input to the PLC which will trip interlock I-200 which will stop P-110 A/B. This will display on the PLC monitor as PA-200 and transmit a signal to the remote "common" alarm. The high pressure set point signals that the column is in need of cleaning. Since this condition is not critical, this signal is not transmitted to the remote location but is displayed as high pressure PA-200. A local pressure gauge, PI-200, (calibrated in inches water column) is provided by the manufacturer. The manufacturer will also provide a local air flow meter (not currently shown).

The instrumentation for the Stripper Effluent Holding Tank, Item T-220, is provided by the General Contractor as part of the treatment system and not by the air stripper manufacturer. To control the level and help control the flow from T-220 to the Liquid GAC Adsorption System, T-220 is equipped with differential pressure type level indicating transmitter LIT-220. LIT-220 measures and transmits the level in the tank to the PLC, where it is displayed by software module LICA-220. LICA-220 represents a level indicator controller alarm. This software module receives the level measurement, provides a software setpoint to FICA-220, displays the current tank level, and displays high and low tank level alarms when the levels reach alarm setpoints. When the high or low alarm setpoints are reached, the PLC displays the alarm, transmits the alarm signal to the remote monitoring location via telephone lines, and activates the "common" alarm light. Additionally, the high alarm triggers I-221 and the low alarm triggers I-220. I-221 sends a digital output to stop

P-110A/B, and I-220 sends a digital output to stop P-220A/B. A one hour time delay is programmed for I-221 to stop K-200 in order to ensure proper treatment of any remaining liquid hold up and in case the system is restarted. The PLC software recognizes which pump is running by first analyzing the status of the software Position Indicators XI-220A and XI-220B. If I-220 is tripped, then the pump must be reset using the appropriate start/stop hand indicator switch, either HIS-220A or HIS-220B. Operator can access HIS-220A and HIS-220B through the PLC interface. These alarms reset when the levels return within setpoint limits. P-220A/B are also equipped with local Hand-Off Auto Hand Switches HS-220A/B.

Pressure gauges PI-220A and PI-220B are installed at the P-220A/B discharge to assist in diagnosing any system problem. A turbine flowmeter, FE-220, measures the discharge flow rate which is transmitted and indicated locally by flow indicating transmitter FIT-220.

7.0 LIQUID GRANULAR ACTIVATED CARBON (GAC) ADSORBER SYSTEM

7.1 Cartridge Filters

7.1.1 Equipment

Before groundwater flows to the Liquid GAC Adsorber System, it is prefiltered by Cartridge Filters F-220A/B/C, which are arranged in parallel. F-220A/B/C are in-line, 10 micron filters, 2 feet in diameter and 5 feet high each capable of handling 250 gpm at a design pressure of 75 psig at 150°F. These filters are constructed of 304 stainless steel. The replaceable filters are made of paper. These filters remove any particulates that may have come through the system. This helps to limit backwashing of the GAC vessels. The units are arranged in parallel so that the system may remain in operation during cartridge replacement.

7.1.2 Instrumentation and Controls

The only instrumentation associated with F-220A/B are local pressure gauges and High-high Differential Pressure Indicating Transmitter PDIT-220A. When the differential pressure across the filters exceeds 20 psi, PDIT-220A sends a digital output to PDIA-220A, which is displayed on the PLC monitor. This high alarm activates the" common" alarm light in the remote control room. Local indication of pressure on upstream and downstream sides of the filters is measured by Pressure Gauges PI-220 C and PI-220D, respectively.

7.2 GAC Adsorbers

7..2.1 Equipment

Groundwater flows from F-220A/B/C to Liquid GAC Adsorber System X-220A/B where the remaining VOCs are adsorbed onto the activated carbon. These two units are arranged as a parallel train. Piping and valving is supplied to allow them to be operated in series. The groundwater flow is split between each adsorber with 250 gpm going to each. Each vessel is a vertical, cylindrical, carbon steel tank 10 feet in diameter and 10 feet high with elliptical heads and a design pressure of 75 psig at 150°F. The system is located inside the treatment system building. The system is purchased as a self-contained system and comes skid mounted including all required interconnecting piping and valving so that the system can be manually backwashed. Groundwater flows from the GAC Adsorber System to the top of the Treated Effluent Storage Tank T-240. Backwash water from the GAC system is sent to Backwash Water Holding Tank T-205. These units are expected to require backwashing approximately once for every 3 to 4 months of operation.

7.3 GAC Adsorber System Instrumentation and Control

GAC Adsorber System X-220A/B is provided with a High-high Differential Pressure Indicating Transmitter PDIT-220B. When X-220A/B registers a 5 psi differential pressure, the alarm is displayed on the PLC monitor to inform the operator that the GAC vessel(s) need to be backwashed.

Each vessel is equipped by the manufacturer with a pressure gauge [not presently shown] and a pressure relief valve, PSV-220 A/B.

8.0 EFFLUENT STORAGE AND DISCHARGE SYSTEM

8.1 Effluent Storage Tank and Discharge Equipment

Treated Effluent Storage Tank T-240 is a vertical, cylindrical, cross linked high density polyethylene tank with a flat bottom and domed top. It is 12 feet in diameter and 12 feet high. The tank is located inside the treatment system building. It has a design pressure of atmospheric at 150°F, and has a capacity of approximately 12,000 gallons. The tank also provides backwash water for X-220A/B. Treated groundwater enters the tank through the domed top via a dip pipe.

The treated effluent discharges to Wallace Creek by gravity from the side of T-240. The effluent is also used for pump seal water and in the polymer addition system and is supplied to the appropriate areas by Reuse Water Pump P-245. P-245 is a centrifugal, carbon steel pump capable of pumping 10 gpm of water at 110 feet TDH using a .75-hp motor. The pump is also equipped with Hand-Off-Auto (HOA) Hand Switch HS-245 that controls the pump. The flow from this pump to the polymer system is controlled by a solenoid valve (on/off type block valve) SV-243.

The effluent used for backwashing the GAC vessels is supplied by Backwash Water Pump P-241. P-241 is a centrifugal, carbon steel pump capable of pumping 200 gpm of water at 50 feet TDH using a 5-hp motor. The pump is also equipped with Hand-Off-Auto (HOA) Hand Switch HS-241 that controls the pump.

8.2 Effluent Storage Tank and Discharge Instrumentation and Control

T-240 uses differential pressure type, level indicating transmitter LIT-240 to monitor the tank level for use as permissive interlocks and to stop P-220A/B at a high-high level condition. LIT-240 measures and transmits the water level in the tank to the PLC where it is displayed by software module LIA-240. LIA-240 is a level indicator alarm. LIA-240 also provides a display and an alarm for low-low level, low level, high level, and high-high level when these setpoints are reached. When the low-low alarms, the PLC transmits the low alarm for T-240 to the remote monitoring location via telephone lines and activates the "common" alarm signal light in the remote control room. When the low alarm on T-240 is tripped, the software provides interlock output signal I-240 which is a permissive interlock in the PLC. If I-240 is tripped, then pump P-241 is disabled and will not be allowed to start; however, if I-240 is tripped while P-241 is in operation, P-241 continues to complete its run cycle. It is then disabled and prevented from starting again. [The PLC also sends

the low low alarm for T-240 to the remote monitoring location via telephone lines and activates the "common" alarm signal light in the treatment system control room.] I-240 and the level alarm is reset when the level returns within the setpoint range.

When the high alarm is tripped, it is displayed in the PLC. When the high-high alarm is tripped, the software provides interlock output signal I-242 to HS-220A or HS-220B, stopping the pump that is operating. The PLC software recognizes which pump is running by first analyzing the status of the software position indicators XI-220A and XI-220B. If I-242 is tripped, then the pump must be reset using the appropriate start/stop Hand Indicator Switch, either HIS-220A or HIS-220B. HIS-220A and HIS-220B are accessed by the operators through the PLC interface. The PLC also sends the high-high alarm for T-240 to the remote monitoring location via telephone lines and activates the "common" alarm signal light in the treatment system control room.

The gravity flow of groundwater discharging from T-240 is measured by V-notch weir FE-240 and transmitted to the PLC by flow indicating transmitter FIT-240 where it is displayed and totalized by software module FIQ-240. FIQ-240 represents a flow indicator totalizer which displays instantaneous flow and totalized flow.

A pressure gauge PI-241 is provided in the line directly after P-241 so that the pressure in the line can be monitored in the field during pump operation to determine if the pump is performing to design parameters.

9.0 SECONDARY AND UTILITY SYSTEMS

9.1 Backwash Water Holding Tank

Backwash Water Holding Tank T-205 is a vertical, cylindrical, glass-lined, cross linked high density polyethylene tank with a flat bottom and domed top. It is 12 feet in diameter and 12 feet high. The tank is located inside the treatment system building. It has a design pressure of atmospheric at 150°F, a capacity of approximately 12,000 gallons, and is vented to atmosphere. T-205 provides surge capacity for backwash water from X-220A/B.

The treated effluent that periodically accumulates in T-205 is slowly pumped to the Iron Removal System Reaction Tank X-130 for removal of the suspended solids. The effluent from T-205 is pumped to X-130 by Spent Backwash Water Pump P-205. P-205 is a centrifugal, carbon steel pump capable of pumping 5 gpm of water at 40 feet TDH using a 1- hp motor. The pump is also equipped with a local Hand-Off-Auto (HOA) Hand Switch, HS-205, that controls the pump operation.

T-205 is equipped with level switches that are used to control P-205. P-205 can be started manually through the PLC interface using HIS-205. As backwash water from P-241 fills T-205 to the height of high level switch LSH-205, LSH-205 sends a signal to the PLC where it triggers PLC interlock I-205. I-205 then transmits a software signal to HIS-241, which then sends a signal to stop Backwash Water Pump P-241. P-205 then pumps the spent backwash water to the Iron Removal System for reprocessing by the system. I-205 is reset when the water level in the tank falls below LSH-205. The level in T-205 slowly falls until it reaches the mounting height of low level switch LSL-205. LSL-205 sends a signal to the PLC where it triggers PLC interlock I-206. I-206 then transmits a software signal to HIS-205, which then sends a signal to stop Spent Backwash Water Pump P-205. I-206 is reset when the tank level rises above the height of LSL-205. T-205 is also equipped with sight glass LG-205 for visually reading the tank level. In addition, P-205 is equipped with pressure gauge PI-205 that is provided in the line directly after the pump so that the pressure in the line can be monitored in the field during pump operation to determine if the pump is performing to design parameters. The operating status of P-241 is displayed on the PLC monitor by position indictor XI-205.

Reuse Water Pump, P-245, provides seal water for the Air Stripper Feed, GAC Adsorber System Feed, and Backwash Water Pumps as well as water required by the Polymer Addition System. It

is equipped with a position indicator, XI-245, and Hand -Off-Auto Switch, HS-245. When I-240 is tripped on low level in T-240, I-240 sends a signal to HIS-245 to stop P-245. P-245 must then be started using HIS-245 at the PLC interface.

9.2 Compressed Air System (DWG P-6)

The groundwater treatment system uses compressed air for many purposes. These include actuation of flow control and block (on/off) valves, aeration in the Iron Removal System Reaction Tank, and running the air operated diaphragm pumps in the metals removal system. Compressed air is supplied from Air Compressor X-150A. X-150A is a reciprocating-type, oilless air compressor equipped with a 30-hp motor. It is constructed of carbon steel and comes as a self-contained unit which includes: a receiver tank (X-150D) with sufficient storage to minimize cycling of the compressor; a compressed air dryer to provide instrument quality air for plant service; all required instrumentation and controls; and a local control panel. The Air Compressor is rated at 30 CFM at 125 psig. The air compressor local control panel is interfaced through contact closures to indicate air compressor trouble (eg. high temperature, high pressure, etc.) that displays an alarm, XA-150, on the PLC monitor and by low air pressure switch, PSL-152 which displays an alarm on the PLC monitor, transmits a signal via modem to the remote monitoring location lighting the "common" alarm and trips Interlock I-152. I-152 stops P-220A/B [not currently shown]. This will induce a cascade total system shutdown. PSL-152 must be reset to enable the system to restart.

9.3 Building Sump System

The treatment system building is equipped with two floor sumps T-025 and T-115, which are used to receive pump seal water and any groundwater or chemical spills that may occur. Each sump is a cast concrete sump 4 feet in diameter and 4 feet deep capable of storing approximately 375 gallons.

These sumps are also equipped with Building Sump Pumps P-025 and P-115. P-025 and P-115 are submergible, centrifugal pumps, constructed of carbon steel; they are capable of pumping 15 gpm

at 40 TDH using a 0.75 hp motor. These pumps send accumulated liquids to the Groundwater Collection Tank T-110 for processing through the treatment system.

T-025 and T-115 are equipped with ball-float-type, level switches that control pumps P-025 and P-115. As the level in T-025 rises to the high level setpoint of ball-float-type, low, high level switch LSHL-025, it provides a contact closure to the treatment system PLC, which displays high level alarm LAH-025. The PLC then provides a digital output to start/stop Hand Switch HS-025 that starts the pump and sends the sump liquid to T-110. As the level falls to the low level setpoint of LSHL-025, LSHL-025 opens the contact closure, stopping P-025 and resetting the LAH-025.

As the level in T-115 rises to the high level setpoint of ball-float-type, low, high level switch LSHL-115, it provides a contact closure to the treatment system PLC, which displays high level alarm LAH-115. The PLC then provides a digital output to start/stop Hand Switch HS-115 that starts the pump and sends the sump liquid to T-110. As the level falls to the low level setpoint of LSHL-115, LSHL-115 opens the contact closure, stopping P-115 and resetting the LAH-115.

9.5 Sanitary Pumps

Sewage is pumped from the GTB sewage collection station by vertical sump pumps, P-150 A/B. These are cast iron pumps rated at 10 gpm at 80 feet TDH. They are controlled by ball-float type low, high and high-high level switch. As the level in the sump rises to the high level setpoint of ball-float-type, low, high level switch LSHL-050, it provides a contact closure to the treatment system PLC, which displays high level alarm LAH-050. The PLC then provides a digital output to start/stop Hand Switch HS-050A that starts the pump and sends the sump liquid to the force main that is connected to the base sewer system. As the level falls to the low level setpoint of LSHL-050, LSHL-050 opens the contact closure, stopping P-050A and resetting the LAH-050.

If the level continues to rise to the High-High setpoint of LSHL, the PLC provides a digital output to start P-150B. When the level falls below the high-high level setpoint, the PLC provides a digital output to stop P-150A. When the low level setpoint is reached, the PLC provides a digital output to stop P-150B. Programming is incorporated to alternating starting between P-150A and P-150B depending on which pump was started first during the previous pumping cycle.