TETRA TECH

TECHNICAL MEMORANDUM

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Cc:	Brad Bijold
From:	Saeed Darian
Date:	11/18/2016
Subject:	NERT Weir Dewatering Treatment Process Control Narrative

At the direction of the Nevada Environmental Response Trust (NERT or Trust), Tetra Tech, Inc. (Tetra Tech) has prepared this NERT Weir Dewatering Treatment Process Control Narrative.

1.0 TREATMENT PROCESS GENERAL DESCRIPTION

The Southern Nevada Water Authority (SNWA) is planning to construct two new weirs on Las Vegas Wash. SNWA will hire a construction company to construct the new weirs. The groundwater generated from the weir construction operations is anticipated to be contaminated with low concentrations of perchlorate. The Nevada Environmental Response Trust (NERT) is responsible for treating the groundwater before discharge to the Wash under the existing NPDES permit. This document provides a detailed description of the treatment process and the control strategy.

The treatment process consists of two pump stations and one central water treatment plant (CWTP). One pump station will be located in the vicinity of the Sunrise Mountain weir. This pump station is called the Sunrise Mountain Pump Station (SMPS). The other pump station will be located in the vicinity of the Historic Lateral weir. This pump station is called the Historic Lateral Pump Station (HLPS). The groundwater generated from the construction activities at the Sunrise Mountain weir will be transferred by the weir construction company to four baker-type influent tanks installed at the SMPS. The groundwater generated from the construction activities at the Historic Lateral weir will be transferred by the weir construction company to four baker-type influent tanks installed at the HLPS. The combined flow from the two weir construction sites shall be no more than 6,900 gpm.

The combined water from the two pump stations will go to the CWTP. The treatment process consists of cyclones to remove large solid particles from the groundwater. Treated water out of the cyclones is sent through several multi-media filters to remove residual suspended solids from the water before ion exchange treatment. The ion exchange is used to remove perchlorate from the water before discharge to the Wash. Treated water leaving the ion exchange system is stored in the treated water tanks before discharge.

The underflow from the cyclones containing the solid waste is sent to a cyclone waste tank for storage. The multi-media filters are first rinsed and then backwashed when the pressure drop across the filters rises to a pre-set value. The filters are initially rinsed with treated water from the ion exchange system to remove perchlorate from

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the filter vessels to prevent contamination of treated water. The rinse water is directed to a rinse water storage tank, and then is pumped into ion exchange to remove perchlorate it contains. After the rinse process the filters are backwashed. The backwash waste is sent to two backwash waste tanks for storage. The solid wastes from the backwash waste tanks are sent to the treated water effluent line where they are blended with the treated water and then discharged together to the Wash. Depending on the CWTP feed water TSS level, the cyclone waste may be sent to the backwash waste tanks directly, mixed with the backwash waste, and combined with the treated water effluent for discharge, or may be trucked out to make sure the combined effluent TSS level is below regulatory requirement.

2.0 GROUND WATER STORAGE AND PUMPING AT THE SMPS

2.1 Groundwater Collection

Four (4) 20,000-gallon baker-style Influent Tanks (TK-1A, 1B, 1C & 1D) will be provided at the SMPS to receive the groundwater generated from the from the weir construction activities. The weir construction company shall be responsible for transferring the groundwater from the weir construction site to the Influent Tanks at the SMPS. The Weir General Contractor will install a by-pass line at their battery limits on the groundwater transfer line that under emergency conditions can return the untreated groundwater to the Las Vegas Wash instead of sending it to the treatment system pump station. The by-pass line and the main transfer line will be equipped with manual shut off valves. During emergency conditions, the valve on the main transfer line from the weir construction site to the SMPS will be shut off and the valve on the bypass line will be opened to return the water to the Wash.

2.1.1 Flowmeter (FM-2010) and Flow Control Valve (FCV-2010) on the Feed Line to Influent Tanks (TK-1A, 1B, 1C & 1D)

One (1) magnetic flow meter (FM-2010) and one (1) electrically-actuated modulating flow control valve (FCV-2010) will be installed on the influent pipe to the Influent Tanks (TK-1A, 1B, 1C & 1D) at the SMPS. FM-2010 shall provide instantaneous and totalized flow for the groundwater entering the Influent Tanks TK-1A, 1B, 1C & 1D. FCV-2010 shall control flow entering the Influent Tanks and shall be normally OPEN. Operations are as follows:

- FM-2010 shall measure instantaneous flow entering Influent Tanks TK-1A, 1B, 1C & 1D.
    - Instantaneous flow shall be sent to the SMPS Control Panel, where it will be totalized. Flows will be totalized per 24-hour period (daily) and over the operating lifetime of the pump station. Daily flows will be recorded and kept for XXX days. The lifetime flow will be recorded and kept for XXX days.
- The reading from FM-2010 shall be summed with the readings from flowmeter FM-3010 installed at HLPS to indicate the total flow fed to the two pump station.
- When the instantaneous flowrate measured by FM-2010 exceeds a pre-set value (6,900 gpm) for XXX minutes:
    - High-Flow Alarm shall be generated. The alarm shall be transmitted from the SMPS Control Panel to the Master Control Panel and then to the Operator via the Auto-Dialer.
- When the water level reaches High-High Level in the tanks:
    - An alarm will be generated alerting the operator of a potential mechanical or control related malfunction.

2.1.2 Online TSS Monitor (AIT-2010) on the Feed Line to Influent Tanks

One (1) online real-time TSS monitor (AIT-2010) will be installed on the feed pipe to transfer groundwater generated from the Sunrise Mountain Weir construction site. AIT-2010 will provide instantaneous TSS readings of flow coming out of the construction site. Operations are as follows:

- AIT-2010 shall measure the instantaneous Total Suspended Solids (TSS) concentration of groundwater being generated from the weir construction site.
    - Instantaneous TSS readings shall be sent to the SMPS Control Panel, and the Master Control Panel at CWTP. The TSS reading shall be recorded and kept for XXX days.
- When the instantaneous TSS reading measured by AIT-2010 at SMPS exceeds a pre-set value (135 ppm) for XXX minutes:
    - High-TSS Alarm shall be generated. The alarm shall be generated by the SMPS Control Panel and transmitted to the Master Control Panel and then to the Operator via the Auto-Dialer.

2.1.3 Level Measurement (LIT-2020 and LIT 2021) at Influent Tanks (TK-1A, 1B, 1C & 1D)

Four (4) 20,000-gallon baker-style Influent Tanks (TK-1A, 1B, 1C & 1D) will be used to store groundwater that is generated from the Sunrise Mountain Weir construction site. The Influent Tanks shall be interconnected with a pipe manifold; the levels in the Influent Tanks are expected to equalize. One (1) ultrasonic level sensor (LIT-2020) will be installed on Influent Tank TK-1B. Another ultrasonic level sensor (LIT-2021) will be installed on Influent Tank TK-1C to serve as a back-up level sensor. Operations are as follows.

- LIT-2020 (or LIT-2021 back-up if LIT-2020 is not in service) shall continuously measure the water level in the Influent Tanks TK-1A, 1B, 1C & 1D. Operator-adjustable levels shall include the following:
    - Low-Low Level: Minimum water level that the alarm shall be generated by the SMPS Control Panel and transmitted to the Master Control Panel to trigger an alarm callout.
    - Low Level: Water level to turn OFF all Influent Pumps PU-1A, 1B & 1C. An alarm shall be transmitted from the SMPS Control Panel to the Master Control Panel and then to the Operator via the Auto-Dialer.
    - Permissive Level One: Water level for one (lead) Influent Pump operation, if fewer than three (3) pumps are operating at both the SMPS and HLPS combined. Under this condition a maximum of two pumps can be operating in HLPS.
    - Permissive Level Two: Water level for two (lead/lag) Influent Pumps operation, if fewer than three (3) pumps are operating at both the SMPS and HLPS combined. Under this condition only one pump can be operating in HLPS.
    - Permissive Level Three: Water level for all three (lead/lag/second lag) Influent Pumps operation, if fewer than three (3) pumps are operating at both the SMPS and HLPS combined. The maximum total number of three (3) pumps shall operate at both the SMPS and HLPS at any given time.
    - High Level:
    - High-High Level: An alarm shall be transmitted from the SMPS Control Panel to the Master Control Panel and then to the Operator via the Auto-Dialer. The control system starts to modulate the control valve and immediately contact the weir construction supervisor to alert them that the modulating valve is being closed. The weir contractor will close the valve on the main transfer line and open the valve on the bypass line to reduce the quantity of water coming to the pump station.

- When the level measured by LIT-2020 or LIT-2021 rises above a pre-set High High level (XX ft) for XXX minutes:
    - Flow Control Valve FCV-2010 shall modulate to reduce flow entering the tanks to maintain the water level in the Influent Tanks TK-1A, 1B, 1C & 1D.
    - An alarm shall be generated by the SMPS Control Panel and transmitted to the Master Control Panel to trigger an alarm callout. The operator immediately contacts the weir contractor supervisor.
- Once the level measured by LIT-2020 or LIT-2021 falls below a pre-set High level (XX ft) for XXX minutes:
    - Flow Control Valve FCV-2010 shall OPEN to allow the flow to enter the tanks the Influent Tanks TK-1A, 1B, 1C & 1D. The operator will contact the weir contractor supervisor and request the bypass line be closed and the valve on the main transfer line be fully opened.
- Once the level measured by LIT-2020 or LIT-2021 falls below a pre-set Low level (XX ft) for XXX minutes:
    - All the operating pumps at SMPS shall STOP.
- Once the level measured by LIT-2020 or LIT-2021 falls below a pre-set Low-Low level (XX ft) for XXX minutes:
    - An alarm shall be generated by the SMPS Control Panel and transmitted to the Master Control Panel and trigger an alarm callout.

2.1.4 Pressure Safety Valve (PSV-201) at Influent Tanks (TK-1A, 1B, 1C & 1D)

One (1) Pressure Safety Valve (PSV-201) will be installed on the line returning flow from the combined header to the Central Water Treatment Plant (CWTP) to Influent Tank TK-1A. Because all the Influent Tanks (TK-1A/B/C/D) are interconnected with a pipe manifold, the levels in the Tanks are expected to equalize. Operations are as follows.

- Once the pressure in the line flowing to Influent Tank TK-1A exceeds a pre-set level (180 psi):
    - PSV-201 shall OPEN to return flow from the combined header to the Central Water Treatment Plant (CWTP) back to Influent Tank TK-1A.
    - An alrm is generated alerting the operator of an emergency in the treatment system.
- Once the pressure in the line flowing to Influent Tank TK-1A falls below a pre-set level (180 psi):
    - PSV-201 shall CLOSE to allow forward flow out of the Influent Tanks TK 1A/B/C/D to the combined header to the CWTP.

2.2 Influent Pumps (PU-1A, 1B & 1C)

Three (3) constant-speed Influent Pumps (PU-1A, 1B & 1C) will be used to send water from Influent Tanks TK-1A, 1B, 1C & 1D to the Cyclone Separators (HC-1A & 1B) at the Central Water Treatment Plant (CWTP) through an 18-inch transmission line. A fourth pump shall be stored on-site as a shelf spare. The pumps shall be controlled via level (as measured by LIT-2020 or LIT-2021) in the Influent Tanks TK-1A, 1B, 1C & 1D, and the Master Control Panel that monitors the total number of operating pumps from both pump stations. The three (3) Influent Pumps shall operate in lead/lag/second lag mode. The configuration of pumps to be used as lead/lag/second lag will be manually cycled once per week by the Operator. Operations are as follows:

- The following information for each of the Influent Pumps PU-1A, 1B & 1C shall be monitored by the SMPS Control Panel and is transmitted to the Master Control Panel at the CWTP:
    - Number of pumps in operation.

    - Number of motor starts and stops.
    - Motor runtimes.
- As the water level in the Influent Tanks TK-1A, 1B, 1C & 1D rises, the pumps shall be turned ON as follows:
    - Level reaches Permissive Level One: Lead pump shall be turned ON, if fewer than three (3) pumps are operating at both the SMPS and HLPS combined. Under this condition no more than two pumps can be operating at HLPS
    - Level reaches Permissive Level Two: Lead pump operating, and lag pump shall be turned ON, if fewer than three (3) pumps are operating at both the SMPS and HLPS combined. Under this condition no more than one pump can be operating at the HLPM.
    - Level reaches Permissive Level Three: Lead and lag pumps operating, and second lag pump shall be turned ON, if fewer than three (3) pumps are operating at both the SMPS and HLPS combined. Under this condition no pump can be operating at the HLPS.
- As the water level in the Influent Tanks TK-1A, 1B, 1C & 1D lowers, the pumps shall be turned OFF as follows:
    - Level reaches Permissive Level Three: Second lag pump, if operating, shall be turned OFF, and lead and lag pumps remain operating, if already started.
    - Level reaches Permissive Level Two: Lag pump, if operating, shall be turned OFF, and lead pump remains operating, if already started.
    - Level reaches Permissive Level One: Lead pump, if operating, shall be turned OFF.
    - Level reaches the Low Level: All pumps OFF
    - Level reaches the Low-Low Level: An alarm shall be generated by the SMPS Control Panel and transmitted to the Master Control Panel to trigger an alarm callout.

3.0 GROUND WATER STORAGE AND PUMPING AT THE HISTORIC LATERAL WEIR CONSTRUCTION SITE

3.1 Groundwater Collection

Four (4) 20,000-gallon baker-style Influent Tanks (TK-2A, 2B, 2C & 2D) will be provided at the HLPS to receive the groundwater generated from the from the weir construction activities. The weir construction company shall be responsible for transferring the groundwater from the weir construction site to the Influent Tanks at the HLPS. The Weir General Contractor will install a by-pass line at their battery limits on the groundwater transfer line that under emergency conditions can return the untreated groundwater to the Las Vegas Wash instead of sending it to the treatment system pump station. The by-pass line and the main transfer line will be equipped with manual shut off valves. During emergency conditions, the valve on the main transfer line from the weir construction site to the HLP will be shut off and the valve on the bypass line will be opened to return the water to the Wash. Flowmeter (FM-3010) and Flow Control Valve (FCV-3010) on the Feed Line to Influent Tanks (TK-2A, 2B, 2C & 2D)

One (1) magnetic flow meter (FM-3010) and one (1) electrically-actuated modulating flow control valve (FV-3010) will be installed on the influent pipe to the Influent Tanks (TK-2A, 2B, 2C & 2D) at the HLPS. FM-3010 shall provide instantaneous and totalized flow for the groundwater entering the Influent Tanks TK-2A, 2B, 2C & 2D. FCV-3010 shall control flow entering the Influent Tanks and shall be normally OPEN. Operations are as follows:

- FM-3010 shall measure instantaneous flow entering Influent Tanks TK-2A, 2B, 2C & 2D.
    - Instantaneous flow shall be sent to the HLPS Control Panel, where it will be totalized. . Flows will be totalized per 24-hour period (daily) and over the operating lifetime of the pump

station. Daily flows will be recorded and kept for XXX days. The lifetime flow will be recorded and kept for XXX days.

- When the instantaneous flowrate measured by FM-3010 exceeds a pre-set value (6,900 gpm) for XXX minutes:
    - High-Flow Alarm shall be generated. The alarm shall be transmitted from the HLPS Control Panel to the Master Control Panel and then to the Operator via the Auto-Dialer.
- When the water level reaches High-High Level in the tanks:
    - An alarm will be generated alerting the operator of a potential mechanical or control related malfunction

3.1.1 Online TSS Monitor (AIT-3010) on the Feed Line to Influent Tanks

One (1) online real-time TSS monitor (AIT-3010) will be installed on the feed pipe to transfer groundwater generated from the Historic Lateral Weir construction site. AIT-3010 will provide instantaneous TSS readings of flow coming out of the construction site. Operations are as follows:

- AIT-3010 shall measure the instantaneous Total Suspended Solids (TSS) concentration of groundwater being generated from the weir construction site.
    - Instantaneous TSS readings shall be sent to the HLPS Control Panel, and the Master Control Panel at CWTP. The TSS reading shall be recorded and kept for XXX days.
- The reading from FM-3010 shall be summed with the readings from flowmeter FM-2010 installed at HLPS to indicate the total flow fed to the two pump station.
- When the instantaneous TSS reading measured by AIT-3010 at HLPS exceeds a pre-set value (135 ppm) for XXX minutes:
    - High-TSS Alarm shall be generated. The alarm shall be generated by the HLPS Control Panel and transmitted to the Master Control Panel and then to the Operator via the Auto-Dialer.

3.1.2 Level Measurement (LIT-3020 and LIT 3021) at Influent Tanks (TK-2A, 2B, 2C & 2D)

Four (4) 20,000-gallon baker-style Influent Tanks (TK-2A, 2B, 2C & 2D) will be used to store groundwater that is generated from the Sunrise Mountain Weir construction site. The Influent Tanks shall be interconnected with a pipe manifold; the levels in the Influent Tanks are expected to equalize. One (1) ultrasonic level sensor (LIT-3020) will be installed on Influent Tank TK-2B. Another ultrasonic level sensor (LIT-3021) will be installed on Influent Tank TK-2C to serve as a back-up level sensor. Operations are as follows.

- LIT-3020 (or LIT-3021 back-up if LIT-3020 is not in service) shall continuously measure the water level in the Influent Tanks TK-2A, 2B, 2C & 2D. Operator-adjustable levels shall include the following:
    - Low-Low Level: Minimum water level that the alarm shall be generated by the HLPS Control Panel and transmitted to the Master Control Panel to trigger an alarm callout.
    - Low Level: Water level to turn OFF all Influent pumps PU-2A, 2B & 2C. An alarm shall be transmitted from the SMPS Control Panel to the Master Control Panel and then to the Operator via the Auto-Dialer
    - Permissive Level One: Water level for one (lead) Influent pump operation, if fewer than three (3) pumps are operating at both the SMPS and HLPS combined. Under this condition a maximum of two pumps can be operating in SMPS.
    - Permissive Level Two: Water level for two (lead/lag) Influent pumps operation, if fewer than three (3) pumps are operating at both the SMPS and HLPS combined. Under this condition only one pump can be operating in SMPS. .

  - Permissive Level Three: Water level for all three (lead/lag/second lag) Influent pumps operation, if fewer than three (3) pumps are operating at both the SMPS and HLPS combined. Under this condition no pump can be operating at SMPS. The maximum total number of three (3) pumps shall operate at both the SMPS and HLPS at any given time. The minimum of two pumps shall operate at a given time at both the SMPS and HLPS at any given time. The minimum of two pumps shall operate at a given time at both the SMPS and HLPS at any given time.
  - The minimum of two pumps shall operate at a given time at both the SMPS and HLPS at any given time.
  - High-High Level: An alarm shall be transmitted from the HLPS Control Panel to the Master Control Panel and then to the Operator via the Auto-Dialer. The control system starts to modulate the control valve and immediately contact the weir construction supervisor to alert them that the modulating valve is being closed. The weir contractor will close the valve on the main transfer line and open the valve on the bypass line to reduce the quantity of water coming to the pump station.
- When the level measured by LIT-3020 or LIT-3021 rises above a pre-set High level (XX ft) for XXX minutes:
  - Flow Control Valve FCV-3010 shall modulate to reduce flow entering the tanks to maintain the water level in the Influent Tanks TK-2A, 2B, 2C & 2D.
  - An alarm shall be generated by the HLPS Control Panel and transmitted to the Master Control Panel to trigger an alarm callout. The operator immediately contacts the weir contractor supervisor.
- Once the level measured by LIT-3020 or LIT-3021 falls below a pre-set Low level (XX ft) for XXX minutes:
  - All the operating pumps at HLPS shall STOP.
- Once the level measured by LIT-3020 or LIT-3021 falls below a pre-set Low-Low level (XX ft) for XXX minutes:
  - An alarm shall be generated by the HLPS Control Panel and transmitted to the Master Control Panel to trigger an alarm callout.

3.1.3 Pressure Safety Valve (PSV-301) at Influent Tanks (TK-2A, 2B, 2C & 2D)

One (1) Pressure Safety Valve (PSV-301) will be installed on the line returning flow from the combined header to the Central Water Treatment Plant (CWTP) to Influent Tank TK-2A. Because all the Influent Tanks (TK-2A/B/C/D) are interconnected with a pipe manifold, the levels in the Tanks are expected to equalize. Operations are as follows.

- Once the pressure in the line flowing to Influent Tank TK-2A exceeds a pre-set level (180 psi):
  - PSV-301 shall OPEN to return flow from the combined header to the Central Water Treatment Plant (CWTP) back to Influent Tank TK-2A.
- Once the pressure in the line flowing to Influent Tank TK-2A falls below a pre-set level (180 psi):
  - PSV-301 shall CLOSE to allow forward flow out of the Influent Tanks TK 2A/B/C/D to the combined header to the CWTP.

3.2 Influent Pumps (PU-2A, 2B & 2C)

Three (3) constant-speed Influent pumps (PU-2A, 2B & 2C) will be used to send water from Influent Tanks TK-2A, 2B, 2C & 2D to the Cyclone Separators (HC-1A & 1B) at the Central Water Treatment Plant (CWTP) through an

18-inch transmission line. A fourth pump shall be stored on-site as a shelf spare. The pumps shall be controlled via level (as measured by LIT-3020 and LIT-3021) in the Influent Tanks TK-2A, 2B, 2C & 2D, and the Master Control Panel that monitors the total number of operating pumps from both pump stations. The three (3) Influent pumps shall operate in lead/lag/second lag mode. The configuration of pumps to be used as lead/lag/second lag will be manually cycled once per week by the Operator. Operations are as follows:

- The following information for each of the Influent pumps PU-2A, 2B & 2C shall be monitored by the HLPS Control Panel and is transmitted to the Master Control Panel at the CWTP:
  - Number of pumps in operation.
  - Number of motor starts and stops.
  - Motor runtimes.
- As the water level in the Influent Tanks TK-2A, 2B, 2C & 2D rises, the pumps shall be turned ON as follows:
  - Level reaches Permissive Level One: Lead pump shall be turned ON, if fewer than three (3) pumps are operating at both the SMPS and HLPS combined. Under this condition no more than two pumps can be operating in SMPS.
  - Level reaches Permissive Level Two: Lead pump operating, and lag pump shall be turned ON, if fewer than three (3) pumps are operating at both the SMPS and HLPS combined. Under this condition no more than one pump can be operating in SMPS
  - Level reaches Permissive Level Three: Lead and lag pumps operating, and second lag pump shall be turned ON, if fewer than three (3) pumps are operating at both the SMPS and HLPS combined. Under this condition no pump can be operating in SMPS
- As the water level in the Influent Tanks TK-2A, 2B, 2C & 2D lowers, the pumps shall be turned OFF as follows:
  - Level reaches Permissive Level Three: Second lag pump, if operating, shall be turned OFF, and lead and lag pumps remain operating, if already started.
  - Level reaches Permissive Level Two: Lag pump, if operating, shall be turned OFF, and lead pump remains operating, if already started.
  - Level reaches Permissive Level One: Lead pump, if operating, shall be turned OFF.
  - Level reaches the Low Level: All pumps OFF
  - Level reaches the Low-Low Level: An alarm shall be generated by the HLPS Control Panel transmitted to the Master Control Panel to trigger an alarm callout.

4.0 COMBINED FLOW AND TSS CONTROL TO THE CWTP

4.1.1 Overall Flow Control

Total flow coming from the two (2) pump stations is limited to 6,900 gpm. Flow signals from the influent flowmeters FM-2010 (at SMPS) and FM-3010 (at HLPS) are sent to the Master Control Panel at the CWTP. Based on the flowrates measured by FM-2010 and FM-3010, the Master Control Panel will modulate the influent flow control valves FCV-2010 and FCV-3010, for the SMPS and HLPS, respectively.

- The Master Control Panel shall continuously calculate the sum of the flowrate readings from FM-2010 and FM-3010, installed at the SMPS and HLPS, respectively.
- When the sum of the flowrates exceeds 6,900 gpm:

- High-Flow Alarm shall be transmitted to the Master Control Panel and then to the Operator via the Auto-Dialer.
- The Master Control Panel shall identify the pump station (either of SMPS or HLPS) with higher flowrate reading by comparing the influent flowrate readings from FM-2010 (at SMPS) and FM-3010 (at HLPS).
- The Master Control Panel shall command to modulate the respective flow control valve (either FCV-2010 for SMPS or FCV-3010 for HLPS) at the pump station with higher incoming flow to reduce that pump station's influent flow until the sum of the flowrate from FM-2010 and FM-3010 is less than 6,900 gpm.
- Operator shall contact weir general contractor and inform them of any required response for flow control.

- When the sum of the flowrates falls below 6,900 gpm
  - The flow control valve (either FCV-2010 or FCV-3010) that had been modulated shall fully OPEN.

4.1.2 Overall Feed TSS Control

Total TSS coming from the two (2) pump stations is limited to 135 ppm. One (1) online real-time TSS monitor (AIT-4010) and one (1) electrically-actuated modulating flow control valve FCV-4010 shall be installed on the common feed header to the CWTP and provide instantaneous TSS readings of the flow entering the CWTP. TSS analyzer AIT-2010 and AIT-3010 will measure TSS concentrations in the incoming water to SMPS and HLPS, respectively.

- AIT-4010 shall measure the instantaneous TSS concentration of groundwater entering HC-1A & 1B.
  - Instantaneous TSS readings shall be sent to the Master Control Panel for recording and monitoring. The TSS reading shall be recorded and kept for XXX days.
- When the instantaneous TSS reading measured by AIT-4010 reaches a pre-set value (135 ppm):
  - High-TSS Alarm shall be generated. The alarm shall be transmitted to the Master Control Panel and then to the Operator via the Auto-Dialer.
  - The Master Control Panel shall monitor the TSS readings from AIT-2010 (at SMPS) and AIT-3010 (at HLPS), and identify the pump station with the higher TSS reading.
  - Operator shall manually CLOSE the respective flow control valve (FCV-2010 for SMPS or FCV-3010 for HLPS) at the pump station with higher TSS reading to prevent the flow entering the influent tanks at that pump station.
  - Operator shall contact weir general contractor and inform them of any required response for TSS control.
- When TSS reading from AIT-4010 falls below a pre-set valve (135 ppm), AND Operator receives the confirmation from the weir general that the TSS is under control:
  - The flow control valve (either FCV-2010 or FCV-3010) that had been closed shall fully OPEN.

5.0 CYCLONE SEPARATORS AND CYCLONE WASTE TANK

5.1 Cyclone System (HC-1A & 1B)

5.1.1 Flowmeter (FM-4010) to Cyclones (HC-1A & 1B)

One (1) magnetic flow meter (FM-4010) will be installed on the common feed pipe to the two (2) cyclone vessels (HC-1A & 1B) at the CWTP. FM-4010 shall provide instantaneous and totalized flow of water entering the Cyclones HC-1A & 1B. Operations are as follows:

- FM-4010 shall measure instantaneous flow entering Cyclones HC-1A & 1B.
    - Instantaneous flow shall be sent to the Master Control Panel, where it will be totalized. Flows will be totalized per 24-hour period (daily) and over the operating lifetime of the pump station. Daily flows will be recorded and kept for XXX days. The lifetime flow will be recorded and kept for XXX days.
- When the instantaneous flowrate measured by FM-4010 exceeds a pre-set value (6,900 gpm):
    - High-Flow Alarm shall be generated. The alarm shall be transmitted to the Master Control Panel and then to the Operator via the Auto-Dialer.
    - The Master Control Panel shall check the total incoming flowrate from two (2) pump stations (SMPS and HLPS) as described in Section 4.1.1.
    - If the sum of the flowrates from FM-2010 and FM-3010 is lower than 6,900 gpm, the Operator shall check the number of operating pumps in the two (2) pump stations to make sure there are no more than three (3) pumps operating at the both pump stations.

5.1.2 Cyclone Vessel Operation

The cyclone system consists of two (2) separate cyclone vessels. The cyclone vessels (HC-1A & 1B) will receive groundwater from the SMPS and the HLPS. The cyclones are designed to remove solid particles from the groundwater before multi-media filters.

Each cyclone vessel shall have three (3) chambers containing a total of 120 operating cyclones, and each cyclone shall be 2 inches in diameter. Depending on the groundwater flow rate, the system can operate as low as a single chamber within a single vessel up to all chambers in both vessels. At the design flow rate of 6,900 gpm, both vessels with all chambers shall be operated. Table 1 lists all chambers and the number of 2-inch cyclones in each chamber.

Table 1 Number of Operating Cyclones per Chamber

Chamber Number	Number of Operating Cyclones
Cyclone Vessel #1	
Chamber 1A	20
Chamber 1B	40
Chamber 1C	60
Cyclone Vessel #2	
Chamber 2A	15
Chamber 2B	45
Chamber 2C	66

Each chamber shall have one (1) motor-operated valve on the inlet line and one (1) motor-operated valve on the overflow line, for a total of 12 motor-operated valves (GV-502, 505, 508, 511, 514 and 517 for HC-1; GV-522, 525, 528, 531, 534 and 537 for HC-2). The valves shall be open-close valves commanded by the Master Control Panel, based on the pressure drop across the cyclone system to accomodate feed flow variation while maintaining the treatment efficiency. The relationship between the solids removal by the cyclone system at different flowrates and the number of operating cyclone units within different chambers, with coresponding system presure drops is shown in Table 2 below.

Table 2 Cyclone Vessel Operation based on Hydraulic Capacity

Minimum Flow Rate (gpm)	Maximum Flow Rate (gpm)	Number of Operating Cyclones	Operating Chambers	Maximum Pressure Drop (psig)	Minimum Solids Recovery
6,525	6,900	240	1A; 1B; 1C; 2A; 2B; 2C	52.2	94.7%
5,800	6,525	225	1A; 1B; 1C; 2B; 2C	53.0	94.9%
5,220	5,800	200	1A; 1C; 2A; 2B; 2C	53.0	94.9%
4,785	5,220	180	1A; 1B; 2A; 2B; 2C	53.0	94.9%
4,205	4,785	165	1A; 1B; 2B; 2C	53.0	94.9%
3,915	4,205	145	1B; 1C; 2B	53.0	94.9%
3,480	3,915	135	1A; 1B; 2A; 2C	53.0	94.9%
3,045	3,480	120	2A; 2B; 2C	53.0	94.9%
2,900	3,045	105	2B; 2C	53.0	94.9%
2,755	2,900	100	1B; 1C	53.0	94.9%
2,320	2,755	95	1A; 1C; 2A	53.0	94.9%
2,000	2,320	80	1A; 1C	53.0	94.9%

Each cyclone vessel will have one (1) pressure safety valve (PSV-501 for HC-1A and PSV-521 for HC-1B) to protect them from excess pressure.

Cyclone units use pressure energy from the flow stream to achieve separation of solids. Liquid with solids enter the cyclone liner tangentially through the inlet. The change in flow direction forces the mixture to spin in a radial vortex pattern. This vortex flow is accelerated as the internal diameter is reduced over the length of the cone. Due to the angular acceleration of the flow pattern, centrifugal forces are imparted on the solid particles forcing them toward the wall of the cone. The solids continue to spin in a radial vortex motion, down the length of the cone, to discharge through the apex to create the underflow (waste) stream. The underflow shall have a flow rate ranging from 3 gpm to 7 gpm with a solids concentration ranging from 4% to 10%, depending on influent flow and TSS. The cone convergence causes the remaining liquid flow to reverse, which is sent upward through the vortex to create the overflow (clean) stream.

The underflow shall be sent either to the Cyclone Waste Tank (TK-5) via KGV-801 or the Backwash Waste Tanks (TK-3A and 3B) via KGV-803, as selected by the Operator.

The overflow shall enter the Multi-media Filters (MMF-1A through 1F).

5.1.3 Differential Pressure Measurement (PIT-5010)

One (1) differential pressure sensor (PIT-5010) will be installed between the feed and outlet headers of the cyclone system. The differential pressure readings shall be transmitted to the Master Control Panel to operate the cyclone system.

- The cyclone system shall be operated with the differential pressure across the system between 40 psi and 55 psi, and performs best at about 54 psi.
- When the differential pressure across the system as measured by PIT-5010 exceeds a pre-set value (55 psi):
    - The Master Control Panel shall open and close control valves (GV-502, 505, 508, 511, 514 and 517 for HC-1; GV-522, 525, 528, 531, 534 and 537 for HC-2) to bring more cyclone units to operation until the differential pressure across the system is within a pre-set range (40-55 psi), and as close to 54 psi as feasible.
- When the differential pressure across the system as measured by PIT-5010 falls below a pre-set value (40 psi):
    - The Master Control Panel shall open and close control valves (GV-502, 505, 508, 511, 514 and 517 for HC-1; GV-522, 525, 528, 531, 534 and 537 for HC-2) to reduce the number of cyclone units in operation until the differential pressure across the system is within a pre-set range (40-55 psi), and as close to 54 psi as feasible.

5.2 Cyclone Waste Tank (TK-5)

During normal option, the cyclone underflow waste shall be sent to the Backwash Waste Tanks (TK-3A, 3B). However, if the Operator determines that the quantity of solids coming from the underflow is too high to be blended with the treated water coming out of the Ion Exchange System, the underflow waste can be manually sent to the Cyclone Waste Tank (TK-5) and pumped via connection to be trucked out for disposal.

The Cyclone Waste Tank (TK-5) is a 17,000-gallon baker-style tank that receives the underflow waste from the Cyclone System. The tank shall be equipped with four (4) vertical-shaft mixers (MX-2A, 2B, 2C & 2D). Each mixer shall be equipped with individual motor controllers and circuit protection.

5.2.1 Level Measurement (LIT-8020 and LIT-8021) at Cyclone Waste Tank (TK-5)

One (1) ultrasonic Level Sensor (LIT-8020) will be installed on the Cyclone Waste Tank TK-5. Another ultrasonic level sensor (LIT-3021) will be installed on the Cyclone Waste Tank TK-5 to serve as a back-up level sensor. Operations are as follows:

- LIT-8020 (or LIT-8021 back-up if LIT-8020 is not in service) shall continuously measure the waste level in the Cyclone Waste Tank TK-5. Operator-adjustable levels shall include the following:
    - Low-Low Level: Minimum waste level to turn OFF Cyclone Waste Pumps PU-4A & 4B.
    - Low-Level: Waste level for one (lead) pump operation
    - Mixer Level: Waste level for operation of the mixers MX-2A, 2B, 2C & 2D; this shall be equal to the required minimum submergence.
    - High Level: Waste level for two (lead/lag) pumps operation.
    - High-High Level: Maximum waste level to provide an alarm to the Operator.

- When the level measured by LIT-8020 drops below a pre-set Mixer level (XX ft):
  - Mixers MX-2A, 2B, 2C & 2D shall be turned OFF.
- When the level measured by LIT-8020 rises above a pre-set Mixer level (XX ft):
  - Mixers MX-2A, 2B, 2C & 2D shall be turned ON.
- When the level measured by LIT-8020 rises above a pre-set high-high level (XX ft)
  - High-High Level Alarm shall be generated. The alarm shall be transmitted to the Master Control Panel and then to the Operator via the Auto-Dialer.

5.3 Cyclone Waste Pumps (PU-4A & 4B)

Two (2) variable-speed progressing-cavity Cyclone Waste Pumps (PU-4A & 4B) will be used to take underflow waste from Cyclone Waste Tank TK-5 to a truck-out connection for optional off-site disposal. Alternatively, the waste in the TK-5 can also be pumped to the Backwash Waste Tanks TK-3A/B. The pumps shall be controlled via level (as measured by LIT-8020) in the Cyclone Waste Tank TK-5. The two (2) pumps shall operate based in lead/lag mode. The configuration of pumps to be used as lead/lag will be manually cycled once a week by the Operator. Operations are as follows:

- The following information for each of the Cyclone Waste Pumps PU-4A & 4B shall be monitored by the Master Control Panel:
  - Number of motor starts and stops.
  - Motor runtimes.
- As the water level in the Cyclone Waste Tank TK-5 rises, the pumps shall be turned ON as follows:
  - Low Level: Lead pump ON.
  - High Level: Lead pump operating, and lag pump shall be turned ON.
  - High-High Alarm: Both pumps operating. An alarm is generated.
- As the water level in the Cyclone Waste Tank TK-5 drops the pumps shall be turned OFF as follows:
  - High-High Alarm: Both pumps operating.
  - High Level: Lead pump operating, and lag pump shall be turned OFF.
  - Low Level: No pumps operating, and lead pump shall be turned OFF.

5.3.1 Truck Connection

When required, the Cyclone Waste Pumps PU-4A & 4B shall be used to pump the underflow waste out of the Cyclone Waste Tank to trucks to be hauled off-site, and this shall be conducted manually by the Operator.

One (1) quick connection with valve KGV-820 will be provided on the discharge line from Cyclone Waste Pumps (PU-4A & 4B).

5.3.2 Underflow Waste Flowmeter (FM-8040)

One (1) magnetic flow meter (FM-8040) will be installed on the common discharge pipe of the Cyclone Waste Pumps (PU-4A & 4B). FM-8040 shall provide instantaneous and totalized flow for the waste entering the Backwash Waste Tanks TK-3A/B or pumped into a truck for off-site disposal. Operations are as follows:

- FM-8040 shall measure instantaneous flow entering Backwash Waste Tanks TK-3A/B.
  - Instantaneous flow shall be sent to the Master Control Panel, where it will be totalized and recorded. Flows will be totalized per 24-hour period (daily) and over the operating lifetime of the pump station. Daily flows will be recorded and kept for XXX days. The lifetime flow will be recorded and kept for XXX days.

6.0 MULTI-MEDIA FILTERS, BACKWASH AND FILTER RINSE WASTE TANKS

6.1 Multi-Media Filters (MMF-1A/B, 2A/B, 3A/B)

Three (3) horizontal multi-media filters will be provided to remove residual solids from the overflow out of the Cyclone System. Each filter vessel is consisted of two (2) filter cells, for a total of six (6) cells. All the filter cells shall be operated in parallel. Water will enter the filters through the inlet feed header and then pass though the multiple layers of filtration media. Filtered water will then flow out of the filters and enter the ion exchange vessels driven by residual pressure out of the filters. The captured solids will accumulate in the filter media, resulting in increased pressure drop across the filter cell. Once this pressure drop exceeds a pre-set value, the filters shall be backwashed. The backwash may also be triggered by a timer from the filter PLC that starts the backwash cycle at a pre-determined time interval. An air scouring system will be used to facilitate filter backwash process.

Each filter cell will have one (1) pressure safety valve (PSV-601 and PSV-602 for MMF 1A and 1B, respectively PSV-621 and PSV-622 for MMF 2A and 2B, respectively; and PSV-641 and PSV-642 for MMF-3A and 3B, respectively).

6.1.1 Filter Inlet Flowmeters (FM-8010, FM-8020 & FM-8030) and Inlet Flow Control Valves (FCV-8010, FCV-8020 & FCV-8030)

Each filter vessel is equipped with a magnetic flow meters (FM-6010, FM-6020 & FM-6030, for MMF-1A/B, MMF-2A/B and MMF-3A/B, respectively) and an electrically-actuated modulating flow control valves (FCV-6010, FCV-6020 & FCV-6030, for MMF-1A/B, MMF-2A/B and MMF-3A/B, respectively). The flowmeters (FM-6010, FM-6020 & FM-6030) shall provide instantaneous and totalized flow of cyclone overflow entering each filter vessel, and based on the readings from these flowmeters, the flow control valves (FCV-6010, FCV-6020 & FCV-6030) will modulate to evenly distribute the feed flow into the three (3) filter vessels. Operations are as follows:

- FM-6010 shall measure instantaneous flow entering Multi-Media Filter MMF-1A/B.
    - Instantaneous flowrate shall be transmitted to the Filter Control Panel and then to the Master Control Panel, where it will be totalized and recorded. Flows will be totalized per 24-hour period (daily) and over the operating lifetime of the pump station. Daily flows will be recorded and kept for XXX days. The lifetime flow will be recorded and kept for XXX days.
    - The flowrate reading is compared with that from the other two flowmeters (FM-6020 and FM-6030) by the Filter Control Panel.
    - Flow Control Valve FCV-6010 will modulate until the flowrate reading from Flowmeter FM-6010 is the same as that from the other two flowmeters (FM-6020 and FM-6030).
- FM-6020 shall measure instantaneous flow entering Multi-Media Filter MMF-2A/B.
    - Instantaneous flowrate shall be transmitted to the Filter Control Panel and then to the Master Control Panel, where it will be totalized and recorded. Flows will be totalized per 24-hour period (daily) and over the operating lifetime of the pump station. Daily flows will be recorded and kept for XXX days. The lifetime flow will be recorded and kept for XXX days.
    - The flowrate reading is compared with that from the other two flowmeters (FM-6010 and FM-6030) by the Filter Control Panel.
    - Flow Control Valve FCV-6020 will modulate until the flowrate reading from Flowmeter FM-6020 is the same as that from the other two flowmeters (FM-6010 and FM-6030).
- FM-6030 shall measure instantaneous flow entering Multi-Media Filter MMF-3A/B.
    - Instantaneous flowrate shall be transmitted to the Filter Control Panel and then to the Master Control Panel, where it will be totalized and recorded. Flows will be totalized per 24-hour

period (daily) and over the operating lifetime of the pump station. Daily flows will be recorded and kept for XXX days. The lifetime flow will be recorded and kept for XXX days.

- The flowrate reading is compared with that from the other two flowmeters (FM-6010 and FM-6020) by the Filter Control Panel.
- Flow Control Valve FCV-6030 will modulate until the flowrate reading from Flowmeter FM-6030 is the same as that from the other two flowmeters (FM-6010 and FM-6020).

6.1.2 Control Valves (BFV-603 through BFV-628) at Multi-Media Filters (MMF-1A/B, 2A/B and 3A/B)

Each Multi-Media Filter Cell will have eight (8) electrically-actuated control valves, for a total of 48 valves. The valves shall be open-close valves and operated by the Filter Control Panel. The valves for each filter cell shall include:

- One (1) influent feed valve
- One (1) filtered water effluent (treated water) valve
- One (1) rinse water inlet valve
- One (1) rinse water discharge valve
- One (1) backwash inlet valve
- One (1) backwash waste valve
- One (1) air scouring drain valve
- One (1) air scouring valve

Table 1 Number of Operating Cyclones per ChamberTable 3 below shows the valve designations for the control valves for each Multi-Media Filter cell:

Table 3 Valve Designations for Multi-Media Filter Cells

MMF Cell No.	Influent Feed Valve	Filtered Effluent Valve	Rinse Water Inlet Valve	Rinse Water Discharge Valve	Backwash Inlet Valve	Backwash Waste Valve	Air Scour Valve	Air Scour Drain Valve
1A	BFV-601	BFV-602	BFV-603	BFV-604	BFV-605	BFV-606	BFV-607	BFV-608
1B	BFV-611	BFV-612	BFV-613	BFV-614	BFV-615	BFV-616	BFV-617	BFV-618
2A	BFV-621	BFV-622	BFV-623	BFV-624	BFV-625	BFV-626	BFV-627	BFV-628
2B	BFV-631	BFV-632	BFV-633	BFV-634	BFV-635	BFV-636	BFV-637	BFV-638
3A	BFV-641	BFV-642	BFV-643	BFV-644	BFV-645	BFV-646	BFV-647	BFV-648
3B	BFV-651	BFV-652	BFV-653	BFV-654	BFV-655	BFV-656	BFV-657	BFV-658

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6.1.3 Differential Pressure Measurement (PIT-6010/6011, PIT-6020/6021 & PIT-6030/6013) at Multi-Media Filter Vessels (MMF-1A/B, 2A/B and 3A/B)

Six (6) pressure sensors (PIT-6010/6011, PIT-6020/6021 & PIT-6030/6031) will be installed on the common feed and effluent lines of each Multi-Media Filter Vessel (MMF-1A/B, 2A/B and 3A/B) trains to measure the pressure difference across the filters. The pressure difference between the inlet and outlet of each vessel may be used to determine when the filters needs to be backwashed. Operations are as follows:

- PIT-6010 and PIT-6011 shall continuously measure the pressure at the common feed and effluent line, respectively, across Multi-Media Filter train MMF-1A/B.
- PIT-6020 and PIT-6021 shall continuously measure the pressure at the common feed and effluent line, respectively, across Multi-Media Filter train MMF-2A/B.
- PIT-6030 and PIT-6031 shall continuously measure the pressure at the common feed and effluent line, respectively, across Multi-Media Filter train MMF-3A/B.
- When the pressure drop measured by PIT-6010/6011, PIT-6020/6021 or PIT-6030/6031 rises above a pre-set level (XX psi), and the liquid levels in the Backwash Waste Tanks (TK-3A/B) and Filter Rinse Water Tank (TK-6) are both lower than respective Permissive Levels One:
    - The Filter Control Panel shall commence the rinsing and backwashing procedures for Multi-Media Filter Skid corresponding to the affected pressure sensor. Multi-Media Filter Rinse/Backwash Procedures are described in Section 6.1.4.

6.1.4 Multi-Media Filter Rinse/Backwash Procedures (MMF-1A/B, 2A/B and 3A/B)

The Filter Control Panel shall only commence the rinsing and backwash of one (1) Multi-Media Filter cell at a time. A timer will be used to allow each filter cell to be backwashed no more than twice a day. If one cell is being backwashed a second cell cannot be backwashed for at least two hours. The filter cell backwash can also be triggered based on differential pressure measurement, as described in Section 6.1.3. Each filter cell will be backwashed once before any of the filter cell is backwashed a second time. Rinse and backwash operations are as follows:

- The Filter Control Panel shall commence the rinsing/backwashing operation on a filter cell by CLOSING the respective influent feed and filtered water effluent valves to stop forward flow from entering the filter cell to be backwashed. Refer to Table 3 above for valve designations.
- The air scouring drain valve then OPENS to allow the water in the cell to be drained by gravity to a level just above the filter media, then the valve closes. The drainage flows to the Rinse Water Tank TK-6. Refer to Table 3 above for valve designations.
- Rinse water inlet and discharge valves OPEN, and then two (2) Filter Rinse/Backwash Pumps (two of PU-5A, 5B or 5C) are turned ON to rinse the filter cell for about three (3) minutes. The rinse water flows to the Rinse Water Tank TK-6. Once finished, the rinse water inlet and discharge valves CLOSE and operating Filter Rinse/Backwash Pumps are turned OFF. Refer to Table 3 above for valve designations.
- Air scouring and air scouring drain valves OPEN, then the air scouring blower (B-XXX) is turned on and operates for XX minutes. Once finished, the two valves CLOSE. Refer to Table 3 above for valve designations.
- Backwash inlet and backwash waste valves OPEN, then two (2) Filter Rinse/Backwash Pumps (two of PU-5A, 5B or 5C) are turned ON to backwash the filter cell for XXX minutes. The spent backwash waste flows to one (1) of the Backwash Waste Tanks TK-3A or 3B. Once finished, the two valves CLOSE, and operating Filter Rinse/Backwash Pumps are turned OFF. Refer to Table 3 above for valve designations.

- After backwash is complete, influent feed valve and filtered water effluent valve OPEN. The filter cell is returned to normal filtration operation. Refer to Table 3 above for valve designations.

6.2 Backwash Waste Tanks (TK-3A, 3B)

The Backwash Waste Tanks (TK-3A, 3B) are 17,850-gallon baker-style tank that receive the backflow waste from the Multi-Media Filters. Each tank shall be equipped with four (4) vertical-shaft mixers (MX-1A, 1B, 1C & 1D for TK-3A, and MX-1E, 1F, 1G & 1H for TK-3B). Each mixer shall be equipped with individual motor controllers and circuit protection.

6.2.1 Level Measurement (LIT-8030 and LIT-8031) in Backwash Waste Tanks (TK-3A, 3B)

One (1) ultrasonic Level Sensor (LIT-8030) will be installed in Backwash Waste Tank TK-3B. The Backwash Waste Tanks shall be interconnected with a pipe manifold; the levels in the Backwash Waste Tanks are expected to equalize. Another ultrasonic level sensor (LIT-8031) will be installed on Backwash Tank TK-3A to serve as a back-up level sensor. Operations are as follows.

- LIT-8030 (or LIT-8031 back-up if LIT-8030 is not in service) continuously measure the waste level in the Backwash Waste Tanks TK-3A/B. Operator-adjustable levels shall include the following:
    - Low-Low Level: An alarm shall be generated. The alarm shall be transmitted to the Master Control Panel to trigger an alarm callout.
    - Low Level: Minimum waste level to turn OFF all Backwash Waste Pumps PU-3A, 3B & 3C.
    - Permissive Level One: Waste level for one (lead) pump operation, and allows a filter rinse/backwash cycle to commence.
    - Mixer Level: Waste level for operation of the mixers MX-1A/E, 1B/F, 1C/G & 1D/H; this shall be equal to the required minimum submergence.
    - Permissive Level Two: Waste level for two (lead/lag) pumps operation. If there is a fault on the lag pump (i.e., pump will not turn ON when commanded), an alarm shall be generated. The alarm shall be transmitted to the Master Control Panel to trigger an alarm callout for Operator to manually turn ON the standby pump.
    - High Level: Waste level for all three (lead/lag/standby) pumps operation.
    - High-High Level: An alarm shall be generated. The alarm shall be transmitted to the Master Control Panel to trigger an alarm callout.
- When the level measured by LIT-8030 or LIT-8031 drops below a pre-set Mixer level (XX ft):
    - Mixers MX-1A/E, 1B/F, 1C/G & 1D/H shall be turned OFF.
- When the level measured by LIT-8030 or LIT-8031 rises above a pre-set Mixer level (XX ft):
    - Mixers MX-1A/E, 1B/F, 1C/G & 1D/H shall be turned ON.

6.2.2 Flowmeters (FM-8011, 8021 & 8031) for Backwash to Multi-Media Filters (MMF-1A/B, 2A/B and 3A/B)

Three (3) magnetic flow meters (FM-8011, FM-8021 & FM-8031) will be installed on the individual backwash inlet headers entering each Multi-Media Filter Vessel (MMF-1A/B, 2A/B, 3A/B). The flowmeters shall provide instantaneous and totalized flow of treated water for backwash entering each filter vessel. Operations are as follows:

- FM-8011 shall measure instantaneous backwash flow entering Multi-Media Filter Skid MMF-1A/B.
    - Instantaneous flow shall be transmitted to the Filter Control Panel and then to the Master Control Panel, where it will be totalized and recorded. Flows will be totalized per 24-hour

period (daily) and over the operating lifetime of the pump station. Daily flows will be recorded and kept for XXX days. The lifetime flow will be recorded and kept for XXX days.

- FM-8021 shall measure instantaneous backwash flow entering Multi-Media Filter Skid MMF-2A/B.
    - Instantaneous flow shall be transmitted to the Filter Control Panel and then to the Master Control Panel, where it will be totalized and recorded. Flows will be totalized per 24-hour period (daily) and over the operating lifetime of the pump station. Daily flows will be recorded and kept for XXX days. The lifetime flow will be recorded and kept for XXX days.
- FM-8031 shall measure instantaneous backwash flow entering Multi-Media Filter Skid MMF-3A/B.
    - Instantaneous flow shall be transmitted to the Filter Control Panel and then to the Master Control Panel, where it will be totalized and recorded. Flows will be totalized per 24-hour period (daily) and over the operating lifetime of the pump station. Daily flows will be recorded and kept for XXX days. The lifetime flow will be recorded and kept for XXX days.

6.2.3 Backwash Waste Pumps (PU-3A, 3B & 3C)

Three (3) variable-speed centrifugal Backwash Waste Pumps (PU-3A, PU-3B & PU-3C) will be used to pump backwash waste from Backwash Waste Tanks (TK-3A & 3B) directly to the effluent line leaving the Treated Water Tanks (TK-4A, TK-4B & TK-4C). The pumping rate shall be proportionally-controlled via the treated water effluent flowrate measured by flowmeter FM-8054, and the level (as measured by LIT-8030 or LIT-8031) in the Backwash Waste Tanks TK-3A/B. The three (3) pumps shall operate based on lead/lag/standby mode. The configuration of pumps to be used as lead/lag/standby will be manually cycled once a week by the Operator. Operations are as follows:

- The following information for each of the Backwash Waste Pumps PU-3A, PU-3B & PU-3C shall be monitored by the Master Control Panel:
    - Number of motor starts and stops.
    - Motor runtimes.
- As the water level in the Backwash Waste Tanks TK-3A/B rises, and any of the Treated Water Pumps (PU-6A/B/C/D) are in operation, the Backwash Waste Pumps shall be turned ON as follows:
    - Level reaches Permissive Level One: Lead pump ON.
    - Level reaches Permissive Level Two: Lead pump operating, and lag pump shall be turned ON. Alarm shall be transmitted to Master Control Panel to trigger an alarm callout for Operator to manually turn ON the standby pump if lag pump will not turn ON when commanded.
    - Level reaches High Level: Lead and lag pumps operating, and the standby pump shall be turned ON.
    - Level reaches High-High Level: Alarm shall be transmitted to Master Control Panel to trigger an alarm callout.
- As the water level in the Backwash Waste Tanks TK-3A/B drops the pumps shall be turned OFF as follows:
    - Level reaches High Level: The standby pump, if operating, shall be turned OFF.
    - Level reaches Permissive Level Two: Lag pump, if operating, shall be turned OFF and lead pump remains operating.
    - Level reaches Permissive Level One: Lead pump, if operating, shall be turned OFF.
    - Level reaches Low Level: All pumps OFF.
    - Level reaches Low-Low Level: Alarm shall be transmitted to Master Control Panel to trigger an alarm callout.

6.3 Filter Rinse Water Tank (TK-6)

The Filter Rinse Water Tank (TK-6) is a 20,000 gallon baker-style tank that receives the gravity drain and rinse water from the Multi-Media Filters at the initial stage of the filter rinse/backwash cycle.

6.3.1 Level Measurement (LIT-8060 and LIT-8061) at Filter Rinse Water Tank (TK-6)

One (1) ultrasonic level sensor (LIT-8060) will be installed on the Filter Rinse Water Tank TK-6. Another ultrasonic level sensor (LIT-8061) will be installed on Filter Rise Water Tank TK-6 to serve as a back-up level sensor. Operations are as follows.

- LIT-8060 (or LIT-8061 back-up if LIT-8060 is not in service) shall continuously measure the waste level in the Filter Rinse Water Tank TK-6. Operator-adjustable levels shall include the following:
    - Low-Low Level: An alarm shall be generated. The alarm shall be transmitted to the Master Control Panel to trigger an alarm callout.
    - Low Level: Minimum water level to turn OFF Filter Rinse Water Transfer Pumps PU-7A & PU-7B.
    - Permissive Level One: Water level for one (duty) pump operation, and allows a filter rinse/backwash cycle to commence.
    - High Level: Water level for two (duty/standby) pumps operation.
    - High-High Level: An alarm shall be generated. The alarm shall be transmitted to the Master Control Panel to trigger an alarm callout.

6.3.2 Filter Rinse Water Transfer Pumps (PU-7A & PU-7B)

Two (2) constant-speed centrifugal pumps (PU-7A & PU-7B) are used to transfer rinse water from the Filter Rinse Water Tank (TK-6A) to the Ion Exchange system. The two (2) pumps shall operate based on duty/standby mode. The configuration of pumps to be used as duty/standby will be manually cycled once a week by the Operator. Operations are as follows:

- The following information for each of the Rinse Water Transfer Pump PU-7A & PU-7B shall be monitored by the Master Control Panel:
    - Number of motor starts and stops.
    - Motor runtimes.
- As the water level in the Filter Rinse Water Tank TK-6 rises, the Rinse Water Transfer Pumps shall be turned ON as follows:
    - Permissive Level One: Duty pump ON.
    - High Level: Duty pump operating, and the standby pump shall be turned ON.
    - High-High Level: Alarm shall be transmitted to Master Control Panel to trigger an alarm callout.
- As the water level in the Filter Rinse Water Tank TK-6 drops , the pumps shall be turned OFF as follows:
    - Level reaches High Level: The standby pump, if operating, shall be turned OFF.
    - Level reaches Permissive Level One: The duty pump, if operating, shall be turned off.
    - Level reaches Low Level: All pumps OFF.
    - Level reaches Low-Low Level: Alarm shall be transmitted to Master Control Panel and trigger an alarm callout.

7.0 ION EXCHANGE SYSTEM AND RESIN CHANGE-OUT

Six (6) ion exchange tanks will be provided to remove perchlorate from the groundwater leaving the Multi-Media Filters before discharge to the Wash. Three (3) trains shall be provided, each consisting of two (2) vessels operated in a lead/lag configuration (6 vessels in total, IX-1A/2A, IX-1B/2B & IX-1C/2C). The trains shall operate continuously until the resin is required to be changed.

Each ion exchange tank will have one (1) rupture disk to protect them from excess pressure.

7.1 Ion Exchange System (IX-1A/2A, IX-1B/2B & IX-1C/2C)

For each train, filtered flow enters the first (lead) ion exchange vessel on each train at the top and exits from the bottom. Water then enters the second (lag) vessel on the same train at the top and exits the vessel from the bottom.

Water out of the lag vessel flows to the Treated Water Tanks (TK 4A, TK-4B & TK-4C) through a single line.

Operator must check the pressure and flow on each vessel on a daily basis by reading the values on the Human Machine Interface (HMI) on the Master Control Panel.

Operator will collect three (3) water samples from each train on a daily basis: the influent to the lead vessels, effluent from the lead vessel, and effluent from the lag vessel. This information will be used to determine when the resin approaches its useful life and when fresh resin must be delivered to the site for exchange. Operator will collect one sample from the effluent line once per week and submit to an outside laboratory for analysis of parameters indicated in the NPDES permit.

7.1.1 Flowmeters (FM-7010, FM-7020 & FM-7030) and Flow Control Valves (FCV-7010, FCV-7020 & FCV-7030) to Ion Exchange Tanks (IX-1A/2A, IX-1B/2B & IX-1C//2C)

Three (3) magnetic flow meters (FM-7010, FM-7020 & FM-7030, for IX-1A/2A, IX-1B/2B and IX-1C/2C, respectively) and three (3) electrically-actuated flow control valves (FCV-701, FCV-721 & FCV-741, for IX-1A/2A, IX-1B/2B and IX-1C/2C, respectively) will be installed on the individual inlet headers entering each Ion Exchange train (IX-1A/2A, IX-1B/2B, IX-1C/2C). The flowmeters (FM-7010, FM-7020 & FM-7030) shall provide instantaneous and totalized flow of filtered flow entering each Ion Exchange skid. The flow control valves (FCV-7010, FCV-7020 & FCV-7030) shall be modulated manually by the Operator using the HMI on the Master Control Panel to adjust the flow into each Ion Exchange train. Operations are as follows:

- FM-7010 shall measure instantaneous flow entering Ion Exchange Skid IX-1A/2A.
    - Instantaneous flow shall be sent to the Master Control Panel, where it will be totalized. Flows will be totalized per 24-hour period (daily) and over the operating lifetime of the pump station. Daily flows will be recorded and kept for XXX days. The lifetime flow will be recorded and kept for XXX days.
- FM-7020 shall measure instantaneous flow entering Ion Exchange Skid IX-1B/2B.
    - Instantaneous flow shall be sent to the Master Control Panel, where it will be totalized. Flows will be totalized per 24-hour period (daily) and over the operating lifetime of the pump station. Daily flows will be recorded and kept for XXX days. The lifetime flow will be recorded and kept for XXX days.
- FM-7030 shall measure instantaneous flow entering Ion Exchange Skid IX-1C/2C.
    - Instantaneous flow shall be sent to the Master Control Panel, where it will be totalized. Flows will be totalized per 24-hour period (daily) and over the operating lifetime of the pump station. Daily flows will be recorded and kept for XXX days. The lifetime flow will be recorded and kept for XXX days.

7.1.2 Lead/Lag Control Valves (BV-701, BV-707, BV-721, BV-727, BV-741 and BV-747; BFV-701 through BFV-708, BFV-721 through BFV-728, and BFV-741 through BFV-748) to Ion Exchange Tanks (IX-1A/2A, IX-1B/2B & IX-1C/2C)

Each Ion Exchange skid shall have ten (10) manually-operated valves to modify the lead/lag configuration of Ion Exchange tanks on a respective train. Table 4 shows the valve designations for each train.

Table 4 Valve Designations for Ion Exchange Trains

Ion Exchange Train	Control Valves for Lead/Lag
1A/2A	BV-701, BV-707, BFV-701 through BFV-708
1B/2B	BV-721, BV-727, BFV-721 through BFV-728
1C/2C	BV-741, BV-747, BFV-741 through BFV-748

In order to configure the Ion Exchange Tanks on a skid for a particular lead/lag operation, the lead/lag control valves shall be positioned as shown in

Table 5 below.

Table 5 Valve Designations for Lead/Lag Operation of Ion Exchange Trains

Ion Exchange Train	Valve configuration for 1X lead/2X lag	Valve configuration for 1X lag/2X lead
1A/2A	*Open*: BV-701, BFV-702, BFV-703, BFV-701, BFV-705, BFV-708 *Close*: BV-707, BFV-704, BFV-706, BFV-707	*Open*: BV-707, BFV-706, BFV-707, BFV-705, BFV-701, BFV-704 *Close*: BV-701, BFV-708, BFV-703, BFV-702
1B/2B	*Open:* BV-721, BFV-722, BFV-723, BFV-721, BFV-725, BFV-728 *Close:* BV-727, BFV-724, BFV-726, BFV-727	*Open:* BV-727, BFV-726, BFV-727, BFV-725, BFV-721, BFV-724 *Close:* BV-721, BFV-728, BFV-723, BFV-722
1C/2C	*Open:* BV-741, BFV-742, BFV-743, BFV-741, BFV-745, BFV-748 *Close:* BV-747, BFV-744, BFV-746, BFV-747	*Open:* BV-747, BFV-746, BFV-747, BFV-745, BFV-741, BFV-744 *Close:* BV-741, BFV-748, BFV-743, BFV-742

7.1.3 Flow Control Valves (FCV-7010, 7020 & 7030) for Flow to Ion Exchange Tanks (IX-1A/2A, IX-1B/2B and IX-1C/2C)

Three (3) electrically-actuated flow control valves (FCV-7010, FCV-7020 and FCV-7030) will be installed on the individual inlet headers entering each Ion Exchange train (IX-1A/2A, IX-1B/2B, and IX-1C/2C). The valves shall be modulated as commanded by Operator using the HMI on the Master Control Panel to balance the flow equally among the three (3) trains. Operations are as follows:

- FCV-7010 shall control the flow entering Ion Exchange train IX-1A/2A.
    - The Operator shall adjust the valve position until the flow as measured by FM-7010 is equal to the flow measured by FM-7020 and FM-7030.
    - Valve position shall be returned to the Master Control Panel.
- FCV-7020 shall control the flow entering Ion Exchange train IX-1B/2B.

- The Operator shall adjust the valve position until the flow as measured by FM-7020 is equal to the flow measured by FM-7010 and FM-7030.
- Valve position shall be returned to the Master Control Panel.

- FCV-7030 shall control the flow entering Ion Exchange train IX-1C/2C.
  - The Operator shall adjust the valve position until the flow as measured by FM-7030 is equal to the flow measured by FM-7010 and FM-7020.
  - Valve position shall be returned to the Master Control Panel.

7.1.4 Differential Pressure Measurement (PIT-7010, PIT-7011, PIT-7020, PIT-7021, PIT-7030 & PIT-7031) at Ion Exchange Vessels (IX-1A/2A, IX-1B/2B and IX-1C/2C)

Six (6) differential pressure sensors (PIT-7010, PIT-7011, PIT-7020, PIT-7021, PIT-7030 & PIT-7031) will be installed on the inlet and outlet line of each Ion Exchange vessel (IX-1A/2A, IX-1B/2B and IX-1C/2C) to measure the pressure difference across the vessels, as indicated in

Table 6 below.

Table 6 Differential Pressure Sensor Designations for Ion Exchange Vessels

Ion Exchange Vessel	Differential pressure sensor
1A	PIT-7010
1B	PIT-7011
2A	PIT-7020
2B	PIT-7021
1C	PIT-7030
2C	PIT-7031

The pressure difference between the inlet and outlet of each vessel will be recorded by the Master Control Panel for use by the Operator. Operations are as follows:

- PIT-7010 through PIT-7031 shall continuously measure the pressure difference in Ion Exchange vessels IX-1A through IX-2C, respectively.
  - Instantaneous pressure shall be sent to the Master Control Panel, where it will be recorded. Pressures will be recorded and kept for XXX days.

7.2 Ion Exchange Resin Change-Out

Resin change-out shall be performed by the Ion Exchange System Supplier. As a result, only a brief description is given here. Refer to the Supplier's Operation Manual for more detailed information.

During the change-out, the fresh resin shall be transported to the site by a service truck operated by the Ion Exchange Supplier. Supplier's Operator's steps for change-out include:

1. Isolating the Ion Exchange vessel containing resin that needs to be replaced by closing the valves around the vessel; the lag vessel on the train shall continue to operate
2. Connecting the lead vessel to the truck using hoses,

3. An air blower on the service truck shall push the spent resin out of the Ion Exchange vessel through a resin discharge line returning to the truck, and then
4. The same blower shall fill the vessel with the fresh resin from the truck through a resin fill line coming from the the truck.
5. Once this is completed, the Supplier's Operator shall position the valves on the Ion Exchange train so that the previous lag vessel is the new lead vessel, and the vessel containing the fresh resin is the new lag vessel.
6. Supplier's Operator shall dispose of spent resin using incineration at an approved incineration facility.

8.0 TREATED WATER DISCHARGE SYSTEM

8.1 Treated Water Tanks (TK-4A, 4B & 4C)

8.1.1 Level Measurement (LIT-8010 and LIT-8011) at Treated Water Tanks (TK-4A, TK-4B, TK-4C, & TK-4D)

Four(4) 20,000-gallon baker-style Treated Water Tanks will be used to store the treated water leaving the Ion Exchange System. The Treated Water Tanks shall be interconnected with a pipe manifold; the levels in the Influent Tanks are expected to equalize. One (1) ultrasonic level sensor (LIT-8010) will be installed on Treated Water Tank TK-4B. Another ultrasonic level sensor (LIT-8011) will be installed on Treated Water Tank TK-4C to serve as a back-up level sensor. Operations are as follows:

- LIT-8010 (or LIT-8011 back-up if LIT-8010 is not in service) shall continuously measure the water level in the Treated Water Tanks TK-4A, TK-4B TK-4C, & TK-4D. Operator-adjustable levels shall include the following:
    - Low-Low Level: An alarm shall be generated. The alarm shall be transmitted to the Master Control Panel to trigger an alarm callout.
    - Low Level: Minimum water level to turn OFF all Treated Water Pumps PU-6A, 6B & 6C.
    - Permissive Level One: Water level for two (lead) Treated Water Pumps operation.
    - High Level: Water level for three (2 lead/1 lag) Treated Water Pumps operation.
    - High-High Level: An alarm shall be generated. The alarm shall be transmitted to the Master Control Panel to trigger an alarm callout.

8.2 Treated Water Pumps (PU-6A, 6B, 6C & 6D)

Three (3) constant-speed Treated Water Pumps (PU-6A, 6B & 6C) are used to transfer the treated water out of the Treated Water Tanks TK-4A, 4B & 4C to the Las Vegas Wash through an 18-inch transmission line. A standby pump (PU-6D) is provided for redundancy. The pumps shall be controlled via level (as measured by LIT-8010) in the Treated Water Tanks TK-4A, TK-4B, TK-4C, & TK-4D. The three (3) Treated Water Pumps shall operate in lead/lag mode with two (2) lead/one (1) lag mode. The configuration of pumps to be used as lead/lag will be manually cycled once per week by the Operator. Operations are as follows:

- The following information for each of the Treated Water Pumps PU-6A, PU-6B & PU-6C shall be monitored by the Master Control Panel:
    - Number of motor starts and stops.
    - Motor runtimes.
- As the water level in the Treated Water Tanks TK-4A, TK-4B, TK-4C, & TK-4D rises, the pumps shall be turned ON as follows:

    - Level reaches Permissive Level One: Two lead pumps ON.
    - Level reaches High Level: Lead pumps operating, and lag pump shall be turned ON.
    - Level reaches High-High Level: Alarm shall be transmitted to Master Control Panel to trigger an alarm callout.
- As the water level in the Treated Water Tanks TK-4A, 4B, TK-4C, & TK-4D lowers, the pumps shall be turned OFF as follows:
    - Level reaches below High Level: Lag pump shall be turned OFF, and lead pumps remain operating.
    - Level reaches below Permissive Level One: Lead pumps shall be turned OFF.
    - Level reaches Low Level: All pumps shall be turned OFF.
    - Level reaches the Low-Low Level: Alarm shall be transmitted to Master Control Panel and trigger an alarm callout.
- The Treated Water Pumps shall also be controlled by the online TSS monitor AIT-8020 on the effluent line as described in Section 8.4.2.

8.3 Filter Backwash Pumps (PU-5A, PU-5B & PU-5C)

Three (3) constant-speed centrifugal Multi-Media Filter Backwash Pumps (PU-5A, PU-5B & PU-5C) will be used to provide filter rinse and backwash water using the treated water from Treated Water Tanks TK-4A, TK-4B, TK-4C, & TK-4D. The pumps shall be operated via level (as measured by LIT-8010 or LIT-8011) in Treated Water Tanks TK-4A, TK-4B, TK-4C, & TK-4D and as needed for the Multi-Media Filter Rinsing and Backwashing procedure per Section 6.1.4. The three (3) Multi-Media Filter Rinse/Backwash Pumps shall operate in two (2) duty/one (1) standby mode. The configuration of pumps to be used as duty/spare will be manually cycled once per week by the Operator. Operations are as follows:

- The following information for each of the Multi-Media Filter Rinse/Backwash Pumps PU-5A, PU-5B & PU-5C shall be monitored by the Master Control Panel:
    - Number of motor starts and stops.
    - Motor runtimes.
- When called by the Multi-Media Filter Control Panel to commence Multi-Media Filter Rinse/Backwash Procedure as described in Section 6.1.4:
    - The Master Control Panel shall commence the rinsing and backwashing procedures for selected Multi-Media Filter vessel.
    - The two (2) duty pumps shall be operated by the Multi-Media Filter Control Panel per Section 6.1.4.
    - If one (1) of the duty pumps fails to turn ON when commanded or if the Backwash Flow as measured by FM-8010 falls below a pre-set value (XXX gpm) for XXX minutes:
        - The standby pump shall turn ON.
- When the water level in the Treated Water Tanks TK-4A, TK-4B, TK-4C, & TK-4D reaches a pre-set low level (XX ft):
    - All pump shall be turned OFF.

8.3.1 Flowmeter (FM-8010) on the Multi-Media Filter Backwash Line

One (1) magnetic flow meter (FM-8010) will be installed on the Muti-Media Filter Backwash line out of the Treated Water Tanks. FM-8010 shall provide the instantaneous and totalized flow of the treated water being discharged to the Las Vegas Wash.

- FM-8010 shall measure instantaneous flow of backwash being sent to the Multi-Media Filters.
    - Instantaneous flow shall be sent to the Master Control Panel, where it will be totalized and recorded. Flows will be totalized per 24-hour period (daily) and over the operating lifetime of the pump station. Daily flows will be recorded and kept for XXX days. The lifetime flow will be recorded and kept for XXX days.

8.4 Treated Water Discharge

8.4.1 Flowmeter (FM-8020) on the Discharge Line to Las Vegas Wash

One (1) magnetic flow meter (FM-8020) will be installed on the effluent line out of the Treated Water Tanks to the Las Vegas Wash. FM-8020 shall provide the instantaneous and totalized flow of the treated water being discharged to the Las Vegas Wash.

- FM-8020 shall measure instantaneous flow of effluent being sent to the Las Vegas Wash.
    - Instantaneous flow shall be sent to the Master Control Panel, where it will be totalized and recorded. Flows will be totalized per 24-hour period (daily) and over the operating lifetime of the pump station. Daily flows will be recorded and kept for XXX days. The lifetime flow will be recorded and kept for XXX days.
- When a filter rinse/backwash cycle has been initiated and the instantaneous flowrate measured by FM-8020 falls below a pre-set value (XXX gpm) for XXX minutes:
    - Low-Flow Alarm shall be generated. The alarm shall be transmitted from the Master Control and trigger an alarm call-out, and the standby Filter Backwash Pump (one of PU-5A/B/C) shall be turned ON.

8.4.2 Online TSS Monitor (AIT-8020) on the Discharge Line to Las Vegas Wash

One (1) online real-time TSS monitor (AIT-8020) will be installed on the effluent line out of the Treated Water Tanks to the Las Vegas Wash. AIT-8020 will provide instantaneous TSS readings of flow entering the Las Vegas Wash. Operations are as follows:

- AIT-8020 shall measure the instantaneous TSS concentration of effluent being sent to the Las Vegas Wash.
    - Instantaneous TSS readings shall be sent to the Master Control Panel. The TSS reading shall be recorded and kept for XXX days.
- When the instantaneous TSS reading measured by AIT-8020 exceeds a pre-set value (135 ppm):
    - High-TSS Alarm shall be generated. The alarm shall be transmitted to the Master Control Panel to trigger an alarm callout.
    - The Treated Water Pumps (PU-6A, PU-6B & PU-6C) shall turn OFF to prevent effluent from being discharged into the Las Vegas Wash.