Idyllwild Water District
Preliminary Engineering Report v. 2

DRAFT

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Specialized Utilities Services Program

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ENGINEERING

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1.0 INTRODUCTION

1.1 Background

The Specialized Utilities Services Program (SUSP Engineering), a subsidiary of California Rural Water Association (CRWA), is providing planning assistance to the Idyllwild Water District (IWD) under a 2021 Agreement. The work under the Agreement is to provide the technical preliminary engineering and civil engineering services to prepare the IWD wastewater treatment plant (WWTP) replacement project (Project) for full design planning and permitting. The preliminary engineering findings are formalized in this Preliminary Engineering Report, volume 2 (Report). The Report is a continuation of Preliminary Engineering Report, volume 1 (PER v1). In PER v1 the historic wastewater treatment plant (plant) data was assessed to formulate parameters for the proposed improvements. The Project includes upgrades to headworks, equalization, secondary treatment facilities, and new controls building and plant wide SCADA system. The proposed improvements will be constructed at the existing plant (Figure 1) and on additional land purchased by IWD. This Report will be used to support funding applications for the Project.

1.2 Scope of Preliminary Design

This Report documents the preliminary engineering and 30 percent design for the Project. The PER v1 laid the groundwork and strategy that was followed to finish the preliminary engineering work. This Report contains the details of the major plant components along with their size, qualities, locations, and controls. The results of calculations, research, coordination with other engineering specialties and IWD are culminated in the following sections. Each part of the Project is graphically displayed in the 30% Drawings attached in Appendix A1 and described here with details of operating intent and relationship to other plant components. The Report includes a list of technical specifications for the project, records of civil planning tasks completed under the Agreement, Project product date, project construction schedule, and a preliminary engineering level construction cost estimate.

1.3 Organization of Report

The second section of this Report summarizes the design parameters for the Project some of which were previously calculated in PER v1. Part 3 of the Report is a summary of the civil planning tasks completed under this Project cycle including topographic survey, preliminary geotechnical engineering, and CEQA documentation. The bulk of the Report is comprised of Part 4 which lays out the technical findings for the proposed plant. Each Project component is broken down into subsystems which are described with information about the proposed location, construction issues, and a description of reasoning for selection and controls. Each subsystem is further broken down into major equipment parts and presented individually noting the following:

- Purpose of system component
- Operating range and conditions, sizing, quantity, layout, configuration, etc.

- Materials of construction and design life
- Proposed brand and model with selected options and features
- Instruments and data collection associated with component
- Component controls and relationship or response to other plant components
- Construction issues facing the component and system overall

Part 6 of the Report contains a narrative approach to completing Project construction with key items of interest for IWD to note for a successful Project outcome. Part 7 includes the strategy for work to be accomplished in the full Project design. The Report concludes with the current project cycle Schedule to completion and estimate of Project construction costs.

2.0 DESIGN PARAMETERS

Providing a facility that effectively and safely protects water quality and meets regulations for IWD rate payers is paramount. The new plant is expected to incorporate state of the art techniques and technology but not add to day to day operational complexity or maintenance demands. Each aspect of the system will be redundant or have quick, simple means of access and replacement. The new facility is not an expansion of capacity, however nominal growth within the existing collection system will be considered in the design. Future expansion of the collection system may be desirable and the design will leave accommodation for additional capacity upgrades during the design life of the plant. Controls and data acquisition are to be a holistic system with inherent resilience and adaptability.

The key goals to guide the project design (repeated here from PER v1) are as follows:

1. Provide redundancy in secondary treatment system.
2. Fully integrated SCADA system for better system monitoring and control, including remote access to status and data.
3. Capacity to operate through a NOAA 100 year storm.
4. Plant must meet the effluent quality criteria laid out in the NPDES permit.
5. Provide adequate treatment capacity over the plant design life.
6. 50 year facility design life and consideration for maintenance and replacement of subsystems with shorter life cycles.
7. Maintain cost efficiency and operational simplicity of the current plant.
8. Consider future expansion of the plant via system scalability and conscientious layout.

2.1 Design Flowrates

The collection system terminates at the headworks as an 18 inch clay tile pipe. Above the WWTP the main beneath Apela drive has a slope of 0.0033 and an approximate maximum theoretical capacity of 3.0 MGD, 2,000 gpm. This is not a realistic number for use in design so influent design values were developed using daily plant records from the last seven years and standard industry methods to estimate peak flows.

Average Daily Flow (ADF) used for the preliminary engineering of the plant is the mean of daily flows recorded at the existing flume from 2017 to 2023 (0.103 MGD). The Average Dry Weather Flow (ADWF) for the plant over the period is 0.096 MGD. This is based on influent from days where less than 0.1 inch of rain fell over the previous 30 days. Average Wet Weather Flow (AWWF) for the plant is 0.108 MGD. This represents the average flowrate on days when there is 0.5 inch or more of rain in the previous 30 days. Many other methods to estimate these variables were considered and calculated. For example dry months of the year versus wet months were used rather than daily weather records. The various methods tend to converge on similar values and mask the reality of the measured flowrates at times. The flowrates can vary widely based on weather and tourism and some years the wet weather is not in the same months as others. After detailed analysis the values above are the most reliable and accurate available.

Table 1: Treatment Plant Flowrates

	Historic Flowrate[1] (MGD)	**Notes**
Average Daily Flow (ADF)	0.103	Based on daily flow records from 2017 to 2023, almost the same as PER v1 (0.106 MGD)
Average Daily Wet Weather (AWWF)	0.108	Based on daily flows with ≥0.5" rain in the previous 30 days
Average Daily Dry Weather Flow (ADWF)	0.096	Based in daily flows with ≤0.1" of rain in the previous 30 days
Maximum Daily Flow (MDF)	0.298[2]	Maximum flow rate of 0.451 MGD is estimated for 24 hour, 100 year storm
Peak Hourly Flow	N/A	Peak hourly flow estimate for the 100 year design storm is 0.611 MGD

1. Based on annual date from 2017 to 2023.
2. Recorded on Feb 14, 2019, higher readings recorded in 2023 were not used because they appear to be outliers.

N/A – not available, the range of the current flume cannot capture peak storm flowrates.

Additional scalers are used to derive flow variations during the day for design. These factors were verified against plant data where possible. A peaking factor (PF) of 4.0 is typical for a plant the size of IWD WWTP and represents the range of flowrate variation expected between the average daily domestic flowrate and the highest and lowest domestic, hourly average flowrate for the plant influent. A factor of safety (FoS) is applied to the flowrates to allow for anomalous conditions and promotes a reasonably conservative design. A FoS of 2.0 is used for most flowrates through various plant facilities. An additional scaler of 1.5 is multiplied by the peak hourly flowrates to estimate peak instantaneous flow (up to five minutes).

The 100 year storm value is estimated based on data from the February 2019 storm in Idyllwild and NOAA design storm comparisons. The Design Capacity is the nameplate plant capacity and maximum permitted daily average discharge for the plant. Maximum hourly flow considers the larger of average daily flow multiplied by a peaking factor of 4.0 or the estimated 100 year storm flowrate. Both are multiplied by a factor of safety of 2.0 and used to estimate maximum hourly flow. Equipment specific flows are detailed in applicable sections of Section 4.0. See Table # for a summary of key design flowrates.

2.2 Engineering Parameters for Structures

The following Subsections summarize additional design parameters for use during final design. Applicability of the loads noted here needs to be qualified for use by the design professional for each individual situation. Special conditions may exist that have not yet been uncovered at this preliminary engineering stage in the Project. The authorities having jurisdiction may be consulted to confirm minimum design loads for any given area or type of construction.

2.2.1 Wind Loads

According to ASCE 7-16 standard assuming the site is in Risk Category 3, the wind design value is 103 mph. According to County of Riverside Building & Safety Design Load Criteria document, a conservative wind speed of 110 mph can be used in non-special wind regions. The County value is more conservative and provided by the local building authority. It will be used in design to develop wind loads on structures by the structural engineer.

2.2.2 Snow Loads

Site elevation is approximately 5,100 feet. ASCE elevation limit on map is the 7-16 standard is 2,800 feet. The County of Riverside design load criteria document provides a formula for calculation of ground snow load at elevations above the elevation limit specified on Figure 7.2-1 of ASCE 7-16. Resulting estimated ground snow load is 67 pounds per square foot. This load can be used in design for roofs and other areas where snow can build up. A structural engineer is to determine the applicable factor of safety to apply based on the facility importance and nature in accordance with standard engineering judgement.

2.2.3 Rain Loads

According to ASCE 7-16, a 15 minute duration rain with intensity of 3.8 inches per hour has a 200 year mean recurrence interval. A 30 minute duration rain with intensity of 2.2 inches per hour has a 200 year mean recurrence interval. In absence of alternative data from local or County sources these values will be used for load, drainage, and runoff calculations in the design.

3.0 PRELIMINARY SITE CHARACTERIZATION

3.1 Site Survey

The Project survey was performed by Hilwig and Goodrow under a contract with SUSP Engineering in early 2022. This survey details the grounds of the easting plant, captures the existing structures, topography, property lines, fence lines, and the traverse from Apela Drive, as well as the easements for the driveway, influent main, and the surrounding landscape easement. The landscape easement has not been used by IWD but was part of an earlier agreement with the Idyllwild Art Academy (Academy).

During IWD discussions with the Academy the District commissioned a second survey by Cozad and Fox. This survey captured the outfall easement, influent main easement, and defined the new parcel as it had been described in one of the proposed site plans drawn by SUSP Engineering in coordination with IWD staff. Cozad and Fox prepared the site map and parcel description for submittal to the County. Some discrepancies between the first and second surveys with lateral location of the map and the elevation for topography were noted. It is recommended that the Hilwig & Goodrow survey be reconciled with the new parcel description to properly establish the fence lines for the Project construction and provide one consistent record for the District. Appendix B has a copy of both surveys and the parcel map.

3.2 Site Acquisition

The existing site is a small parcel that has been cut from a larger 80 acre parcel owned by the Idyllwild Arts Academy. Initial outreach to the Academy was performed by SUSP Engineering in late 2021. Once the parties to the negotiations for additional land were established, IWD continued the discussions privately between IWD and the Academy. Ultimately an agreement was reached in 2023 to increase the size of the IWD parcel with enough space to expand the WWTP as needed.

3.2.1 Parcel

The additional land acquired via purchase by IWD from the Academy is conveyed as a lot line adjustment to the parcel, APN 557-120-002. The former area owned by IWD was 0.79 acres. The newly acquired area is 0.93 acres for a total area of 1.72 acres. Reportedly the Academy required the parcel be formally subdivided as a condition of the sale. The new subdivision map was prepared by licensed surveyor, Cozad and Fox and submitted to the County for approval in 2023. The County review is ongoing at this time. Once the property is fully transferred and recorded, the documents can be used to support the funding application(s).

3.2.2 Easements

During the Cozad and fox survey the collection system influent main corridor was surveyed from Apela drive to the treatment plant parcel. The effluent main outfall to the percolation ponds was also surveyed to the downstream edge of the parcel that surrounds the plant, APN 557-120-001.

Beyond that boundary the outfall enters US Forest Service land and continues to the percolation ponds. These areas were surveyed to be included in the negotiation with the Academy to formalize the easements and record their locations for future maintenance and improvement activities. It is unclear if the easements were ultimately included in the agreement with the Academy.

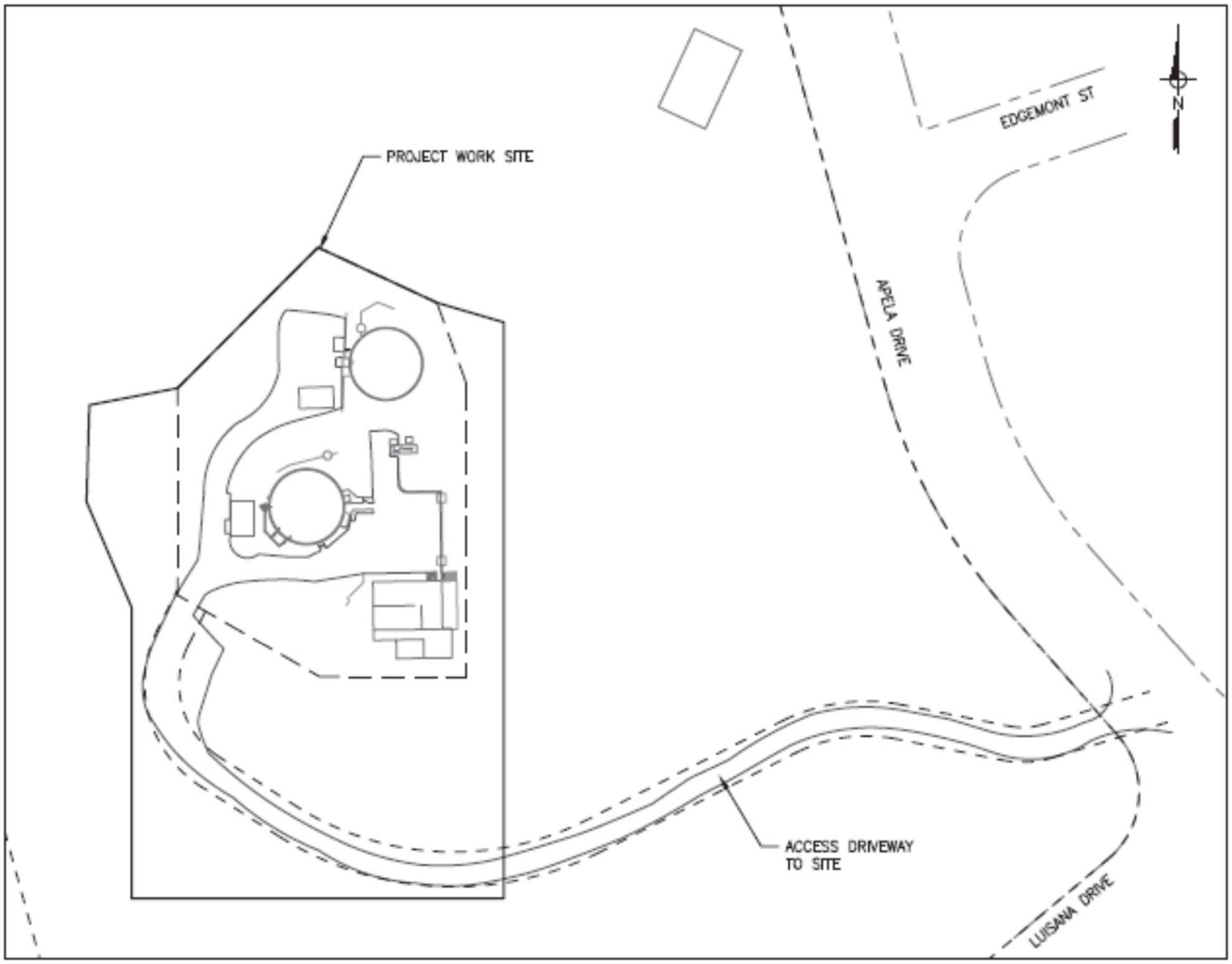

Figure 1: Existing Site Layout and New Parcel Boundary

3.3 CEQA Study

Dewberry (CEQA consultant) in coordination with SUSP Engineering and IWD provided a CEQA documentation for the Project. The Report detailed the findings of the biological survey and the cultural surveys performed by Dewberry staff in December 2023 and January 2024 respectively. The CEQA work included a formal inquiry with the State Native American Heritage Commission (NAHC) which resulted in no specific findings. Letters were sent to 33 tribes to initiate an AB 52 consultation with IWD. One tribe, Cahuilla Band of Indians, entered into a consultation with IWD and plans to monitor the site for cultural resources during ground disturbing activities when the Project is constructed.

The Draft Initial Study / Mitigated Negative Declaration (IS/MND) report was submitted by Dewberry for 30 day public comment period on 5/24/24. The review garnered one agency comment from the South Coast Air Quality Management District (SCAQMD). The comment on the proposed backup generator was addressed by Dewberry with supporting data from Control Point Engineering (Electrical Engineer). No other comments from the public were received.

Dewberry submitted the Final IS/MND report on 7/8/24; see Appendix C for the text. The IS/MND was accepted and approved by the IWD Board of directors on 7/17/24 at the standing July Board meeting. The IS/MND and Notice of Determination was filed with applicable fees by IWD and Dewberry at the State Clearinghouse and the County of Riverside Clerk's office on 7/23/24. The State Clearinghouse number is SCH Number 2024051129. Applicable fees were paid to the County, 30 day public review and comment period was observed, and the filing was completed within the 5 day window. Since no court challenges were filed within the 30 day statute of limitations after the filing, the CEQA documentation for the Project is complete.

3.4 Geotechnical Investigation

A preliminary geotechnical investigation was conducted by LOR Geotechnical Group, Inc. (Geotechnical Engineer) during late 2023 into 2024. A review of geotechnical literature, geologic field reconnaissance, a subsurface field investigation and laboratory testing of soil samples were conducted to develop geotechnical recommendations for site grading and foundation design for the proposed improvements to the existing plant. The Geotechnical Report dated January 19, 2024 is attached to this Report as Appendix D.

3.4.1 Seismic conditions

No faults are known to exist on site, as such, seismic ground rupture is unlikely to occur on site. The San Jacinto fault is located approximately 1.6 miles to the southwest, and the San Andreas fault zone is located approximately 14.1 miles to the northeast, it is reasonable to expect a ground motion seismic event to occur during the lifetime of the proposed improvements. The effects of ground motion can be mitigated by requirements and procedures in California Building Code and ASCE 7. Likelihood of liquefaction, tsunamis, landsliding, and rockfalls is considered very low. Flooding may occur if water storage facilities on site rupture. The geotechnical engineer defined the soil at the plant as Site Class C (very dense soil/soft rock). Seismic design parameters determined by the Geotechnical Engineer are listed in Table 2 below.

Table 2: Seismic Design Parameters

Parameter	Abbr	Value
Site Class	-	C
Mapped Spectral Response Acceleration at 0.2 second	S_S	1.525
Mapped Spectral Response Acceleration at 1 second	S_1	0.600
Design Spectral Response Acceleration at 0.2 second	S_{DS}	1.220
Design Spectral Response Acceleration at 1 second	S_{D1}	
Seismic Design Category	-	D

3.4.2 Soil conditions

Bedrock formations were discovered 3 to 7 feet below the surface. Practical refusal of borings occurred at 18 to 20 feet below grade. No groundwater was discovered during borings. Colluvium overburden was comprised of silty sand and contained roots and pinhole porosity and was characterized by loose to medium density. Bedrock fragments anticipated to be rippable to marginally rippable by conventional earthmoving equipment. It is recommended that an experienced, well qualified contractor with knowledge of appropriate ripper equipment be selected for grading operations.

The Geotechnical Report finds the existing fill and colluvial soils will not provide adequate support for the proposed structures. The site can be developed following recommendations to remove fill and colluvial strata and use structural fill subgrades or extend foundation structures to competent bedrock. The site investigation found 3 to 8 feet of overlying soils will be unfit for foundation subgrades. Local soils were found to have very low expansion potential and negligible sulfate content and so can be used for non-structural fill. A detailed corrosion analysis found that the local soils have low corrosion potential across a variety of vectors and recommended that imported materials be tested for corrosive properties prior to use.

The Geotechnical Report calls for constructed cut and fill slopes should be no steeper than 2 parts horizontal to 1 part vertical. Fill slopes should be overfilled and then cut back to expose compacted soil. Proposed structures may be safely founded on conventional foundations on a minimum of 24 inches of compacted engineered fill. Settlement of shallow foundations is expected to be approximately 0.5 inches.

4.0 PROJECT PRELIMINARY ENGINEERING

4.1 Proposed Improvements Overview

As previously discussed, the Project will entail replacing the single treatment process with a dual train process configured for redundancy and resiliency. The existing splitter box and flume will be replaced and integrated into a new whole plant SCADA control system. Two bioreactors will be constructed leaving space for a third basin should expansion of capacity become necessary at a later date. The Project will expand the equalization capacity via reuse of the existing bioreactor basin. The proposed plant will have a new RAS / WAS pump station and equalization lift station. A separate sludge settling tank will also be constructed. Finally, a new electrical, controls, and office building will be constructed while the existing building will continue to house the blowers and a renovated lab area.

4.1.1 Plant Layout

The plant layout has progressed through several iterations to optimize facility locations within the available space. The proposed locations are likely to remain through full design with minor modifications as needed. The layout is determined to make efficient use of the space, to maximize mass transfer processes by gravity flow, and consider constructability of tanks on the sloped parcel with shallow bedrock. The constraints of keeping the existing treatment plant running during construction and repurposing the existing plant to serve the needs of IWD in the proposed plant are incorporated into the preliminary design. See Sheet C2 in the 30% Drawings for an overview of the proposed plant. Figure 2 below is an excerpt.

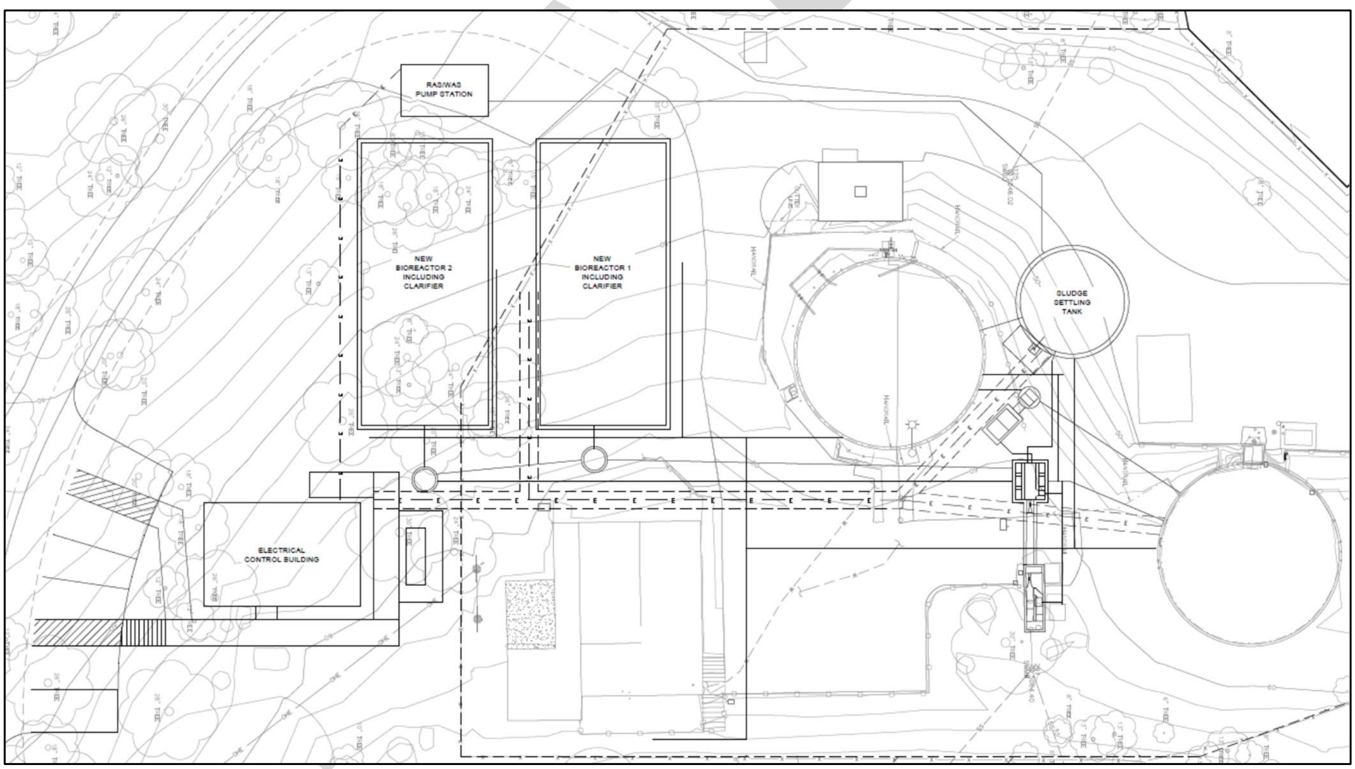

Figure 2: Proposed Site Layout

In brief, the headworks is divided into two areas connected by an open channel to keep the existing components and construct a new splitter box without obstructing vehicular access to the existing equalization basin area. The proposed equalization lift station is located between the two equalization basins and serves both. Influent flows by gravity across the plant yard to the new bioreactors and continues through them to the outfall main without additional pumping. The proposed RAS / WAS pump station is located to the west of the bioreactors in the area in front of the existing plant gate. The sludge settling tank is located near the equalization basins mainly to preserve space and keep it near the solids discharge forcemain to the drying beds. The new control building is located near the plant entrance because that area is higher elevation. Some parking spaces are added near the new gate there. Finally the existing building is to be modified to house an additional blower and improved laboratory and storage areas. A new generator is to be installed outside and housed in a sound attenuating weather enclosure near the existing generator housing.

4.1.2 Process Flow

The new wastewater treatment plant will function similar to the existing one. The main difference will be the duality of most operations. A process flow diagram was developed for the 30% Drawings, see Sheets C3 & C4. The influent will be quantified by the replaced flume and divided by the proposed splitter box between the two treatment trains and equalization. A second equalization basin will be available to buffer surges in influent from severe storms but will typically be offline. An additional blower will be installed to augment aeration zone capacity and add air mixing to the EQ basins and sludge settling tank. From the splitter box to the final effluent box the piping, treatment, clarification, and sludge pumping are all dual train fully redundant systems. The proposed sludge settling tank will be singular and operate similar to the existing system with nearly twice the capacity. The proposed equalization lift station will have redundant pumps and serve both equalization basins. Detailed descriptions of these systems are in the following sections.

4.1.3 Hydraulic Profile

The plant has existing influent headworks and effluent main that are going to remain in place for this Project. The invert elevation of the channel at the screen discharge is 5059.20 feet based on the Hilwig & Goodrow survey and will remain the starting datum for gravity flow through the proposed plant. The invert elevation at the existing connection point to the 8 inch discharge main is approximately 5056.95 feet. This gives a total fall across the existing treatment plant of 2.25 feet. Throughout this Report losses in elevation are noted for each piece of equipment and system. The estimated fall across the proposed plant adds up to 3.30 feet. Capacity calculations on the existing effluent main indicate sufficient capacity to function under the proposed configuration. Elevation values across the plant are shown in the Hydraulic Profile on sheet C5 of the 30% Drawings.

4.1.4 Plant Odor Control System

An odor control system was considered for the proposed plant early in the preliminary engineering process. Typically odor control is accomplished by enclosing the treatment plant in a building or roofing over individual component structures. The physical barriers contain the gases and vapors that are emitted by the plant. There is a lot of high humidity (basically low temperature steam) emitted by all the processes of a plant because of the air being continuously pumped through the wastewater. This necessitates that the containment structures be much more robust than common construction to withstand the constant moisture and corrosive environment. Subsequently the moisture laden gases must be processed to remove odor. There are several methods used including mechanical scrubbing systems, chemical stripping systems, and solid media beds that rely on biological degradation of odor causing compounds. All the systems require energy, capital investment, space, and maintenance to operate successfully. The lowest cost systems considered by SUSP Engineering were estimated to cost well over $1 million for construction over only the bioreactors and sludge settling tank. Although it may be desirable to consider an odor control system for the IWD plant, it is recommended that this be done as a separate project and no odor control system be constructed as part of this Project.

4.2 Headworks

The Project improvements associated with the headworks will allow the plant to better manage flows across a range of conditions and be automated for better control and data collection. The existing headworks continues to serve the plant during and after construction. The influent piping is not modified and the grinder pump and screen remain in service. The flume and splitter box are replaced in this Project with new components. Both the existing and new components will be integrated into the proposed SCADA system. The bypass piping and channels used for maintenance activities are modified to connect to the proposed splitter box and the equalization influent mains. The new splitter box can be fully bypassed using the proposed camlock discharge port on the equalization lift station and discharging into one or both secondary treatment train influent mains.

4.2.1 Headworks Layout

The proposed headworks maintains the operation of the existing headworks with modifications to the splitter box and flume. The grinder and auger screen equipment will remain in place with minor alteration to direct the solid waste from the auger to the south side of the equipment. The existing flume and splitter box will be replaced. The existing flume will be cut out to form the beginning of an open channel to transfer influent to the new flume at a location approximately 16 feet to the west. The channel will have a grate over it and an approach driveway constructed on either side to allow vehicular traffic to access the existing equalization basin similar to present accessibility, see C6 in the 30% Drawings. On the west end of the channel a new flume will be installed, with a radar level sensor on the inlet, and discharge into the proposed splitter box.

In addition to the flume the splitter box will have three other inlets to its upper level: the bypass discharge main will enter to the north of the flume, the lift station forcemain discharge will be through the west wall on the north side, and the sludge settling tank decant forcemain will enter through the west wall to the south. The splitter box will discharge via two V-notch weirs on the south side to the bioreactor influent mains and one rectangular notched weir to the equalization basins on the north side, see Sheet C7. The lower splitter box levels serve to allow for variable weir elevation settings and enough fall for proper weir operation to proportion flows to each system. The weirs are mounted on a lower set of curbs that will permit excess flows to over top them and flow to treatment without overtopping the outer high curb of the splitter box and causing a sanitary sewage spill.

The existing automatic sampler and chemical feed pump will be reconfigured for the proposed headworks. The sampler will draw from the open channel just downstream from the auger screen. The chemical feed line will discharge into the outfall of the proposed flume to facilitate mixing in the turbulent water of the splitter box basin and weir outfalls.

4.2.2 Headworks Flowrates

Flow through the headworks is the raw influent from the collection system. The preliminary design of the headworks component maximum capacities is based on a maximum instantaneous flowrate of 1.35 MGD which is only expected to occur for up to 5 minutes. Other pertinent conditions for the headworks design are summer maximum flows for the bypass main facilities that will only be used during planned maintenance, minimum flows that may affect the operation of components such as flume and screen, and diurnal and storm flow patterns that will affect the division of flow volumes at the splitter box.

Table 3 below contains the key flowrates through the headworks that are used to size the capacities of various components. The Maximum Instantaneous Flow (Maximum Hourly Flow x 1.5) is the highest flow expected for these systems under foreseeable conditions and is a safety value that represents the surge volume for freeboard design to prevent spills. The Maximum Hourly Flow is the highest sustained flow including FoS to size components for expected heavy conditions. The Minimum Flow could actually be zero for short times but here is estimated by dividing ADWF by the PF and represents the lowest flowrate for up to an hour used to select components for operational conditions.

4.2.2.a Diurnal Flows

Diurnal flowrates from six weeks during the dry season of 2021 were analyzed to develop a diurnal curve for the plant. Diurnal curves are based on domestic flow variations so dry seasons data was used to preclude infiltration and inflow effects. The curves developed were consistent across summer and fall and weekdays versus weekends with slight predictable variations. The diurnal curves are typical for a community the size and composition of IWD's wastewater service area. A diurnal curve was fitted to the data for use estimating daily flowrates to bioreactors and equalization from the new splitter box. The range of flowrates and temporal distribution shows a daily peak of approximately 1.44X average flow and a minimum of approximately 0.3X ADWF.

Table 3: Headworks Design Flowrates

Flowrate	MGD	gpm	Notes
Average Daily (ADF)	0.103	72	Based on daily records from 2017 to 2023
100 Year Storm Day	0.451	313	Modelled from 2019 storm influent and NOAA 100 year storm rainfall
Design Capacity	0.250	174	Plant design value
Maximum Hourly	0.901	626	Maximum sustained flowrate for short periods of approx. 1 hour (0.902 MGD)
Maximum Instantaneous	1.35	940	Max flowrate over short surges up to 5 minutes at a time (1.35 MGD).
Minimum	0.024	17	Lowest flow expected, average dry weather flowrate scaled by peaking factor

4.2.2.b Storm / Emergency Flows

Storm flows were based on the analysis completed for the PER v1. The findings were estimated using the Feb 2019 storm as the basis for the raw data and the NOAA design storms to scale the inflow and influent observed to model 100 year storm events over various time periods. Reworking the calculations indicate the most severe consequences for the plant will occur during the longer duration 100 year events such as 3 day, 4 day, or 7 day storms. In all events analyzed both equalization basins were required to buffer excess influent and keep the treatment bioreactors working within their normal and emergency design capacity. At the headworks increased influent may over top the individual components during the most severe conditions but would be contained by the curbs around the basins and connecting channel. The most severe conditions for the headworks would occur during the shorter duration storms because the rainfall in the shorter storms is more intense. For the 12 hour event the maximum hourly influent is estimated at 0.611 MGD.

4.2.3 Flume

The purpose of the flume is to measure the influent as it enters the plant. The current flume is too close to the auger to operate correctly so a new flume is going to be installed nearby.

Open channel structures, such as weirs and various types of flumes are used to measure water flow with error ranges as low as 2 to 5 percent when functioning as intended. The Parshall flume is a type of a short throated flume. Water is accelerated by a contracting the channel and ramping down rather than up as in other types of flumes. Empirical equations can be used to estimate the flow under unsubmerged conditions using a single head measurement with 3 to 5 percent accuracy. The Parshall flume loses accuracy or ceases function if the discharge is submerged by excessive water levels downstream. Sedimentation is not a problem with this type of flume, as water is not stagnant and reaches supercritical velocities. Other influent measuring devices considered were weirs, long throated flumes, and magnetic meters. These alternatives were more cumbersome to manage and maintain with only limited benefits for accuracy and space required. A Parshall flume is self-cleaning, passes solids, does not require a closed conduit, and minimizes the headloss across the device. The gains in accuracy that are possible with a magnetic meter or long throated flume are negated when considering the solids build up that would affect accuracy and cost of regular maintenance required.

The proposed flume is an 18 inch deep, standard dimension, 3 inch wide, Parshall flume made of composite material or stainless steel, cast into concrete. The flume is designed to operate under 'free flow' conditions across the entire 18 inch range. The flume is mounted in a concrete weir at the end of the open channel from the existing screen auger. The channel may have a cross bar at the head to limit the flow of foam into the flume and smooth the water entering the flume.

Parshall flumes have a high operating range, which is the case in this application. Typically, 0.1 MGD flow through the plant, however, it ranges as low as 0.024 MGD and as high as 0.451 MGD, with estimated peak hour rate of 0.901 MGD. The 3 inch flume measurement range is 0.1 to 1.5 feet in depth representing 0.018 to 1.20 MGD (13 to 835 gpm) with +/- 3 to 5 percent accuracy. The losses through the flume will be 1 inch at low flows up to 9 inches at capacity plus the distance of fall from the flume into the splitter box. The maximum splitter box water level is 9 inches above the flume converging floor elevation for the flume to operate at full capacity. The ASTM D1941, fiberglass flume by Open Channel Flow (or equal) will have a design life of approximately 25 years. The flume flow range covers all expected plant influent levels, however overtopping would not result in a sanitary overflow because the curbs the concrete weir it is built into would contain the excess flow.

4.2.3.a Flume Instrumentation

A single radar level sensor, Vega brand, model Vegapuls 6X, or similar is recommended for mounting over the converging floor (inlet) to collect flume water levels. Ultrasonic sensors are used to monitor the water level in many applications. Ultrasonic and radar sensors are electronic, have no moving parts, do not interfere with the flow of water and are accurate. Obstructions such as foam and turbulence can give an incorrect measurement of water level with ultrasonic sensors but this is not an issue with radar level sensors.

4.2.3.b Flume Systems Integration

In the case of computer or power failure the flume would operate normally but the flow data would be lost. The only plant controls that are planned to be reliant on the flume data are the headworks sample station and chemical feed pump. In the case of sustained high flows due to a storm or other cause a warning may be generated for the operator adjust the plant mode and equalize some of the excess flow. For more information on changing adjusting modes see the section on Splitter Box Controls. There are no emergency functions associated with the flume, the plant will function similarly when it is offline to when it is online.

4.2.3.c Flume Construction Strategy

The installation of the flume will be completed prior to the demolition of the existing flume. The proposed flume can be constructed with the new splitter box while the existing flume and splitter box remain online. The existing flume can be removed from service after the new bypass is constructed. The bypass will send influent to equalization where it can be pumped to the existing bioreactor while the existing flume is being removed. Once the new flume is brought online, the influent can be directed to the new bioreactor trains or sent to equalization for continued pumping to the existing bioreactor as Project conditions require.

4.2.4 Existing Headworks SCADA Integration

The existing plant has a sampling station and chemical feed pump located in the small shed near the headworks. The two items will be integrated into the new SCADA system to run based on influent as measured by the flume or by setpoint and timer as they do now. The status and operation of the devices will be recorded by the SCADA system. The sampling station and chemical feed pump rates will adjust based on average current flowrate through the flume.

The existing grinder pump operates continuously. There is no current sensor associated with the grinder. There are some discrete alarms as well as a run status that will be brought into SCADA. No other changes are planned at this time for the grinder pump.

The screen and auger run on differential water levels in the existing plant as reported by two local sonic switches near the equipment. The auger will continue to operate on differential water level up- versus downstream from the screen. The new channel that the screen discharges into will necessitate a reconfigured auger discharge on the side of the headworks into a conveniently placed trash receptacle. The auger run status, switch alarms, and other device alarms will be monitored and recorded by the proposed SCADA system.

There are also a pH and an electrical conductivity sensor at the headworks which must be integrated into the new plant SCADA system. These instruments provide monitoring wastewater quality to help operators run the plant effectively. No other plant processes are directly dependent on the sensors and the data is simply collected and logged for analysis.

No other plant systems are reliant on data from the headworks to operate. In the event of a power or control system failure, the influent will bypass the grinder and screen passively without spilling from the headworks basin. Data from the equipment systems would be lost but the plant could operate without these systems being online. The chemical feed pump being offline would potentially affect the performance of the rest of the plant. The failure to grind and collect incoming solids would also lead to more trash and rags making their way into the plant while headworks systems are offline. Downstream systems are designed to deal with this type of occurrence which would also be the case if the equipment is taken offline for maintenance.

4.2.5 Splitter Box

A flow splitter box serves to evenly distribute incoming wastewater flow among multiple treatment processes or units. Its primary function is to divide the influent into predetermined portions, ensuring that each treatment unit receives an appropriate and balanced amount of wastewater to continue treatment processes. By distributing the flow, the flow splitter box helps optimize the performance of each plant component, preventing overloading or underutilization of any specific process. The splitter box will be located as shown in Sheet C6 of the 30% Drawings. Splitter box sections for more detail are shown on Sheet C7.

Three adjustable weirs are provided in the splitter box to allocate flows as required to various systems. The weirs are automated to change height accommodating various plant operating modes such as diurnal, storm, and emergency. Each mode will have the weirs set to preselected elevations that can be changed via the controls by the operators. Modes will be manually selected by operators. Weirs can also be raised manually and locked out to isolate one or more processes for maintenance or other purposes.

The two weirs to the treatment trains are V-notch type and the weir to equalization is rectangular shaped. The V-notch weir, also known as a triangular weir, covers the range of flows that need to be split between the bioreactors evenly. The V-notch allows for even splitting of low flowrates and flows through the weirs increase exponentially as the water level behind the weir increases across the area of the triangular shape. The recommended weirs for the splitter box are 60 degree angle V's designed to be flowing at 2.5 to 3 inches above the V apex when the water starts to overtop the rectangular weir to equalization. As the water level in the splitter box increases beyond 3 inches the flow to both equalization and the treatment trains continues to increase over the three weirs. A rectangular weir is used for the equalization side because once the flows to treatment approach the average diurnal flowrate a significant portion of additional flow needs to be segregated for equalization. The rectangular weir set at a level where the V-notch weirs approach ADWF equalizes the correct portion of flows above ADWF improving equalization performance.

The splitter box is designed with the bottom sloped toward the secondary treatment influent mains. The upper basin is 8' 4" L and 2' 6" W. Three spaces on the south side are set for treatment trains, one for future plant expansion and two for the current Project. The north side has one rectangular weir gate in the center position for equalization. Using one weir for each equalization basin was considered but deemed unnecessary because the second basin will only be used during larger storms or extended maintenance events and they can be managed for those conditions by valves on the influent mains. The eastern third on the north side of the splitter box is the location of the bypass inlet. The three weirs have 12 inch wide openings in 16 inch wide gates. The Vs are 60 degrees at the apex and 7 inches in height to a rectangle 12" W x 3" H to complete the opening. The estimated maximum flowrate through each V-notch opening at the when water just submerges it is 0.691 MGD. The lower part of the rectangular weir is 8" W x 3” H and the upper area is the taller than the V-notch, 12” W x 4.5” H to allow the equalization upper limit to be above the upper limit of the V-notch opening. The maximum flowrate of the rectangular weir at V-notch submergence height is 0.827 MGD. The weir plates and frames are made of Type 304 stainless steel for a design life of 20 years or more, with replaceable HDPE or similar seals/bearings in the rails. The rest of the splitter box is made of reinforced concrete for a design life of at least 50 years.

4.2.5.a Splitter Box Flowrates

The splitter box is designed manage the full range of influent at the headworks. When any of the weirs are overtopped, the flows go to equalization or treatment as they overflow the lower curbs but are contained by the higher outside curb. Any of the mains leaving the splitter box can accommodate the Maximum Instantaneous Flowrate. The only way for the influent to spill at the splitter box is for a much larger flowrate than planned occur or for both equalization basins and both treatment trains be taken offline by the manual isolation valves. The isolation valves have position indicators connected to the SCADA system to warn operators if this condition is inadvertently set. An overflow for the splitter box is unnecessary.

4.2.5.b Valves

The only automated process control valves on the splitter box are the weirs themselves. The V-notch weirs modulate the flow to the treatment trains and a rectangular notched weir measures the flow to the equalization basins. Two manual plug valves will be used to select which equalization basin influent mains are active. A manual plug valve and removeable (manually) slide gate valves isolate the bypass system when not in use. Duck bill check valves prevent back flow to the sludge settling tank decant forcemain and the equalization return forcemain that discharge to the splitter box. There are no additional valves on the treatment train influent mains at the splitter box.

4.2.5.c Splitter Box Controls

The splitter box is the control center for the plant modes. The positioning of the weirs discussed above will determine the flowrates to various plant processes. During preliminary engineering the diurnal flowrates were calculated for the splitter box. Table 4 lists the flowrates past each weir when the splitter box is in diurnal mode across a range of influent flowrates. Weir levels will be set by reversable electric motors with position sensors connected to the SCADA system. The weirs work with a large threaded rod connected to a motor that can count the number of turns from one level to another. The SCADA system will control the changes between modes after field calibration of the weirs. The weirs’ position status will be displayed with other data such as flowrates (from the flume and flow meters) on the controls interface.

Table 4: Estimated Flowrates Over Weirs Across Range of Influent Conditions

Influent Flowrate Range (MGD)[1]	One V-notch Weir (MGD)	Equalization Weir (MGD)	Water Height Above V Apex (in)
0 to 0.048	0 to 0.024	0	0 to 2.75 – all low flows to treatment trains
0.048 to 0.110	0.024 to 0.044	0 to 0.023	2.75 to 3.5 - some equalization as influent approaches ADF
0.110 to 0.240	0.044 to 0.081	0.023 to 0.080	3.5 to 4.5 – equalization volume increase to 33% as influent approaches design capacity
0.240 to 0.425	0.081 to 0.133	0.080 to 0.158	4.5 to 5.5 – equalization volume is >33% of treatment volume up to 100 year storm flowrate
0.425 to 0.845	0.133 to 0.243	0.158 to 0.328	5.5 to 7 – equalization volume is exceeding 40% as flowrate is approximately Maximum Hourly.
0.845 to 1.66[2]	0.243 to 0.511	0.328 to 0.642	7 to 9 – weirs are not overtopped even under highest estimated flowrates.

1. Influent flowrates do not match plant design flowrates due to calculations being based on water height.
2. These are peak instantaneous flowrates only seen for 5 minutes or less per event.

It should be noted that every hour of the day under ADWF the average water height over the V is greater than 2 and less than 4 inches. Higher flowrates will occur for short periods of time but the splitter box will function in the ranges described in the first 3 rows of the table above most of the time.

There will be several modes with similar but slightly varied weir plate levels. The following modes are expected:

- Diurnal with equalization filling
- Diurnal with equalization pumping back
- Storm
- Emergency

Table 5 summarizes conceptual weir plate levels for various plant modes. Weirs will also be capable of being changed manually to customize modes based on operator experience and to change flows for maintenance conditions. During full design the weirs will be modeled for all modes to ensure proper sizing and range of elevations for the splitter box components.

Table 5: Equalization Weir Height For Different Modes

Mode Name	Influent Flow Range (MGD)	EQ Weir Height Above V (in)	Notes
Diurnal EQ Filling	up to 0.767	2.75	8" rectangular weir maximizes efficiency for EQ volume captured
Diurnal EQ Emptying	up to 0.767	3.75	EQ height is raised to prevent capturing influent during return pumping
Storm	up to 1.35	≤2.25	EQ height is lower to capture a greater percentage of influent for return over multiple days.
Emergency	up to 1.35	≥2.25	EQ height will be higher than storm by some amount to push treatment rate above nameplate capacity and preserve EQ space

The splitter box will also have a self-cleaning mode. During diurnal equalization emptying cycle when equalization volume is being pumped back to the splitter box and the rectangular weir is raised to prevent water from reentering the equalization basin, a cleaning cycle can be run. The cleaning cycle is accomplished by one or both of the V-notch gates being raised to allow influent, returned equalization flows, and splitter box basin volume to run into the treatment train influent mains off the bottom of the splitter box upper basin without obstruction. After a few minutes the V-notch weirs are returned to their usual preset positions and the cleaning cycle is ended. This action is automated and part of the diurnal mode control scheme managed by the SCADA system.

The positions of the weirs, current mode, and positions of the valves on the influent mains to equalization and treatment trains will all be recorded and displayed by the SCADA system. warning system based on recent, sustained, average flowrates measured at the flume will alert operators to change modes to match the influent flowrate. Manual valves in unusual positions will also generate warnings. In the event of a control system failure the weirs and valves will be operable by hand.

4.2.5.d Splitter Box Construction Strategy

The splitter box will be constructed prior to bringing the new treatment trains online. It may be necessary to move the influent main to the existing bioreactor to construct the splitter box. The bypass main from the headworks to the new splitter box can be constructed with the splitter box to be used while the new flume and channel are connected to the existing headworks.

Equalization mains may be constructed any time after the splitter box is online. While the first new treatment train is being commissioned and started up half the influent can be directed to the existing bioreactor via the second V-notch weir in the proposed splitter box.

4.2.6 Bypass

The bypass is designed to facilitate maintenance activities on all parts of the headworks. It is set up with valves and slide gates to allow for various parts or the entire headworks to be bypassed. It is not designed for use during or immediately following wet weather events. The flowrate used for design is ADWF scaled by the design PF and the FoS for the bypass (1.5). This gives a maximum capacity of 400 gpm (0.576 MGD) to cover maximum instantaneous surges in flow for the bypass system. The bypass system does not have a grinder or mechanical screen but relies on the existing fixed bar screen to capture solids.

Figure 3: Existing Headworks Bypass Channel And Bar Screen

The existing bypass system allows influent to bypass the grinder and the auger screen and works via open channel controlled by manually operated slide gate panels, see Figure 3. The existing system discharges upstream from the existing flume inlet and will remain part of the new bypass system operating in the same fashion. The new bypass will be constructed as a 10 inch main starting at the side wall of the existing channel and continue parallel to the proposed open channel to the splitter box and the equalization mains. The proposed bypass improvements will facilitate taking the flume out of service or the entire splitter box based on valves on the bypass main. The proposed main will have a manual slide gate on the inlet end to use for taking existing headworks and new flume offline. To bypass the flume the inlet and splitter box slide gates will be removed and the valve to the equalization mains will be closed. To bypass the entire splitter box the slide gate to the splitter box will be in place and the valve to the equalization mains opened. The operator can select which equalization basin to fill with the valves on the equalization mains as with normal equalization operations. A slide gate groove to isolate the equalization inlet at the splitter box from bypass flows may be needed when servicing the equalization weir. All the valves in the bypass system are manually operated. If flows are sent to equalization for an extended period they can be pumped to the bioreactors while keeping the splitter box offline using the camlock fitting in the lift station vault and a temporary hose system to pump the flow into the bioreactor main inlets at the splitter box. See the 30% Drawing sheet C6 and C7 for more detail.

4.3 Equalization

Equalization storage allows the plant treatment trains to run at a more constant rate by storing influent from high flow times and returning it to the bioreactors during low flow periods. Daily equalization takes a portion of the flow during heavy influent in the day and returns it in the late night when flows are much lower. Equalization is even more important to buffer the plant from high flowrates caused by storms. Precipitation events may exceed the plant capacity unless an equalization tank is available to take a fraction of the storm influent and hold it for treatment when influent flows subside to more normal levels over subsequent days.

After this Project, the plant will have two equalization basins. The existing tank, Equalization Basin 1, is 113,000 gallons in size with a depth of 13 feet and water level up to 11 feet The overflow on Equalization Basin 1 will be modified during the Project to fill to 12 feet to match the overflow height of the second tank. The existing bioreactor will be converted to Equalization Basin 2 after decommissioning and has a capacity of 167,000 gallons. Equalization Basin 2 has a depth of 16.6 feet and 15.3 feet of water capacity. The combined capacity of the two tanks is 280,000 gallons. Basic measurements and details can be seen in Table 6 and Sheets C10 to C13 of the 30% Drawings.

Table 6: Equalization Basin Statistics

	EQ Basin 1	EQ Basin 2
Base Elevation (ft)	45.90	42.62
Top Elevation (ft)	58.90	59.20
Top Water Elevation (ft)	57.90	57.90
Height of Overflow (ft)	12.0	15.3

Diameter (ft)	40.0	44.3
Capacity (gal)	113,000	167,000

Both basins are constructed of reinforced concrete and are in good condition for their age. It is recommended that new penetrations be installed with seals cast into grout for longevity with restrained mechanical joints on the exterior side where connected to mains. Ductile iron fittings and plug valves will be used for the mains. Mains are recommended to be mortar lined and asphalt coated ductile iron pipe (DIP) but SDR 26, PVC pipe is also an option. The influent mains are 10 inches in diameter with valves at the inlet end near the splitter box. The discharge mains are 8 inch diameter with valves located at the pipe entrance just outside the equalization basin wall for cleaning and inspection accessibility. The aeration lines and diffusers are discussed in the aeration section below. The design life of these components exceeds 50 years with the exception of the valves.

4.3.1 Reconditioning Existing Equalization Tank

The existing equalization tank will be reconfigured to connect to the proposed splitter box and equalization lift station. Existing paddle mixers and aeration equipment will be removed and new influent and effluent pipe penetrations installed. The existing lift station will be dismantled and the overflow weir will be reconstructed to match the higher level overflow planned for the second equalization basin with the new overflow being plumbed to the plant outfall.

4.3.2 Repurposing Existing Bioreactor for Equalization

The existing bioreactor will be repurposed to be Equalization Basin 2 in the proposed plant. The aeration, tank baffles, plumbing, and clarifier equipment will be removed. The floor and walls will be repaired as necessary and existing penetrations sealed. Proposed penetrations for influent, effluent, and sludge settling tank overflow will be constructed. The new overflow will be raised to the high tank level of 5057.90 and will remain plumbed to the plant outfall main. The existing plant must remain functioning during construction of the proposed plant. Equalization Basin 2 construction will not commence until after the new bioreactors are online and commissioned.

4.3.3 Equalization System Operation

The equalization system has relatively simple operation. The basins fill by gravity from the influent that goes over the equalization weir in the splitter box. The basins empty by gravity into the equalization lift station where contents are pumped back to the splitter box and flow to the treatment trains. Electronically controlled aeration systems run on operator settings via the SCADA system. The overflows are only intended to prevent sanitary overflows by diverting such excess influent to the plant outfall.

4.3.3.a Diurnal Equalization

Daily equalization basin storage was estimated by modeling the performance of the splitter box weir system using the diurnal curve shown above. During ADWF conditions about 17,000 gallons of influent will be diverted to equalization during heavy flow times of day (8 AM to midnight). This amounts to approximately 16 percent of total ADWF. The volume will vary widely from day to day based influent variation across days of the week and time of day. The average return flowrate from midnight to 8:00 is 0.051 MGD (35 gpm).

4.3.3.b Storm Water Equalization

Storm equalization will occur whenever wet weather flows cause equalization volumes to exceed the diurnal return pumping and water is left over when a new daily filling cycle begins. This could occur from heavy weekend flows too. But with larger storms the equalization basins will fill much more and may take many days to be emptied. The plant should be run in storm mode for these times so that lower BOD concentration water will not flush out the bioreactors. Storm mode will sequester a greater fraction of dilute wastewater in equalization to be returned over several days or a week as influent reverts to more average strength. For exceptionally large storms both equalization basins will be used. When this occurs operators must be vigilant to monitor the weather and the equalization levels and decide whether to put one or both treatment trains into emergency mode to keep equalization from over filling. Conditions where equalization capacity is exceeded and emergency mode must be used are expected to be quite rare if the equalization capacity is correctly allocated, on the order of once per ten years or less.

4.3.4 Equalization Aeration / Mixing

The equalization basins will both have coarse air diffusers with a capacity of 10 SCFM (standard cubic feet per minute) of air per 80 sq ft of bottom area. A Type 304 stainless steel tubular diffuser is recommended, although orifice models may more evenly distribute mixing energy. Stainless steel diffusers with galvanized steel piping are recommended because they will be exposed to sunlight for much of the time when the equalization basins are empty. The air serves a dual purpose to mix the wastewater and to aerate as needed. The mixing is provided to keep solids in suspension and reduce anaerobic zone development. The aeration is to manage oxygen levels and prevent anaerobic conditions in the water column. The diffusers will be distributed evenly across the bottom of the basin with consideration to ensure the basin drains to the effluent main as cleanly as possible. The air will be supplied by galvanized, NPT threaded, steel pipe.

4.3.5 Equalization Instrumentation and Control Strategy

Influent mains are placed online for service by manually operated plug valves. The valves are equipped with electronic position indicators to indicate open or closed status to the operators via the SCADA system. The basins are equipped with radar level sensors to report fluid levels to the SCADA system. The basins discharge by gravity to the equalization lift station when manual plug valves on the effluent lines are open. These valves also have electronic position indicators connected to the SCADA system. Aeration systems in each basin operate via electronic solenoid valves through the SCADA system. The air is for mixing and to maintain oxygen levels and is controlled by timer to run for 15 to 60 minutes per hour or simply on or off continuous mode by the operator. Sensor and indicator data is recorded for plant records and analysis, alarms are sent for various preset conditions like high level or closed valves against typical mode position.

4.3.6 Equalization Construction Strategy

The existing equalization basin can remain online through the beginning of construction. At some point during the dry season and after the new treatment trains, air system, RAS / WAS pump station, and controls are built the reconditioning can be done and new mains installed. Although the pumping will still be done by the existing lift station until the proposed one is built. The existing bioreactor basin will be used for equalization for the brief time that Equalization Basin 1 is offline for this Project.

The existing bioreactor will not be renovated until the new treatment trains are both fully functional and demolition of the existing clarifier and bioreactor equipment is complete. It is expected that the equalization lift station and sludge settling tank will be completed prior to taking the existing sludge basin out of service (in the existing bioreactor). Equalization Basin 2 will likely be among the last parts of Project work done at the plant.

4.4 Equalization Lift Station

The equalization lift station (lift station) returns water from the equalization basins to the splitter box to be divided and flow by gravity to the treatment trains. The proposed location is between the equalization basins and the proposed splitter box. The pumps are located in a circular wetwell with a single 8 inch main entering from each equalization basin. Two pumps discharge to riser pipes merging into a single forcemain to the splitter box. There are check valves and a flow meter in a vault located next to the wetwell. The lift station is designed to cover a range of flowrates during diurnal and storm equalization conditions. Return flows are metered to allow the SCADA system to monitor and manage equalization return flows to the bioreactors.

4.4.2 Lift Station Flows

Diurnal flows will be pumped back to the splitter box each night during low flow times between midnight and 8:00 AM. The average return flowrate for this time range is 35 gpm, or approximately 2,125 gallons per hour.

Wet season flows will be similar to dry season equalization volumes with more volume being equalized during rainy weather. Typically the equalization lift station will operate similar to the diurnal dry weather mode and return equalization volume daily for treatment. During larger rain events the equalization volume will increase and be returned to the splitter box over 2 or more days to buffer the load to the treatment trains. For 100 year precipitation events the full equalization volume of both basins may be used and pumped back to the splitter box over many days. Flowrates through the lift station will increase when the equalization basins are full because the higher water levels in the wetwell will significantly reduce the static head resulting in very low TDH and much higher flowrates through the short forcemain. The highest flowrate for storm conditions is estimated at 99 gpm. This represents the difference between AWWF and plant design capacity and is based on the premise that in order to lower the equalization basins after one storm to prepare for another the plant may be operated at capacity as necessary. Based on the max flowrate and a FoS a safety operating mode with both pumps running covers 197 gpm.

4.4.3 Lift Station Inlet Piping and Valves

Inlet mains to the equalization lift station are sloped to maintain a velocity of 3 to 10 ft/s to ensure suspended solids stay in suspension. The main length from Equalization Basin 1 to the wetwell is approximately 40 feet. The length from Equalization Basin 2 is approximately 10 feet. The inlet mains are sized to allow gravity filling of the wetwell at a rate that exceeds the combined pump rates when the equalization basins are nearly empty. Eight inch, mortar lined, ductile iron inlet mains running at half full on a slope of 0.0075 ft/ft are calculated to flow at 235 gpm or 3 ft/s. The selected slope minimizes depth of the wetwell and allows both pumps to run down to a 4 inch depth in either equalization basin.

Each inlet main will have an 8 inch, manual plug valve with open / closed indicator near the wall of the equalization basin. Plug valves are designed to pass solids without fouling and the location near the basin will allow for periodic inspection or cleaning when the basin is empty. These valves will be epoxy lined and coated ductile iron with mechanical joints for buried installation. Typically equalization basins that are online for use will have the valves open and they will be closed when one or both basins are offline as applicable. It is not anticipated that the basins will be alternated frequently so these valves have manual controls with local visual indicators and position sensors to report status to the SCADA system. DeZURIK 100 percent port eccentric plug valves meet the industry standards for this application and are included in the selected equipment product data in Appendix E.

4.4.4 Wet Well

The equalization lift station pumps will be housed in a 5 foot diameter concrete wetwell constructed of precast concrete manhole riser sections with sealed and grouted joints. The wetwell is designed to minimize footprint while permitting enough room for the pump mounting and rail system. The wetwell is founded on a cast in place slab and has grouted tapers in the bottom to maximize solids removal by the pumps and minimize cleaning maintenance. The top of the wet well is a precast concrete cover with cast in place, 36” x 36” clear opening, horizontal access hatch to permit removal of the pumps for maintenance.

The depth of the wet well is 2 feet below the entrance of the lowest inlet main to maintain pump submergence and cool the motors during low flow conditions. The wetwell is 19’ 3” deep with a rim elevation 6 inches above the rim of Equalization Basin 2 (9.6” above the rim of EQ 1). The grading outside the wetwell will be adjusted to several inches below the rim elevation and slope away from the structure for drainage. Typically, the water level in the wetwell will match that of the online equalization basin. The basins will flow, via the wetwell, from the higher liquid level to the lower if they are both online simultaneously. A radar level sensor will report the wetwell fluid level to the SCADA system. For more detail on the relative elevations of the wetwell and adjacent components see the Hydraulic Profile on Sheet C5 and Sheet C9.

4.4.5 Lift Station Pumps

Submersible, solids handling pumps will lift water from equalization to the splitter box where it will flow to the treatment trains. Each pump is sized to convey the storm water return flowrate, 99 gpm. Calculations estimate the TDH of the system at 17 feet for the design flowrate. The recommended pump is Flygt brand, model NP 3085 SH 3~ Adaptive 453. The 3 hp pump features a self-cleaning open channel impeller and 61 percent best efficiency point (BEP) at 16.5 TDH and 120 gpm. The TDH and flow range on the pump curve is 13 feet at 155 gpm when the equalization basins are full to 21 feet at 80 gpm when the wetwell is empty. The diurnal TDH range for Equalization Basin 1 is 16 to 18 feet at 105 to 115 gpm over the range of water level in the basin expected for diurnal equalization. Static head is 10.8 to 12.6 feet. The pump covers all system operating conditions within the acceptable operating range.

The pumps will be mounted on a stainless steel rail system where they hang in position by gravity and can be removed for maintenance by a davit crane. The discharge risers will be 3 inch, flanged, mortar lined, ductile iron pipe. Fittings will be of the same materials. Due to the large volumes in the equalization basin relative to the pump size and the modes of operation outlined below, the pumps would be unlikely to short cycle under operating conditions.

The pumps selected for the equalization lift station have to be solids handling for raw wastewater. The smallest pumps that can pass 3 inch solids per industry standard have capacities around 100 gpm for low TDH application like this. The flowrate needed for diurnal equalization return is less, approximately one third of the pump capacity. To be able to cover the lower range flowrates at the lift station with a solids handling pump, a full speed, pulsed mode of operation is recommended. There will be two pumps which typically will operate on lead / standby configuration. They will be able to pump simultaneously as lead, lag if needed. The use of a VFD is considered unnecessary for pumps this small and could not achieve the low diurnal flowrates even at its lowest setting anyway.

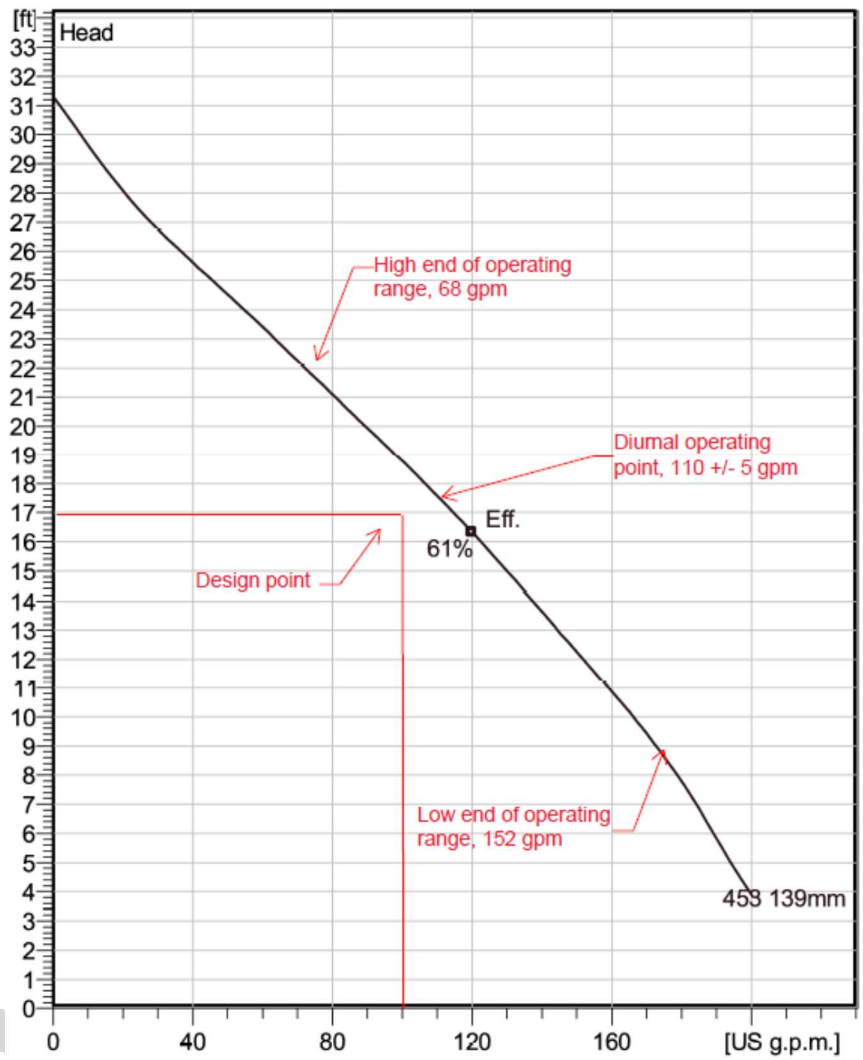

Figure 4: Lift Station Pump Curve

4.4.6 Lift Station Forcemain and Valve Vault

The discharge riser pipes leave the wetwell below grade and enter a nearby precast concrete valve vault. The vault is 8’ 6” L x 5’ 0” W inside to accommodate assembly and maintenance of the forcemains and valve components inside. Inside the vault the riser pipes have 3 inch full port check valves, model CVS 250A by Apco with exterior closing weight and air cushion options to prevent backflow to the pumps. Check valves are followed by two plug valves used for isolation of each riser pipe or the forcemain to service the pumps, check valves, or flow meter. At the merge of the two riser pipes the is a bypass fitting consisting of a branch to a 3 inch camlock fitting with a 3 inch ball valve closure. This will allow the equalization flow to be diverted to a temporary main for maintenance purposes such as to remove the splitter box from service. An electromagnetic flow meter is located after the maintenance bypass fitting. The 3 inch, M2000 model by Badger Meter has a range from 2 to 956 gpm and will permit 3 inch solids passage. A 3 inch plug valve located outside the vault will allow for isolation downstream from the flow meter.

From the vault the 3 inch ductile iron forcemain extends a short 10 to 20 feet to the splitter box where it discharges via a duckbill check valve on the south side. The forcemain will be sloped upward along its length to remain full past the check valves when not flowing (this promotes more accurate flow measurement), and to expel gases and air in the line when the pumps activate to prevent air locking.

4.4.7 Lift Station Instrumentation and Control Strategy

The equalization lift station will be controlled by the SCADA system via liquid level in the wet well and the equalization basins as reported by the radar level sensors in each location. The lift station will operate at set times for some treatment plant operating modes or be set to run manually to draw down the equalization tanks over time.

During diurnal mode(s) the pumps will run at low flow hours of the day as selected by operators. At the beginning of each low flow half hour a pump will be called to run for a set amount of time, typically 5 to 15 minutes. At the end of the low flow period any remaining equalization volume will be left for the following day's equalization. If volumes gradually increase in the equalization basin the time of pumping set point can be adjusted by the operators. The timer can be set to empty the basin the majority of days near the end of the low flow period. The pumps are called in alternating lead / standby order.

Pumps may run on a timer as just described or return flow could be calculated based on equalization basin level and pumped back in fractional amounts based on the flow meter readings on the lift station. The pulsing would be similar in this case with alternating pumps starting every 30 minutes and running until the cumulative flow registered a preset quantity of approximately 1/15th of the volume or until the wetwell is empty. Both modes of diurnal operation will be preprogramed into the SCADA system and be adjustable for specific variables such as start frequency, run time, and hours of operation.

When the plant is operating under a storm or emergency mode of the SCADA system the equalization lift station pumps will be set to draw down the equalization basins as the influent flow subsides below a set flowrate as reported by the flume. The pumps will run every hour (or other cycle length) to a set volume on the lift station flow meter. The pumps will start only on hours when influent has averaged below an operator determined set point as reported by the flume over the previous hour. Alternatively the pumps may be managed manually to pump back a continuous set quantity or run time per hour or other increment of time.

Lift station data from the instruments as well as monitoring devices in the pumps will be recorded by the SCADA system. Alarms on pumps for overload, temperature, moisture, will be reported to operators. The level sensor will record continuously and report alarms for high levels. Flow meter data may need a delay when pumps start to clear air in the riser pipe.

In the case of control system failure, the lift station may be operated manually. Floats in the wet well will offer redundant alarm conditions for low and high levels and shut pumps off on low level. A timer similar to the limiting dial on a light switch will be used to limit run time on the pumps to not more than 200 minutes.

4.4.8 Lift Station Construction

Due to excavation near the existing bioreactor and proposed splitter box, the lift station construction will be scheduled late in the Project. The lift station foundation is near the base of the existing bioreactor basin. It is Recommended that the wetwell construction commence after the existing bioreactor is taken out of service. Shoring will likely be needed to protect existing facilities from settlement during the construction of the wetwell. The sludge settling tank construction will be done at the same time.

4.5 Plant Air Supply System

Air is required for multiple processes across the plant. The primary and largest demand for air will be to the aeration zones in the treatment trains. The aeration system must supply enough air to oxidize all the biological oxygen demand (BOD) and the biological nitrification demand in the aeration zone of the bioreactors. Air will also be piped to the equalization basins for use in mixing to keep solids in suspension and to add oxygen to prevent anaerobic conditions that can cause odors. Additionally, air lines to the sludge setting tank will provide air there for mixing and stabilization of the waste activated sludge.

The air supply system has to have a range of output to reduce aeration at lower demand times and increase oxygen delivered at peak demand times. This is accomplished by turning on or off banks of diffusers in the aeration zone automatically via actuated solenoid valves, based on effluent oxygen levels. Blowers will be sized precisely during full design to optimize air capacity to the plant loads and minimize energy use by the blowers.

4.5.1 Blowers

Two types of blowers can cover the range of air volume (250 to 1110 SCFM) at the pressure required (approximately 7 to 9 psi) for the IWD plant. Single stage centrifugal blowers and positive displacement blowers can serve these application points. Centrifugal blowers can be throttled with an inlet valve to reduce flowrates by up to 60 percent. Positive displacement blowers can turn down up to 50 percent using a VFD on the motor. Both types can cover the range by having two units operating in parallel with output control on both blowers. However, positive displacement blowers are unlikely to be significantly more efficient, can be louder when operating, and have greater maintenance requirements which increases their life cycle cost. Centrifugal blowers can cost more upfront, but their life cycle costs are expected to be somewhat lower. Centrifugal blowers with actuated butterfly valves for throttling are recommended for this application.

Three 555 SCFM, 40 hp, blowers are proposed to supply air to the new plant. The blowers will be on soft starters as required for motors 40 or more horsepower. Blowers will operate in a lead, lag, standby alternating sequence to keep usage even across the units. This portion of the preliminary engineering calculations indicate that there is no excess range available to the low end or the full demand on two units. The blowers are the primary equipment in the plant and use approximately 80 percent of the energy and sizing must be carefully verified during full design.

4.5.2 Plant Air Flows

Preliminary engineering estimates for the air supplied to each plant component indicate a combined maximum demand of approximately 1110 SCFM. Each bioreactor will have a capacity of up to 350 SCFM. Equalization Basin 1 has a demand of 160 SCFM and Equalization basin 2 has a demand of 190. The sludge settling tank has a demand of 60 SCFM. These lesser demands per square foot are standard for mixing and will keep tanks from becoming anaerobic. The equalization basins and sludge setting tank arrays must be throttled to keep them from reducing the pressure in the system especially when the tank levels are low. Table 7 below summarizes demands for each system.

Table 7: Plant System Air Demands

System	Air Demand SCFM
Equalization Basin 1	160
Equalization Basin 1	190
Bioreactor Low	130
Bioreactor Medium	220
Bioreactor High	350
Sludge Settling Tank	up to 1.35
All System Running	1,110

The plant blowers will often be running singularly near full capacity. But when the equalization basin or the sludge setting tank require air two blowers will operate both at reduced capacity to match the load. The arrays in the bioreactor aeration zones will be staggered at 130 SCFM and 220 SCFM. Alternatively, they could be 150 and 200 SCFM or any ratio depending on how many diffusers are in each array. The goal is to maximize steady state operation for the blowers by aligning the air flow with the oxygen demand.

4.5.3 Air System Distribution

Stainless steel pipe is recommended for the air distribution design. The air at the plant is undried and condensate inside the pipe is corrosive and will destroy it over time while adding particulates that foul fine bubble diffusers and the filters that protect them. The cost for stainless steel pipe relative to the project is fairly small and the cost for an air drier to protect iron pipe would likely be more than the cost difference between stainless steel and iron pipe. Schedule 10, Type 304, stainless steel pipe with welded or Victaulic joints will form air distribution mains across the yard to each basin. The pipe inside the equalization basins and sludge settling tank will be galvanized steel since it can be replaced with regular maintenance and the diffusers are course bubble and will not be affected by corrosion particulates. The diffuser headers in the aeration basin may be stainless steel or galvanized steel depending on the diffuser manufacture's requirements and IWD maintenance preferences. It is anticipated that regular maintenance of the diffusers will permit galvanized pipe to be replaced before corrosion sets in and can damage the diffusers. The piping in the basins is not recommended be plastic due to UV degradation when it is exposed to the sun. The piping in the basins will be designed to be removeable in sections for maintenance without draining the tank, while the remaining branches remain in service.

4.5.4 Diffusers

Fine bubble diffusers are recommended for the aeration zones of the proposed bioreactors. Fine bubble diffusers have approximately twice the oxygen transfer rate compared to coarse bubble diffusers in applications similar to the proposed plant. Fine bubble diffusers for the aeration zones would require air filtration to remove dust and impurities from the air supply to keep diffusers from clogging. Fine bubble diffusers also require regular cleaning and can become less efficient over time due to fouling. The data collected over time comparing oxygen level with air flowrate may be used to evaluate how much fouling is occurring in the fine bubble diffusers and when maintenance is required.

Course bubble diffusers are recommended for the sludge settling tank and the equalization basin applications. Course bubble diffusers, also called nonporous diffusers, do not require air purification, require less maintenance, and cost less than fine bubble diffusers over their design life. The lower cost must be weighed against oxygen transfer rates and the additional energy costs associated with pumping twice the air. During full design if more air is needed for mixing than for oxygen transfer in the aeration zones, coarse bubble diffusers can be used there as well to save money on the air filtration and diffuser cleaning labor. Coarse bubble diffusers come in two general types: orifice and tube. It is expected that tube type diffuser will be more cost efficient for the equalization basins and the sludge settling tank applications.

4.5.5 Air Control Strategy and Instrumentation

Blowers will be called in lead / lag / standby sequence to maintain similar hours and starts on each unit. The air supply will be measured by a pressure transducer on the discharge manifold and maintained in a range at an operator adjustable set point. The blowers will run to maintain the pressure by modulating the motor controlled inlet valves and calling an additional unit or shutting one down as demand fluctuates. On the demand side the aeration systems will be manually turned on or off for the equalization basins and the sludge settling tank no more than once every 30 minutes. At the aeration zones in the treatment trains the air will be managed by the SCADA system to change flowrates and amount of air delivered based on the oxygen level in the mixture as reported by the discharge oxygen sensor in each bioreactor. The SCADA will turn air to the aeration zone up or down based on the oxygen level set point for the current plant operating mode based on the oxygen sensor reading. The system will only adjust air once every 30 minutes based on the previous half hour sensor average. Air delivered to the aeration zone modulates across three levels by the actuated solenoid valves to the diffuser banks in the zone. The modulation of the aeration lines in the aeration zone is buffered by the time delay and the pressure transducer at the blower manifold has to have sufficient range to prevent instability and frequent starting on the blowers.

4.5.6 Air System Construction

The air system construction will be complicated because it needs to be built in the same location as the existing system while the existing system continues to operate. The construction sequence needs to be carefully planned during full design and the planning should consider adaptation by the Contractor where changes are helpful in making the process safer and more resilient. Due to the blowers being needed to commission the new treatment trains, it will be necessary to complete the blower construction early in the Project.

It is anticipated that the proposed motor starters will be constructed in the motor control center in the new electrical building. The blowers will have to be installed one at a time with the proposed distribution piping built out in advance parallel to the existing distribution. The following sequence will be followed. The first blower will be connected to the new distribution system and be commissioned. Then the new distribution will be connected to the existing bioreactor and be started up to supply it while the existing blowers remain on call as backup. When the first blower startup period is complete, a second blower will be installed in the place of one of the existing blowers. After commissioning and startup of the second blower is complete and it can be backup to the existing bioreactor. Then, the last existing blower can be replaced by the third new one and all will be operating on the new control system while supplying the existing bioreactor. At this time the new treatment trains will be able to be commissioned assuming the other supporting systems have been commissioned and are ready for startup.

4.6 Secondary Treatment

Secondary treatment is intended to stabilize wastewater and reduce the nitrogen levels. The most important goal of the Project is to provide redundancy in the treatment trains at the plant. There are two proposed treatment trains equal in size and functionality. See Sheets C14 to C16 and C21 in the 30% Drawings. The bioreactors are designed to function as a Modified Ludzack Ettinger process to maximize nitrogen reduction.

4.6.1 Treatment Inlet Piping and Valves

The inlet piping from the splitter box to the treatment trains is set up to keep the mains running above critical flowrates, be redundant with bypass capacity for maintenance, and maintain the hydraulic profile of each treatment train at the same elevation. The 10 inch ductile iron mains run parallel to two manholes centered on the east ends of the bioreactors. The longer main to Bioreactor 2's manhole has a slope of 0.005 ft/ft and length of 135 feet. The shorter main has a slope of 0.007 ft/ft and a length of 96 feet and terminates at the Bioreactor 1 manhole. Short mains with steeper slopes discharge influent into the bioreactors' anoxic zones below the water surface.

In each manhole there are two manually operated, stainless steel, slide gate valves. These valves are located on the discharge mains to the bioreactors and the bypass main between the manholes. The valves on the discharge mains are normally open and only closed when flow is diverted from to remove a bioreactor from service. The valves on the bypass mains are normally closed and would only be opened during maintenance operations that required taking one of the influent mains out of service.

4.6.2 Bioreactor Tank Structure

The bioreactor tanks combine the containment for the anoxic zone, the aerobic zone, and the clarifier. Each treatment train has the relevant components installed in a single monolithic tank. The tanks will be constructed of reinforced concrete with cast in place seals at all joints. Each tank is estimated to be 65' L x 29' W x 16.5' D with 18" freeboard. These measurements may change somewhat during final design and sizing and based on the proposals of Bidders. The current measurements are conservative to allow for the plant layout to remain consistent through the full design and bidding.

The tanks will be mostly buried on the east side and mostly above grade on the west ends. This will result in the wall loading varying based on exterior grade. The west side where the clarifier is located may have a sloped wall that matches the clarifier design. The tanks will have a fiberglass reinforced plastic (FRP) catwalk on each long side running the length of the structure with several locations in the wall for davit crane pockets where a portable crane may be installed as needed by operators. The walkways will be supported by hot dipped galvanized steel frames and have aluminum railings on both sides. A structural engineer will be required to certify the full design of the bioreactor vessels and associated structures.

4.6.3 Anoxic Zone

The proposed 24 foot long by 29 foot wide anoxic zone is made to promote denitrification. Denitrification occurs when nitrate and nitrite are consumed by microbes in the absence of free oxygen. The anoxic zone will be separated from the aerobic zone by a permeable baffle that will be at least partly submerge to allow floating debris to pass and have clear openings at the floor level to keep sinking debris to move to the aeration zone. The corners of the bioreactor vessel may be curved to promote mixing and keep solids from accumulating and stagnating.

4.6.3.a Anoxic Zone Mixing

The anoxic zone will be mixed by one or more hyperboloid mixers. These mixers rotate slowly and have a fluted cone shaped 'impeller' base that moves the water smoothly downward and outward. The fluid moves upward when it comes to the wall and back toward the mixer at the top of the column. This keeps the whole area mixed without adding extra oxygen or wasting energy.

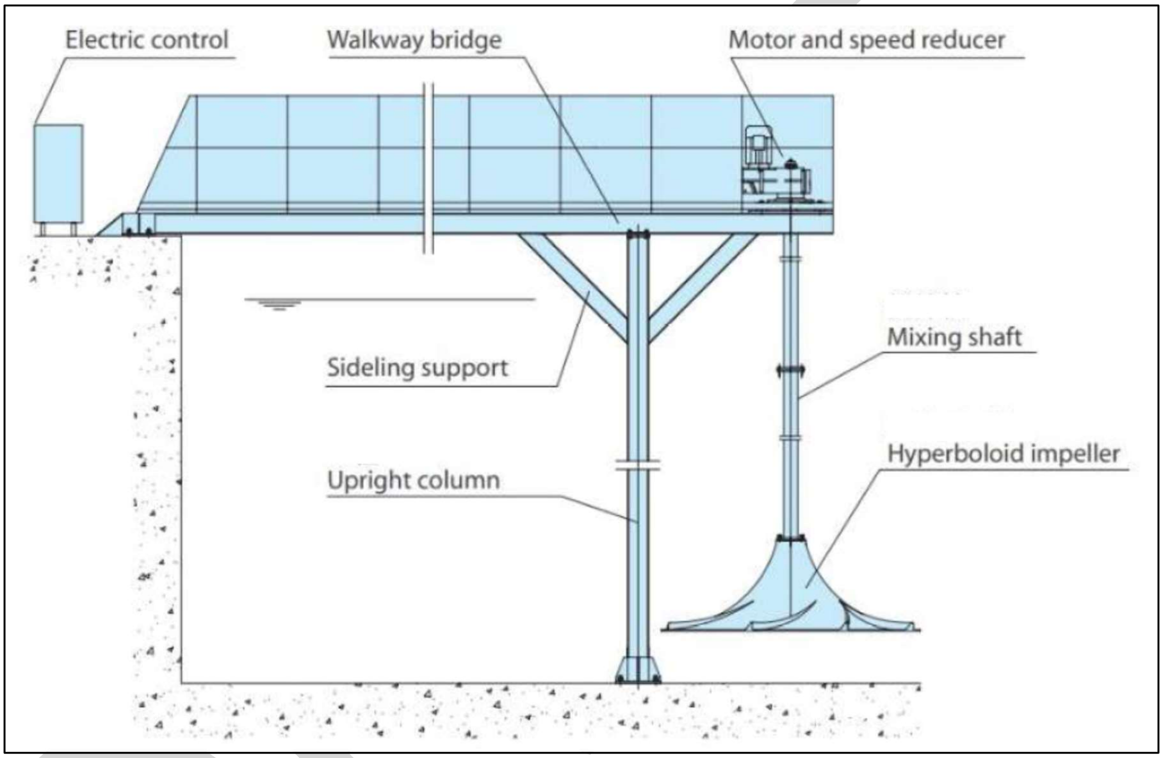

Figure 5: Hyperboloid Mixer

4.6.3.b Anoxic Zone Instruments and Control Strategy

It is anticipated that mixing will run continuously and the SCADA system will monitor status via status and moisture and over temperature switches in the motor. There is a dissolved oxygen and pH sensor in the anoxic zone. These report data continuously to the SCADA system but do not have any contingent processes based on them. The data from the anoxic zone is recorded for operator use and there are no automated processes in the anoxic zone.

4.6.4 Aeration Zone

The aeration zone is a partially segregated area in the bioreactor where dissolved oxygen levels are maintained at higher levels to facilitate microbial growth so that BOD is consumed and nitrification takes place. The water enters the zone around a baffle that separates aerobic from the anoxic zone. The aeration vigorously mixes the volume while adding oxygen and stripping carbon dioxide via gas transfer.

The aeration diffusers are distributed evenly across the aerobic zone on two arrays. Each array covers the whole zone but one has approximately 2X the number of diffusers. The arrays are controlled by separate solenoid valves on the supply mains. When the smaller array is on this is essentially the low setting for air to the aeration zone. When only the larger array is operating this will be a medium oxygen loading level. Both arrays can operate when high levels of oxygen transfer are needed. The arrays are sized to cover a range of expected operating conditions and save energy by not over pumping air when it is not needed. The smaller array must cover the mixing requirement to keep solids in suspension and prevent anaerobic regions from forming.

4.6.4.a Aeration Diffusers

Fine bubble diffusers are recommended for the aeration zone because they have gas transfer rates about 2X higher than coarse bubble diffusers and oxygen level is typically the limiting factor in the aeration process. A 10 SCFM disc type diffuser is recommended for this application. These diffusers come in many different materials and are relatively low cost. Seven separate headers with 5 diffusers each will be constructed of galvanized steel pipe and be removable to facilitate operator maintenance activities. Each header can be shut down with an isolation ball valve and removed at a union coupling near the top of the tank wall for cleaning, inspection, and diffuser replacement while the other headers in the array continue to operate unaffected.

4.6.4.b Aeration Zone Instrumentation and Control Strategy

The aerobic zone has two banks of sensors to inform operators and run processes via the SCADA system. The oxygen, pH, and temperature sensors are located near the influent end of the aerobic zone and the effluent (clarifier) end. The data is reported and recorded by SCADA for operators' analysis and record keeping. The oxygen readings will be tied to the control of the solenoids for the air diffuser arrays. The SCADA system will manage the oxygen level within an accepted range by opening one or the other or both arrays to keep oxygen levels within the range set in the plant operating mode (diurnal, storm, etc.) as adjusted by operators. Changes to the air supply via opening and closing the solenoids will be done with preprogrammed delays to prevent short cycling the blowers and associated control system. It is expected that the arrays online will be reset by the SCADA no more than once per 20 or 30 minutes or even less frequently. With reasonable equalization, the aerobic zone is expected to run at a steady state predominantly or adjust only a few times a day.

4.6.4.c Scum and Foam

Scum removal and handling equipment has not been selected at this preliminary engineering level but is expected to be part of the full design. Foam control will also be part of the complete design. The scum in the plant will collect at the edges due to the churning of the air bubbling up thorough the column. A scum collection system at the influent and effluent ends of the aerobic zone would collect the scum effectively without a mechanized rake. Scum and water captured by the collector would flow into a sump for pumping to the sludge setting tank. The two treatment trains would share a common sump that would be pumped into the WAS forcemain via a separate pump that runs on a float system or other local control. Foam over the aeration zone will be suppressed by a water spray system connected to the existing plant recycled water supply. The system would run on / off continuously or on a locally controlled timer periodically. Neither system would be connected to the SCADA system or require automatic controls beyond the local controllers for each.

4.6.5 Secondary Clarification

At the end of each treatment train is a proposed upflow clarifier. The treated water enters through the bottom which is narrow and rises to the top where it spills over a long weir trough called the laver. The water slows down as it rises because the clarifier gets steadily wider toward the top and the solids begin to flocculate and settle slowly toward the bottom. The solids, fine, light particles that behave similar to dandelion seeds, settle downward and slide down the clarifier walls toward the collector manifolds at the bottom of the wall. There they flow into the RAS / WAS pump station inlet main.

The clarifiers are current proposed to have walls angled at 30 degrees from vertical orientated across the bioreactors. They are approximately 16.5 feet long and 29 feet wide. Two lavers extend across the width. The clarifier design will be further refined during full design.

4.6.5.a Clarifier Discharge Piping

Two or more lavers will collect clarified effluent at the top of the clarifier. The lavers will extend across the width of the bioreactor tanks due to the two dimensional expansion of the clarifier being lengthwise in the preliminary configuration. The lavers discharge into a collection trough and flow through submerged (full) piping with an electromagnetic flow meter and into the final effluent box. The final effluent box is shared by both bioreactors and serves as a manifold to merge the flows prior to discharge into the existing plant outfall main.

4.6.5.b Discharge Flow Meters

Each clarifier discharge has a 6 inch electromagnetic flow meter. The flowrate through the clarifier is determined by the influent flowrate through the V-notch weirs at the splitter box. The bioreactors buffer the flowrate flow by their large volume and the secondary weirs of the lavers but over a given time the two flows should be equal. The flow meters at the clarifier serve to be an accurate measurement of each bioreactor's processing rate. These measurements will make it possible to tune the splitter box weir set points and calibrate the flume more accurately. The effluent flow meters are the primary flow measurement at the plant and in conjunction with the WAS flow measured by the RAS / WAS pump station flow meters will account for the total flow out of (and in theory in to) the plant.

4.6.5.c Final Effluent Box and Outfall Main

Connecting the proposed effluent box to the existing, C909, PVC, 8 inch outfall main without additional pumping for effluent disposal is recommended for design. The plant outfall is a gravity main that flows full through a low area under the wetland to the west of the plant and over a nearly flat area on the far side. The main subsequently drops as the hill steepens down to the sprinkler fields (land application) and percolation ponds. The main hydraulic point that would require pumping to convey the effluent is the low point and flat area right near the plant. Preliminary calculations indicate that the proposed outfall box water level is 5056.13 feet AMSL compared to the existing effluent box water level of 5056.95 feet. The difference of approximately 10 inches will not noticeably affect the outfall capacity. Outfall capacity is estimated to be 0.3 MGD with the 8 inch pipe running half full and 0.6 MGD at full pipe. Realistically the pipe flows full through the low spot in the wetlands and may have reduced capacity due to sedimentation in that area as solids deposit due to low flow velocities. Just the same, the capacity is considered sufficient for the existing and proposed plants and should not pose any problems. It is advisable to regularly maintain the upper portion of this outfall main to keep the pipe clean to ensure capacity that may be needed during a storm or other effluent increase event since there is no alternative main or redundancy and a backup may result in an overflow at the plant.

4.6.5.d Clarification Control Strategy and Instrumentation

The proposed clarifiers work by gravity and depend on the reliable function of other systems, especially the RAS / WAS pump station and the aerobic zone to work well. Each clarifier has a radar level sensor. This sensor generates alarms for high or low levels and records water level in the clarifier over time. There are conductivity, pH, and temperature sensors in the shared final effluent box. These along with the data from the individual flow meters are collected and recorded by the SCADA system for plant records and operational analysis. No process automation set points or controls are associated with these data sources.

An optional sludge blanket level detector may be an idea to generate alarms or even support control automation for the RAS pumps. However, due to the complexity of sludge settling management and variables involved this is not recommended for full design at this time and it is expected that the plant (and the clarifier) will best be managed by the controls recommended in this preliminary engineering report.

4.7 RAS / WAS Pump Station

The proposed RAS / WAS pump station (pump station) is located on the west end of Bioreactor 2. The pump station is configured as two separate pump stations, one for each bioreactor, in a single building. The sub systems are linked together to be capable of pumping from one bioreactor to the other and to share a common forcemain to the sludge settling tank. See Sheet C17 for a detailed view of the interior plumbing proposed.

4.7.1 RAS / WAS Pump Station Functions

The pump station recirculates sludge from the end of the treatment train to the beginning and removes excess quantities by pumping to the sludge settling tank. In a Modified Ludzak Ettinger plant, the sludge is removed from both the clarifier and fractionally from the aerobic zone to increase the nitrate of the sludge feeding into the raw influent in the anoxic zone. The sludge is pumped to the head of the bioreactor where it mixes with influent entering the anoxic zone and increases the rate of denitrification as well as nitrogen removal generally. Automated valves send some of the sludge to the sludge settling tank to prevent the volume of solids in the system from becoming too high. Chemicals to reduce filamentous bacteria or facilitate preferred biochemical reactions may be added downstream from the pumps prior to discharge to the bioreactor by a chemical injection pump.

4.7.1.a Pump Station Flowrates

The RAS / WAS pump station has a flow range from 65 gpm at 5.5 feet TDH to 125 gpm at 15.5 feet TDH. The former is a single pump running at low speed on a VFD and the latter is both pumps running at full speed. It is expected that the pump station will operate much of the time at 65 gpm. Similar to the lift station, this pump station is the lower range limit for 3 inch solids handling or grinder pump for this low flowrate. Flowrates may be higher to support clarifier function or during the dry season when wastewater is stronger. Wasting sludge will likely be reduced during wet weather to retain solids in the treatment train at high hydraulic loading.

Table 8: Pumping Flowrate Ranges for Different Modes.

Mode Name	RAS Flow Range (gpm)	WAS Flow Time Per Hour	Notes
Diurnal	65 to 100	5 to 15	RAS flowrate is adjusted to manage clarifier and on wastewater conditions. WAS is the same
Storm	75 to 100	5 to 10	RAS is increased to counter higher hydraulic load. WAS is decreased on weaker wastewater.
Emergency	100 to 125	0 to 10	RAS flowrate increased to keep clarifier functional. WAS low to none to keeps solids from washout.

4.7.1.b Pump Station Inlet Piping and Valves

The RAS / WAS pump station inlet piping begins as a manifold in the clarifier. The collection system is a series of openings in the sludge collection channels at the bottom of the clarifier. The openings ‘vacuum’ the collecting solids when the pumps are on. The manifolds merge just inside the bioreactor wall into a 4 inch ductile iron pipe through port. A second 3 inch, inlet pipe is located near the downstream end of the aerobic zone. This is a similar inlet manifold across the bioreactor width. It is connected to the other inlet pipe outside the bioreactor wall. The inlet piping runs below grade to the pump station and comes up through the floor in the corner of the building where it turns horizontally and connects to the 4 inch pump intake manifold.

4.7.1.c Pumps

The proposed pumps for the pump station are Flygt model NT 3085 SH 3~ Adaptive 455 with a 2 hp motor. These submersible motor pumps will be installed in a dry pit vertical configuration and are recommended by the manufacturer for this type of service. The pumps are raw wastewater rated with adaptive impellers that permit passage of rags and other solid contaminants to reduce clogging. A cutting blade on the inlet also reduces the chance that these pumps will need maintenance to clear clogs. These pumps were selected because an alternative grinder pump could not be identified for the application. The proposed dual treatment trains have lower individual capacity than the existing combined treatment train and the sludge pumping rate is subsequently lower. The existing grinder pump is the smallest model made by Vaughn and typically runs on the VFD at the lowest setting. The smaller Flygt pumps will be more efficient while also preventing clogs. The pumps will have VFDs and two pumps can run in parallel to increase flows as necessary. Typically they will operate on a lead / standby alternating basis unless higher flowrates make running them as lead / lag beneficial. Since a dedicated standby pump is not proposed a single spare pump stored at the pump station will serve both bioreactors' pump stations. Each pump has a pair of isolation plug valves, one on the inlet and one on the outlet, and a slow closing swing check valve on the discharge. See Figure 6 for the pump curve.

4.7.1.d Pump Station Forcemain and Valves

The RAS forcemains leaving the pump station return to the bioreactor of origin and the WAS forcemains merge before heading across the plant to the sludge setting tank. The pumps discharge into a 3 inch manifold that turns vertical at the rear (east side) of the pump station building. The first tee in the column has a manually operated plug valve that is normally closed. This is a branch line that can be opened manually to allow the sludge to be pumped into the other bioreactor. This feature is useful when reseeding the other bioreactor is necessary and for draining one bioreactor into the other for maintenance activities. The second tee higher in the column leads to the two forcemains via an electromagnetic flow meter. The top of the column has an air release valve to collect and remove entrained gases that have come out of solution in the pipes. Downstream from the flow meter is the actuated 3 way plug valve that selects between the RAS forcemain and the WAS forcemain. The valve is controlled by the SCADA system.

Past the 3 way valve the upward branch is the WAS forcemain and has a check valve to prevent backflow from the other bioreactor's pump station. A manual plug valve follows for isolation and an ARV is shared by the two sides since this WAS merging manifold is a high point in the WAS forcemain. From the manifold the 3 inch forcemain exits the pump station through the floor and continues to the sludge settling tank.

The horizontal branch at the 3 way, actuated valve turns downward and exits the pump station. The chemical feed injection point is located on the down pipe. The 3 inch ductile iron forcemain continues below grade to the head of the anoxic zone. The pipe enters the treatment train via wall penetration and discharges across the influent inlet pipe to promote mixing with the raw wastewater.

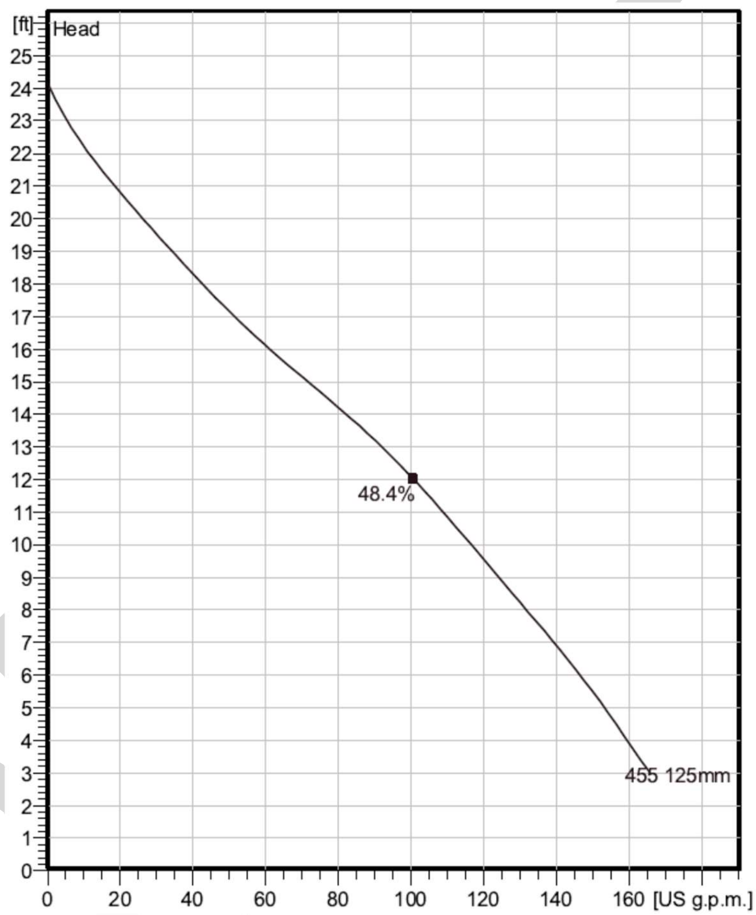

Figure 6: RAS Pump Curve

4.7.1.e Pump Station Chemical Feed Pumps

Each treatment train will have a peristaltic, chemical dosing pump in the pump station. The pump will be connected to SCADA. The pumps will work at a preset rate or at a flow scaled rate based on the flow meter readings. A timer function will shut the pump off several seconds prior to the pump station pumping WAS to the sludge setting tank to conserve chemicals and restart the pump when the pump station goes back to RAS pumping.

4.7.2 Pump Station Building

The RAS / WAS pump station will be located in a concrete block building with a slab foundation. The insulated roof structure will be light timber framed with galvalume sheet metal roofing and flashing. A dome skylight will provide natural light. The building is 12' W x 20' L with 3' 0" commercial steel door and 6' 0", weatherproof, steel, rollup door on the west side. The interior wall height is 9' 0". The pumps are laid out in parallel and extend inward approximately 5 feet from the north and south walls. Piping will enter and leave the building below grade and be located on the north, south, and east walls. The center of the room has space for storing chemical drums and pallets to supply the chemical feed pump at the pump station. The building will have a vent and exhaust fan to cool it during the summer.

4.7.3 Pump Station Instrumentation and Control Strategy

The chemical feed pumps, flow meters, and 3 way actuated valves are the RAS / WAS pump station components controlled by the SCADA system. The pump station pumps will typically run continuously at a given rate as determined by the flow meter and modulate via the VFD and running one or both pumps at a time. The WAS cycle will begin periodically on a timer (e.g. once per half hour) and run for several minutes until a set volume has been wasted as reported by the flow meter. The WAS volume and WAS cycle frequency will be set points preset for various plant modes such as storm or diurnal, and operator adjustable within wide ranges. The RAS flowrate will be similarly preset based on plant mode and adjustable. The chemical pump settings and control are described in the section above on Chemical Feed Pumps. Pumps will shut down when the 3 way plug valve is actuated. To save energy it is best to not run WAS cycles simultaneously, however the pumps can handle this operation and will remain in normal operating range.

The valves that connect the aerobic zone to the inlet main are manually operated to proportion the flow and do not have electronic position indicators. Operators will adjust them by hand based on the impact that flow has on treatment outcomes and oxygen levels in the anoxic zone. A 3 inch ball valve with locking position handle is used to activate and modulate the flow from the aerobic zone. The clarifier collection pipes are always online and have only isolation valves at the pump inlets for maintenance.

Pumps will have alarms for temperature, moisture in windings, and current overload reported by the SCADA system. The status of the pumps, chemical feed pump, 3 way valve position, and flow meter will be reported and recorded continuously. In the event of a control failure the pumps can be set to run at a given rate manually. The 3 way valve can be manually switched to waste as needed.

4.7.4 Backup RAS Pumping System

An air powered backup RAS system for each bioreactor is included in the proposed plant. The system is simple and low cost and could keep the plant operating if the RAS / WAS pump station is offline for any length of time. The backup system consists of a branch main from the inlet pipe to the anoxic zone. There the branch goes through the bioreactor wall and turns upward going almost to the water surface. The system is activated manually by turning on the air line to the vertical pipe via a 1/2 inch ball valve and manually opening a 4 inch plug valve in a valve box at the pump station inlet main. No automation or monitoring is associated with the air lift backup systems.

4.7.5 Pump Station Construction

The pump station is necessary to run the new treatment trains and must be completed by the time they are to be commissioned. The sludge forcemain will have to be temporarily plumbed to the existing sludge settling tank for use during commissioning and startup and until the proposed sludge settling tank is brought online. Otherwise the pump station construction should be relatively straightforward since there are no conflicts with the location and it is a relatively simple system.

4.8 Sludge Management System

The sludge settling tank and supporting equipment serve as a storage and processing unit for waste activated sludge and scum solids from secondary treatment. The primary function is to make a place to store sludge as it is thickened by gravity settling and stabilize the sludge by digestion. As the sludge settles the liquid above clarifies and is removed by pumping. This decanting process substantially reduces the volume of sludge being pumped to the existing drying beds.

4.8.1 Sludge Settling Tank

The sludge settling tank (tank) has a volume of 60,000 gallons, approximately 60 percent more than the existing tank. The circular tank is 24' in diameter and 29' feet deep with 1' 0" freeboard at the overflow invert elevation. The tank will be constructed of reinforced concrete with cast in place seals at construction joints. Because the tank is almost completely below grade on one side and exposed on the northwest side it will act as a retaining structure to the hillside and other structures in the vicinity. A structural engineer will design the tank with consideration to the variable loads of full versus empty and saturated versus unsaturated lateral earth pressure.

The tank will have a galvanized steel deck on the southeast side for operators to manage the system. A davit crane located there will raise and lower the pump to allow for decanting and sludge pumping operations. There will also be a series of manually operated valves at hand to turn on and off the air system and direct flow to the decant or sludge disposal forcemains. See Sheets C22 and C23 for imagery of the tank and appurtenances.

4.8.2 Sludge Settling Tank Connections

The connections to the sludge settling tank and the fittings, valves, and accessories are planned to be ductile iron pipe (DIP) with flanged connections above grade and restrained mechanical joints below grade. The inlet piping to the sludge setting tank is the 3 inch WAS forcemain. It discharges through a duck bill check valve to prevent backflow. The discharge point is near the top of the tank to prevent the new sludge from churning up the lower, settling sludge already in the tank when the WAS cycle runs. A layer of decant water over the settling solids will mitigate mixing due to falling water. A variable height discharge pipe may be considered in final design to allow adding new sludge at a variety of tank levels to minimize disturbance of the tank contents.

Discharge from the sludge settling tank will be via pumping with the pumped decant or sludge material being sent to the selected forcemain by manual valves located at the top of the tank wall adjacent to the operator platform. Two 3 inch plug valves are proposed. The 40 to 50 foot, 3 inch decant forcemain is active when the first is open and the pump is running. It discharges to the splitter box with a duckbill check valve. The 3 inch sludge forcemain is active when the second valve is open and the first is closed. The proposed sludge forcemain connects to the existing sludge forcemain to the drying beds to the west of the plant site.

The sludge settling tank overflow penetration discharges into Equalization Basin 2 because of the its proximity. Alternatively, this could discharge to Equalization Basin 1. The overflow is intended to only be used when the sludge tank is over filled on error and will sequester the excess sludge in the basin to give operators time to manage it without creating a spill or other emergency.

4.8.3 Sludge Pump

The submersible sludge settling tank pump is the same make and model as the lift station pumps. The pump faces almost identical TDH conditions and the sludge is not so thickened that it will affect the pumps operation. The non clog features and having to stock only one spare pump in stock for both plant systems will simplify and streamline maintenance. The pump hangs from the davit crane installed on the tank wall at the operator platform. The crane will be used to lower and raise the pump to decant supernatant off the upper column or pump sludge off the bottom of the tank. A flexible pressure hose connects the discharge flange of the pump to the NPT threaded connection at the top of the tank wall near the forcemain valves. The pump will operate manually on or off by the operators. A local timer system included in the controls will shut the pump off after the set time is expired.

4.8.4 Sludge Settling Tank Aeration and Mixing

The sludge settling tank is equipped with an air system. Coarse air diffusers, the same type used in equalization, are arrayed across the tank bottom to evenly release air for mixing or aeration as needed to stabilize the sludge. Air is turned on or off by operators via a manual ball valve at the tank wall near the platform. Diffusers will be installed on two or more manifolds to allow individual manifolds to be removed for cleaning, inspection, or replacement while the sludge settling tank has sludge in it and while the other air manifolds remain functional.

4.8.5 Sludge Settling Tank Effluent and Sludge Disposal

The 3 inch sludge disposal forcemain will be connected to the existing, Sch 40, PVC, 4 inch sludge forcemain to the drying beds. The plant sludge disposal forcemain is currently a pumped system. In the project design this will continue to be the case and the proposed pump is estimated to operate within the normal operating range for the application. The 4 inch forcemain parallels the existing outfall main through the wetlands. Some of the upper forcemain was replaced with the upper portion of the outfall main around 2015.

4.8.6 Sludge Settling Tank Instruments and Controls

The sludge settling tank has a radar level sensor and oxygen sensor connected to the SCADA system for alarms. The pump motor will also be monitored for alarm conditions based on its moisture and temperature sensors and overload conditions. The aeration system is manually operated and has no instruments or controls connected to the SCADA system. The decant and sludge forcemain valves are also manual without position indicators. No means is planned for measuring flows from the sludge management system although decant water is measured by the flume on entry and the secondary flow meters prior to the outfall. A control system failure would not affect operation of the sludge management system and only the monitoring and alarm data would be lost during the outage.

4.8.7 Sludge Settling Tank Construction

The sludge settling tank needs to be online to receive sludge from the new bioreactors in order to take the existing bioreactor basin offline for refurbishment. The tank is built into a slope comprised partly of fill of unknown stability. It is recommended tank be constructed concurrently with the lift station wet well while the existing bioreactor basin is still being used for sludge management but secondary treatment is being done by the new treatment trains.

5.0 ELECTRICAL, CONTROL, AND INSTRUMENTATION DESIGN

The electrical, controls, and instrumentation system design has been developed to support the equipment and devices selected and laid out by the civil design team. We have utilized a two-step approach to preliminary design that provides an efficient and effective means to evaluate and execute this task. This approach has been used successfully on numerous water and wastewater projects throughout California and beyond. The information presented in the document will be the foundation for the final design task. Our approach is outlined below.

5.1 Step 1: Develop Process and Instrumentation Diagrams (P&IDs)

These drawings are presented as I series drawings I001 thru I910 and based on the information included within the Process Flow Diagram (PFD) designed by the civil design team. P&IDs are the basis of the electrical, controls, and instrumentation system design. These drawings include typical diagrams and detailed design information such as programmable Logic Controller (PLC) inputs and outputs (IO). IO for each anticipated electrically driven piece equipment, process monitoring, and control device are presented on these drawings. P&IDs are also used to create instrument and equipment schedules, electrical load calculation, and conduit and conductor schedules.

Equipment numbering is an important aspect of the development of the P&IDs, this numbering system is utilized throughout the electrical, controls, and instrumentation system design. Unique numbering for all devices and equipment are crucial for the development of the Supervisory Control and Data Acquisition system (SCADA) that will be provided as part of the completed project. Aside from system design tasks and SCADA, these numbers are often utilized for Operation and Maintenance (O&M) tasks including equipment inventory and Computerized Maintenance Management Systems (CMMS).

5.2 Step 2: Develop Single Line Diagram and Load Calculations

These drawings are presented as E series drawings E001 thru E007. These drawings are based on the information and equipment schedules gleaned from the P&IDs. Equipment Horsepower (HP) provided by the civil design team and other electrical loads are utilized during this step of the predesign to develop the electrical system load calculation. This information is used to create single line diagram that are in turn used for Motor Control Center (MCC) design, standby generator and utility service sizing. During final design, these schedules will be important for the development of conduit and conductor schedules.

5.3 Site Power

5.3.1 Existing Site Power

Electrical power is provided to the site by Sothern California Edison (SCE). The existing utility system is made up of three 50kVA pole mounted transformers with secondary windings arranged in a Wye configuration. These transformers feed an underground 400-amp three phase 277/480-volt Main Switchboard (MSB). MSB includes a utility metering section and 400-amp service disconnect housed in a 90 inch tall floor mounted structure. The 400-amp MSB feeds a wall mounted 400-amp Automatic Transfer Switch (ATS) ahead of a wall mounted 400-amp distribution panel. During failure of the utility power, a standby 125 kW Onan diesel generator capable of producing 188 amp of power is provided. The 400-amp distribution panel serves an MCC and lighting transformer in the main building, and a MCC located in the pump room. Some of this equipment is from the original project with major improvement implemented around 1999. Due to the age of some of the equipment, and constructability concerns, most of the exiting equipment is recommended to be replaced. Exact details of demolition will be provided as part of the final design.

5.3.2 Utilization of Existing SCE Utility Service

Based on our findings and calculations, the existing 400-amp 277/480 volt utility service will adequately service the proposed improvements. The exiting service will be loaded to approximately 63% when all proposed and existing loads that will remain are considered. Good engineering practice, and equipment limitations, limits the maximum load on the utility service main breaker to 80%. The maximum load allowable for the existing service would be 320 amps. Table 9 below, shows the existing service will be loaded with approximately 251 amps, or 63% of capacity. This value is well below the 80% limit and allows for additional loads if determined necessary during final design or future expansion.

Table 9: Electrical Service Load Calculations

SERVICE LOAD CALCULATION					
LOAD CENTER: MSB-100 (E)		480 VAC, 3 PHASE		4-WIRE	
FED FROM: SCE OH UTILITY		CONNECTED		UTILITY	GENERATOR
EQUIPMENT DESCRIPTION		LOAD AMPS	LOAD (KVA)	RUN (KVA)	RUN (KVA)
MCC-100	MOTOR CONTROL CENTER 100	216.9	216.9	219.8	165.7
SUBTOTAL (KVA)			216.9	209.0	165.7
SUBTOTAL (AMPS)			260.9	251.3	199.3

UTILITY:		GENERATOR:		
SERVICE SIZE	251 A		SERVICE SIZE	199 A
MAIN BREAKER SIZE	400 A	GEN SIZE (kW)	200	301 A
% LOADED	63%		% LOADED	66%

5.3.3 Proposed Power Distribution

Power distribution for the proposed improvements will be proved from the new MCC-100 and a Power Panel PP-100. The primary function of MCC-100 is to house motor control equipment and devices while the Power Panel distributes power to stand alone equipment such as the existing headworks equipment and proposed Motor Operated Valves (MOVs). The exact configuration of this equipment may change because of the final design considerations. For example, if a Bio Reactor System is selected that is provided with vendor control panels, the Anoxic Mixers may move from the MCC as currently shown, to be fed from the Power Panel. Total loads are not expected to vary, only the location of the power distribution source. This is done to reduce costs as MCC space is considerably more expensive than circuit breaker space in a power distribution panel. The proposed layout for the MCC-100 and PP-100 can be found in the E series drawings. Electrical load calculation for this equipment is shown below in table 10 and 11 respectively.

Table 10: MCC-100 Load Calculation

LOAD CALCULATION										
LOAD CENTER: MCC-100				480 VAC, 3 PHASE SERVICE			3-WIRE			
FED FROM: ATS				CONNECTED			UTILITY		GENERATOR	
EQUIPMENT NUMBER	HP KVA	MOTOR CONTROL	EQUIPMENT DESCRIPTION	LOAD (AMPS)	QTY	LOAD (KVA)	RUN QTY	RUN (KVA)	RUN QTY	RUN (KVA)
PMP4011,2	3	FVNR	EQ LIFT PUMPS 1 & 2	4.8	1	4.0	1	4.0	1	4.0
BLR5011~3	40	SSRV	BLOWERS 1 - 3 (2(E) 1 (N))	52.0	3	129.7	3	129.7	2	86.5
MXR7121	5	FVNR	ANOXIC MIXER 1A	7.6	1	6.3	1	6.3	1	6.3
MXR7221	5	FVNR	ANOXIC MIXER 1B	7.6	1	6.3	1	6.3	1	6.3
PMP8111~3	3	VFD	RAS PUMP 1A - 3A	4.8	3	12.0	2	8.0	2	8.0
PMP8211~3	3	VFD	RAS PUMP 1B - 3B	4.8	3	12.0	2	8.0	2	8.0
PMP8011,2	3	FVNR	SLUDGE SETTLING TANK PUMP	4.8	1	4.0	1	4.0	1	4.0
PMP9011	2	FVNR	PLANT WATER PUMP	3.4	1	2.8	1	2.8	1	2.8
PP-100		CB	POWER PANEL		1	19.8	1	19.8	1	19.8
LP-100		CB	LIGHTING PANEL		1	12.5	1	12.5	1	12.5
SUBTOTAL						209.4		201.5		158.2
LARGEST MOTOR @ 25%				40	HP			10.8		
TOTAL								212.3		158.2
			3 PHASE CURRENT	255 AMPS						
				100% MAXIMUM LOAD CURRENT						
			CALCULATED SERVICE SIZE	255 AMPS						
			MAIN BREAKER SIZE	400 AMPS						
			% MAIN BREAKER LOAD	64%						

Table 11: PP-100 Load Calculation

PANEL SCHEDULE - PP-100												
	LOCATION	ELECTRICAL/CONTROL BUILDI		MAIN BKR	MLO	AMPS						
	VOLTAGE	480		SYSTEM	3Φ, 3W	200						
	TRIM	SURFACE		BUS RATING	225A							
				PHASE LOADS-AMPS								
CKT	LOAD	VA	AMPS	CB	A	B	C	CB	AMPS	VA	LOAD	CKT
1		1000	3.6		7.2				3.6	1000		2
3	MOG2041	1000	3.6	15/3		7.2		15/3	3.6	1000	MOV8141	4
5		1000	3.6				7.2		3.6	1000		6
7		1000	3.6		7.2				3.6	1000		8
9	MOG2042	1000	3.6	15/3		7.2		15/3	3.6	1000	MOV8142	10
11		1000	3.6				7.2		3.6	1000		12
13		1000	3.6		19.9				16.2	4500		14
15	MOG2043	1000	3.6	15/3		19.9		30/3	16.2	4500	HEADWORKS PANEL PNL-1010	16
17		1000	3.6				19.9		16.2	4500		18
19		2500	20.8		41.7				20.8	2500		20
21	LIGHTING TRANSFORM XFMR-LAB	2500	20.8	90/3		41.7		100/3	20.8	2500	MCC-EXISTING PUMP ROOM	22
23		2500	20.8				41.7		20.8	2500		24
25			0.0		0.0				0.0			26
27			0.0			0.0			0.0			28
29			0.0				0.0		0.0			30
31			0.0		0.0				0.0			32
33			0.0			0.0			0.0			34
35			0.0				0.0		0.0			36
Notes					A	B	C					
(L)	Lockout Provision Required				76 A	76 A	76 A					
(H)	HACR - Rated Breaker				9116 VA	9116 VA	9116 VA					
(G)	Ground Fault Interupt Rated Breaker				PHASE LOADS			AVERAGE	76 A			
(A)	Arc-Fault Interupt Rated Breaker				100%	100%	100%	TOTAL	27 KVA			

5.3.4 Backup Power

The proposed generator is located outside the electrical building and the existing generator room near the onsite electrical service drop. The generator will be housed in a custom manufacturer constructed and performance tested, Level 2 sound attenuating weather enclosure. Part of the decision to place the generator outside was to allow the existing plant to continue operating with the existing backup generator during construction. Building a new generator with a factory supplied housing is likely lower cost than reconstruction of the existing generator room too.

Backup power will be provided by a proposed 200kW diesel powered standby generator. This generator will be capable of providing 301 amps of backup power. The existing generator cannot provide enough power to adequately support the proposed improvements therefore will be removed as part of the improvements project. The proposed 200 kW generator will meet the current California Air Resource Board (CARB) requirements, be provided with a weatherproof sound attenuating enclosure, and critical use rated exhaust system. A subbase fuel tank will be sized to operate the generator for a minimum of 24 hours at 100 percent rated output. This generator will start automatically when the utility power is interrupted. Engine block heaters will be required to keep the generator at a constant temperature for easy starting and fast spin up during power outages, particularly important during cooler weather.

Based on the electrical load calculation presented in table 1 above, the proposed generator will be loaded to 66 percent of rated capacity. This level of loading provides ample motor starting capacity and available capacity for future expansion. It should be noted that not all plant loads are expected to operate during utility power failures. The plant control system will be utilized to shed loads during generator operation to keep the generator loaded within operating limitations. Reference Table 2 above for anticipated loads that will operate on standby power.

The proposed generator will report operational statuses to the plant SCADA system for alarms and notifications.

The operation of the proposed generator will be managed by a new delayed transition ATS located in the MCC-100 lineup. The ATS will handle scheduled generator exercising and ensure the plant power system is maintained within normal voltage and Hz operating ranges.

The ATS will report operational statuses to the plant SCADA system for electrical alarms and notifications.

5.4 Instrumentation

For the final design, analytical instrumentation should be specified to match currently installed equipment where possible. Plant operations staff are familiar with these instruments and their continued use will help simplify the transition to the new plant processes proposed for the improvements project. Currently, the plant utilizes Hach™ instruments for monitoring plant process. Hach instruments are used throughout the wastewater industry. They have a very good support system and offer local service centers to provide calibration and repair services. These existing analytical instruments appear to be in good working order. It is recommended that these devices be utilized for the improvements project. These existing instruments and proposed new instruments will be connected to the SCADA system for monitoring, control and alarm functions.

New flow meters, level and pressure transmitters, and other discrete type instrumentation devices are necessary for monitoring and control of the proposed improvements. These instruments are listed in the instrument index shown below in Table 12.

Table 12: Instrument Index

I Drawing	Tag No.	Description	Type	Specification Section	Range	Size	Power	NEMA/IP Rating
I101	LE 1051	Level Element	Ultrasonic	Existing	-	-	-	-
I101	LE 1052	Level Element	Ultrasonic	Existing	-	-	-	-
I101	FIT 1071	Flow Indicating Transmitter	Remote	40 91 02	TBD	-	120VAC	4X
I101	FE 1071	Flow Element	Ultrasonic	40 91 02	-	-	-	Class 1, DIVII
I400	LIT 4151	Level Transmitter	Radar	40 91 06	TBD	-	LOOP	Class 1, DIVII
I400	LIT 4251	Level Transmitter	Radar	40 91 06	TBD	-	LOOP	Class 1, DIVII
I400	LSHH 4152	Float Switch	N.O.	40 91 07	-	-	ISR	Submersible
I400	LSHH 4252	Float Switch	N.O.	40 91 07	-	-	ISR	Submersible
I430	LIT 5352	Level Transmitter	Radar	40 91 06	TBD	-	LOOP	Submersible
I430	LSLL 4351	Float Switch	N.C.	40 91 07	-	-	ISR	Submersible
I430	LSHH 4351	Float Switch	N.O.	40 91 07	-	-	ISR	Submersible
I430	FIT/FE 4371	Flow Meter	Magnetic	40 91 02	TBD	3"	120VAC	4X
I501	PIT 5061	Pressure Indicating Transmitter	Gauge	40 91 08	0-150PSI	1/2"	-	6P
I710	AIT 7181	Analytical Indicating Transmitter	Remote	40 91 12	TBD	-	120VAC	4X
I710	AE 7181A	Analytical Element	Dissolved Oxygen	40 91 12	0-10mg/L	-	-	Submersible
I710	AE 7181B	Analytical Element	pH	40 91 12	0-14 pH	-	-	Submersible
I710	AE 7181C	Analytical Element	Temperature	40 91 12	TBD	-	-	Submersible
I710	AIT 7182	Analytical Indicating Transmitter	Remote	40 91 12	-	-	120VAC	4X
I710	AE 7182A	Analytical Element	Dissolved Oxygen	40 91 12	0-10mg/L	-	-	Submersible
I710	AE 7182B	Analytical Element	pH	40 91 12	0-14 pH	-	-	Submersible
I710	AE 7182C	Analytical Element	Temperature	40 91 12	TBD	-	-	Submersible
I710	AIT 7183	Analytical Indicating Transmitter	Remote	40 91 12	-	-	120VAC	4X
I710	AE 7183A	Analytical Element	Dissolved Oxygen	40 91 12	0-10mg/L	-	-	Submersible
I710	AE 7183B	Analytical Element	pH	40 91 12	0-14 pH	-	-	Submersible
I710	AE 7183C	Analytical Element	Temperature	40 91 12	TBD	-	-	Submersible
I710	LIT 7151	Level Transmitter	Radar	40 91 06	TBD	-	LOOP	Class 1, DIVII
I710	FIT/FE 7171	Flow Meter	Magnetic	40 91 02	TBD	TBD	120VAC	4X
I720	AIT 7281	Analytical Indicating Transmitter	Remote	40 91 12	-	-	120VAC	4X
I720	AE 7281A	Analytical Element	Dissolved Oxygen	40 91 12	0-10mg/L	-	-	Submersible
I720	AE 7281B	Analytical Element	pH	40 91 12	0-14 pH	-	-	Submersible
I720	AE 7281C	Analytical Element	Temperature	40 91 12	TBD	-	-	Submersible
I720	AIT 7282	Analytical Indicating Transmitter	Remote	40 91 12	-	-	120VAC	4X
I720	AE 7282A	Analytical Element	Dissolved Oxygen	40 91 12	0-10mg/L	-	-	Submersible
I720	AE 7282B	Analytical Element	pH	40 91 12	0-14 pH	-	-	Submersible
I720	AE 7282C	Analytical Element	Temperature	40 91 12	TBD	-	-	Submersible
I720	AIT 7283	Analytical Indicating Transmitter	Remote	40 91 12	-	-	120VAC	4X
I720	AE 7283A	Analytical Element	Dissolved Oxygen	40 91 12	0-10mg/L	-	-	Submersible
I720	AE 7283B	Analytical Element	pH	40 91 12	0-14 pH	-	-	Submersible
I720	AE 7283C	Analytical Element	Temperature	40 91 12	TBD	-	-	Submersible
I720	LIT 7251	Level Transmitter	Radar	40 91 06	TBD	-	LOOP	Class 1, DIVII
I720	FIT/FE 7271	Flow Meter	Magnetic	40 91 02	TBD	TBD	120VAC	4X
I810	FIT/FE 8171	Flow Meter	Magnetic	40 91 02	TBD	TBD	120VAC	4X
I820	FIT/FE 8271	Flow Meter	Magnetic	40 91 02	TBD	TBD	120VAC	4X
I850	AIT 8581	Analytical Indicating Transmitter	Remote	40 91 12	-	-	120VAC	4X
I850	AE 8581	Analytical Element	Dissolved Oxygen	40 91 12	0-10mg/L	-	-	Submersible
I850	LIT 8551	Level Transmitter	Radar	40 91 06	TBD	-	LOOP	Class 1, DIVII
I880	AIT 8881	Analytical Indicating Transmitter	Remote	40 91 12	-	-	120VAC	4X
I880	AE 8881A	Analytical Element	Electrical Conductivity	40 91 12	0.1-200 uS/CM	-	-	Submersible
I880	AE 8881B	Analytical Element	pH	40 91 12	0-14 pH	-	-	Submersible
I880	AE 8881C	Analytical Element	Temperature	40 91 12	TBD	-	-	Submersible
I910	ZS 9191A~J	Intrusion Switch	snap action		-	-	24VDC	1
I910	ZS 9192	Intrusion Switch	snap action		-	-	24VDC	1
I910	LSL 9189	Level Switch	-	26 32 13	-	-	-	-

The Instrumentation and Control Strategies discussed elsewhere within this document provide detailed explanation of the anticipated monitoring and control features. Signals from the instrumentation discussed in this section will be heavily utilized for monitoring and control of the proposed improvements. O&M on these instruments will be crucial for precision control of the plant processes moving forward.

5.5 Plant SCADA (Supervisory Control and Data Acquisition)

In a SCADA system for a wastewater treatment facility, many components work together to monitor and control various processes involved in treatment and management of wastewater. Following, is brief breakdown of these components:

5.5.1 Programmable Logic Controller (PLC)

PLCs are used to control field devices and execute control logic. They collect data from sensors and other field devices and send commands to equipment such as motors, pumps, and valve actuators. The PLC for this project will be installed within Control Panel CP-100 located in the electrical room of the new control building. PLC programming will reside within the PLC to automate and optimize the operation of the wastewater treatment processes. These algorithms will include control loops, process optimization, and fault detection.

Custom PLC code will be written to execute process control as presented in the process control strategies found elsewhere within this document. In the final design, these strategies will be further embellished by the electrical and controls design team for use by the SCADA system integrator to develop the SCADA system. SCADA integration development and deployment is discussed in more detail later in this section.

5.5.2 Field Devices

Numerous field devices will be required for monitoring and control of the treatment process. All the devices required for process monitoring and control for this project are presented on the P&IDs within the pre-design drawings set. These devices include:

Sensors: Measure physical parameters such as flowrates, levels, pH, turbidity, and temperature. Common sensors include flow meters, level sensors, pH sensors, and dissolved oxygen sensors.

Actuators: Perform physical actions based on commands from the SCADA system, such as opening or closing valves, starting or stopping pumps, and adjusting chemical dosages. Typically, these devices also report back to the PLC to signal that the requested action has been taken.

Transducers: Convert physical measurements into electrical signals that can be interpreted by the SCADA system. Examples include pressure transducers and temperature transducers.

Switches: Change position to indicate an action has taken place. Examples include limit switches within valve actuators to indicate open and close positions.

5.5.3 Communications Infrastructure

Network: Facilitates communication between different components of the SCADA system, including field devices, PLCs, SCADA and Data Servers, and the Internet for remote access and alarm notification. This can include wired networks (Ethernet, fiber optics) and wireless networks (radio, cellular). Due to the relatively small footprint of this facility, a wired Ethernet network will be utilized.

5.5.4 SCADA Servers

Servers: Host the SCADA software, databases, and communication services. At a minimum, two servers will be provided. The first server will support the Human-Machine Interface (HMI) (see below), Reporting and alarming software. The second will host the data historian software and backup tool. These servers will reside in the control room in the new control building.

5.5.5 SCADA Software

Human-Machine Interface: Provides a graphical user interface for operators to interact with the SCADA system. It displays real-time data, alarms, and control options, thus allowing operators to monitor and manage the wastewater treatment processes. The HMI software will utilize custom developed screens which display data points within the PLC. The data points that are anticipated to be included within the graphics screens are shown on the P&IDs in the “SCADA OI Display” banner. Various screen captures of custom SCADA graphics examples are presented at the end of this section.

Data Historian: Stores historical data collected by the SCADA system. This data will be used for trend analysis, reporting, and performance monitoring.

5.5.6 Alarm and Notification Systems

Alarms: Generate alerts for abnormal conditions or deviations from normal operating parameters. They are configured to notify operators of potential issues requiring immediate attention. The anticipated alarms that will be configured for this project can be found on the “Alarm Call-Out” banner of the P&IDs.

Notification Systems: Can include email, SMS, or automated phone calls to alert personnel about critical events. From our experience, we have found the most useful alarm notification method to be SMS texts.

5.5.7 Data backup and Recovery System

Backup Solutions: Ensure that data is regularly backed up to prevent loss in case of system failure or data corruption. This function will reside on the data server and synchronize data storge to onsite or off-site storage media. The final method for data backup will be discussed with plant operation staff during final design.

Recovery Plans: Outline procedures for restoring system functionality and data in the event of a failure or disaster. This is one of the most commonly overlooked features of a well-designed system. Whether backup data is stored on or off site, Standard Operating Procedures (SOP) for system restoration is critical for rapid repair of a failed component.

5.5.8 Security Systems

SCADA systems play a crucial role in monitoring and controlling treatment processes by gathering real-time data and issuing commands to control processes. As these systems increasingly become interconnected and rely on network communications, they face significant security risks. The protection of SCADA systems is paramount to ensure the reliability and safety of the plant and public health. Detailed recommendations for the design and implementation of SCADA security systems are beyond the scope of this document. If the reader wishes to familiarize themselves with recognized security criteria, we recommend the Cyber Security Guide published by AWWA. Key aspects of the security system include:

Firewalls and Network Intrusion Detection Systems: Protect the SCADA network from unauthorized access and cyber threats. Staying current with OS and SCADA software patches and security updates are very important. It is recommended that the district engage in a service contract with the system integrator for regular SCADA system maintenance.

Access Controls: Manage user permissions and authentication to secure the system from unauthorized users. This is one of the most neglected aspects of security. We often find operators sharing logins and passwords. Sticky notes with login credentials pasted to the SCADA computer display are not uncommon. We recommend a policy for strict access control be implemented by the district.

Intrusion Detection: Senses when critical workspaces and control equipment doors are opened. We have included several intrusion detection door switches in the pre-design. Use of intrusion detection switches may be expanded as refinements are made to the final design. These devices can be found on drawing I910 of the P&IDs

5.5.9 SCADA System development and deployment

Various options for the development and deployment of the SCADA system are available. We have seen these options utilized with varying success. These options include:

SCADA System included in the bid documents: This option is often the least costly. However, your system will be developed and commissioned as part of a low bid contract. As SCADA system are typically developed and deployed at the end of a project, contractors maybe low on funds and looking for areas to cut cost. We have seen this work well on the project. We have also seen on projects and the result is a system that is just OK. It is all dependent on the contractor.

SCADA system cost included as an allowance in the bid documents: This option allows the district to preselect a SCADA integrator for a fixed cost. This cost is then included in the bid documents. We have seen this option work very well. One drawback is that some system integrators do not wish to be under contact with the low bid prime contractor. Also, the prime contractor will add overhead and profit to the allowance so the cost will be higher.

SCADA system included as a part of engineering services during construction: This is often the costliest option. It does ensure the best result as the system design team has a vested interest in outcome of the project. It is our recommendation to use this option if funding can be secured. If this option is selected, selection of the final design engineering teams SCADA capabilities should be considered.

5.5.10 Conclusion

The complete SCADA system design will be included within the final design specification documents. From our experience with various SCADA software application, it is recommended that Ignition™ developed by Inductive Automation be specified and implemented for this project. Ignition™ has been developed as a cost-effective graphical interface into the plant process environment that includes process control, alarming, process trending, historical data trending and reporting as core elements without the need to utilizing third party applications.

High performance graphics are recommended and have become the standard for treatment plant SCADA systems. The graphics below present various screens developed utilizing high performance graphics. Project specification should be developed for the final design to ensure SCADA graphics of this functionality and quality are provided at a minimum. There are detailed product data and screen shots for the Ignition SCADA in Appendix E.

5.6 Control Building

The proposed electrical control building is also a new office and operations facility. The 36' L x 24' W, single story structure will have 9 foot ceilings throughout. It is located at the southeast end of the recently acquired parcel area near the proposed entrance gate. A six space parking area will be situated in front of the building just inside the entrance. Sidewalks and landscaped areas circle the building leading to the electrical equipment and the main entrance on the east side. The proposed generator is located in the back (north side) and the bioreactors are outside the electrical room to the west.

The electrical building will be constructed of concrete block for long term low maintenance durability. It will rest on a reinforced concrete slab foundation with several grade beams in each direction. The roof structure is light timber or steel framing with an insulated envelope secured from the elements by a galvalume sheet metal roof system. These building materials are selected for longevity and fire resistance as well as for decades of low or no maintenance use. Other building details and cladding should keep these parameters in mind during full design and construction.

The building houses the proposed controls for the project along the north wall in a single 24 foot long panel bank. The room has a 5' 0" double commercial door on one end and the required 42 inch clear space in front of the panels. A 3' 0" commercial door midway across the room leads into the rest of the building. The electrical room has a space about 11 feet along the wall opposite the panels that can be used for storage and future SCADA system expansion needs.

The majority of the building is comprised of new office space and other facilities for operator use. There is a small conference room in the southwest corner with double doors and several windows. This space would likely also be used as a break room and media room for the facility. To the north a small galley kitchen shares space with a large storage cabinet for supplies and records. Across the common walkway to the east there is an ADA bathroom and 3' x 4' closet for additional storage. Centered on the east wall facing Apela Drive is the front entrance which has an office area and coat closet. The southwest corner overlooking the driveway is a private plant operator's office.

The building will be climate controlled to protect the electrical panels from heat and moisture and ensure the comfort of occupants. A small water heater will provide hot water for the kitchen and restroom. The building will be wired to code with 120 v power. The plant land line and internet connection will be housed there and a router will provide plant-wide Wi-Fi.

6.0 PROJECT CONSTRUCTION STRATEGY

6.1 Site Civil Work

At the start of any construction project an assessment of the civil tasks is necessary to properly plan for them and integrate them into the construction schedule to ensure a timely and successful project. Besides the administrative tasks and engineering services during construction there are civil project tasks that must be done to facilitate a successful project. Some of these are included in the Agreement for the Contractor to accomplish. Others are best kept for the Owner and their supporting consultants to do to keep a check on the Contractor's quality and progress.

6.1.1 Clearing Trees

As construction begins several large and smaller trees will be removed from the site. The County requires a permit to cut down trees and it is anticipated that permit procurement will be part of the tree cutting Contractor's duty. Due to storms and fires many large trees have already been removed in the construction zone. It may be best to cut trees under a separate agreement prior to the construction of the Project. If done during the Project, the additional tress to be cleared will be noted in the drawings. Consideration should be given to protecting the new facilities and buildings when deciding which tress will be removed. Additional trees can be planted during landscaping to beautify the grounds or screen the new WWTP facilities from view.

6.1.2 CEQA Compliance

The environmental permitting phase of the Project is complete and during construction the mitigation conditions must be adhered to. The most notable requirement is for biological monitoring during certain seasons and cultural monitoring during ground disturbing activities. It is anticipated that biological monitoring will occur between February 1 and August 31 prior to the initial phases of construction when trees are removed and the areas are to be graded, cleared, and grubbed. Tribal cultural monitoring will be performed by a representative of the Cahuilla Band of Indians stationed onsite. IWD will pay the monitor for the work out of the Project budget and this monitoring will likely be longer in duration compared to the biological monitoring. The monitoring may last for almost the entire Project schedule depending on the agreement between the parties and the construction schedule for excavations. It may be possible to limit the time somewhat by coordinating with the Cahuilla Band of Indians to monitor only when earthmoving activities are underway since the project has multiple phases and may have lengthy periods of commissioning and startup activities that do not involve excavation or other ground disturbance. The other aspects of the CEQA mitigation strategies are fairly routine best management practices (BMPs) and involve reductions of noise, dust, pollution, and other hazards for both people and the environment. These requirements are summarized in Appendix B of the CEQA documents attached to this Report (in Appendix C).

6.1.3 Site Survey and Staking

The site will need to be surveyed to confirm property lines and elevations and maintain horizontal and vertical control. It is recommended that a preconstruction survey be done on the Owner's behalf to confirm the recent parcel boundaries are accurate and the elevations on the plans match fixtures on the site. This survey may also establish a bench mark for the Contractor to use during construction. While construction is under way the Contractor typically maintains vertical and horizontal control over the site and new facilities being built using his own personnel or a hired survey crew. The Owner should anticipate checking the Contractor's work on critical elevation facilities as the work progresses and certainly prior to acceptance of any given features. These surveys during progress should be formally recorded and done by a licensed surveyor since subsequent construction activities or unusual settlement can result in warrantee claims. The initial Owner's survey may be done as part of the services rendered under full design planning.

6.1.4 Site Grading

Site grading is going to be extensive for the new facilities foundations but will not result in the final grades changing very much. Due to the shallow rock formations there is some potential for extra effort to be required to excavate for the lower foundations such as the bioreactors. As much as possible these risks need to be addressed in the Contract Documents to avoid change orders and schedule delays. Additional measures should be considered in the design such as reappropriating excavated stones as rip rap and boulders in the final grading and landscape design. This can reduce costs twice by not having to remove materials from the site and not having to import materials where fill may be called for. Material management strategies like minimizing foundation depth should be a included in the design for every major earth moving activity of the Project.

6.1.5 Geotechnical Monitoring

When key facility foundation subgrades are excavated it is advisable to have the geotechnical engineer of record visit the site and inspect conditions for conformance to the design and recommendations in the geotechnical report. The large tanks being built on the rocky slope have foundations that span many feet of depth profile. Improper preparation and construction of the subgrade can result in differential settlement in cases like these. During complete design the foundation plans are meant to fully mitigate the problems that can arise in these conditions. However, it is recommended that the geotechnical engineer observe the subgrade over-excavation and preparation prior to placing concrete for the larger tank footings.

6.1.6 Drainage and Erosion Control

The proposed plant will result in concentrated runoff during precipitation events from rooftops and pavements. The Project site is on a hill side with shallow rock formations and limited forest growth. Natural drainage channels surround the lower sides of the site. The Contractor will have to maintain the site during construction to protect these drainages. The complete design needs to take these site conditions into consideration when detailing final grading and drainage for new roof top and hardscape conditions. Basic mitigations such as infiltration basins, swales, erosion prevention measures, and culverts will be incorporated into the grading plans to protect the natural environment from runoff at the proposed plant.

6.2 Construction Items

Much of the discussion below is outlining how to approach the construction in very general terms. The goal is not to define the construction here but to set an agenda for dialog between IWD and their Engineer. This dialog is to determine an agreeable plan to approach the project and incorporate the plan in greater detail into the contract documents during design completion. The full design will result in a set of contract documents for bid and these items should be previously settled by IWD and their Engineer to present a unified expectation for the process while construction is underway.

6.2.1 Construction Sequencing

The Project by its nature requires that the existing plant continue operating until commissioning and startup is complete on the proposed facilities. This will necessitate provisions in the contract to coordinate efforts between the Contractor’s team and IWD operators to accomplish this imperative. The design has to incorporate and allow for construction and startup of new bioreactors prior to stopping the operation of the existing bioreactor. Water treatment outcomes must be met continuously throughout the construction process. A rudimentary sequence of construction to achieve this is listed below:

- Clear and grub site as needed for new facilities.
- Install perimeter fencing to secure the site during construction.
- Prepare subgrade and construct proposed bioreactor tanks, controls building, generator, and RAS / WAS pump station.
- Construct the splitter box, flume, and influent mains and manholes while making provisions for temporary connections as needed to existing systems.
- Complete the control building and allow the Owner to occupy so that renovation can proceed in the existing building.
- Install new blowers and aeration piping to all bioreactors, commission and switch over to new air system. Renovate existing building per plans.
- Commission and start up the new bioreactors (run concurrently with existing bioreactor for 30 or more days).
- Remove the existing bioreactor (and generator) from service, keep the sludge processing portion online temporarily. Renovate existing RAS pump house per plans.
- Construct, commission, and startup the proposed equalization lift station and sludge settling tank.
- Decommission the existing bioreactor tank and renovate to be an equalization basin.
- Complete all improvements, grading, and landscaping to the satisfaction of IWD.

This list generally outlines a strategy for getting the new plant built and operational while running the existing plant. The following sections have additional information on the construction sequence.

It cannot be stressed how important it is to have a plan for operations and commissioning agreed to, in writing, with the Contractor prior to starting the onsite activities. This agreement can be included in the Contract Documents or procured via Contractor submittal process or any hybrid of these options. It is unadvisable to approach this haphazardly during construction.

6.2.2 Project Demolition

The demolition portion of the Project will be spread out across the construction sequence. Most demolition activities cannot begin until new project components are constructed, commissioned, started, and probably accepted. For example the existing aeration blowers cannot be stopped until the new ones are online and attached to an air distribution system that can take over the operation at the flip of a switch. In all likelihood one new blower will be brought online as one is removed in a sequence until the two existing blowers are replaced by three new ones. Many plant components will be managed this way and this will impact the Project costs, schedule, and management strategy. The demolition and commissioning specification section(s) should clearly define the actions expected by IWD from the Contractor.

6.2.3 Temporary Operation of Existing Plant

A specification section has been allocated to temporary WWTP operations. It is expected that IWD staff will continue to operate the plant during construction. This specification section will define what type of standby equipment, monitoring, personnel, temporary connection materials, etc. the Contractor must provide to IWD when building and maintaining the temporary connections, equipment, power, and controls needed to allow them to build the new plant within the same site as the existing plant. The section may also include limits on the time of year or weather that permit certain construction activities affecting the plant operation.

6.3 Plant Startup and Commissioning

Due to the sequential stages across this project scope the commissioning and startup tasks will be dispersed throughout the project schedule. Commissioning means the testing and proving of new equipment and facilities to demonstrate they have been constructed to the full requirements of the Contract Documents and they are completely finished and ready to be placed in service. This occurs prior to Owner acceptance. Startup means the placement of new equipment and facilities into their intended service. Owner acceptance can precede or follow startup activities. It is advisable that a reasonable amount of time be given to startup to allow operators to become familiar with and confident in the new systems prior to acceptance. Acceptance is typically the time when the warranty period begins for new construction. These handoff points and proving periods should be stipulated in writing within the project Specifications or other Contract Documents

7.0 PROJECT PLANNING OUTLOOK

The next step in the IWD WWTP Project is to pursue funding and complete the design. The funding application has already begun under an agreement with SUSP Engineering and this Report will be part of the technical documentation to support the application. The completed design will pick up where this preliminary engineering effort leaves off and fill in details of the proposed plant. Project planning steps include: writing upfront bid documents, formulating technical specifications for products and construction that meet IWD standards and goals, and rendering drawings to 100% level, resulting in a fully developed set of bid documents ready for implementation. An updated engineer's estimate of project cost will be part of the full design effort.

7.1 Design Status

The current project stage has resulted in the Preliminary Engineering Report, 30% Drawings, Technical Specifications TOC, and preliminary engineering level Construction Cost Estimate.

Much of the civil project work was completed during the preliminary engineering stage. This includes geotechnical engineering report, CEQA surveys and documentation, land acquisition, topographic surveying, and funding research and application package assembly. Having these tasks completed will make the design stage of the project that much more efficient. In the following stage every part of the project described and all preliminary product selections and engineering calculations and estimates must be revisited to insure full compatibility and applicability to the intended purpose and IWD goals. Each plant system must be evaluated and the design must incorporate all interfaces between existing and proposed system components. Additional specialty engineering professionals will detail the structural, electrical, HVAC, and controls aspects of the design. The plans and specifications will go through several iterations on course to a final product with review periods for IWD at multiple points.

7.2 Project Design

The complete Project design is the next stage in the process of IWD implementing a new WWTP. Design during funding procurement is recommended to hasten the process and align funding awards with the project cycle. As detailed below, complete design can mean up to permitting or bidding or even include bid support all the way to contract award. It is up to IWD in coordination with their design team to define the Project steps and make agreements to achieve them.

7.2.1 100% Drawings

The 100% Drawings set becomes the cornerstone of the Contract Documents. They will be submitted for permits and after the permit conditions are incorporated into the planset, they are called the Bid Set and released for procurement. Once a qualified and fully vetted Contractor is selected, another planset is often released incorporating changes made by addendum during bidding and called the Construction Set. The full design Drawings developed in the next Project phase will stop at 100%, Bid, or Construction depending on the preference of the Owner and their agreement with the designer.

In the process of developing a 100% Drawings set there will be lesser plansets developed for review and consideration by IWD. Typically a 60% and 90% planset is used to allow the Client to review the progress and direct edits implementing their goals for the Project. Additional review periods are perfectly acceptable depending on the level of oversight and input the Owner wants to expend on the Project design. The goal for the designer is always to have good communication with the Owner to ensure minimal comments on preliminary submittals. Each agreed milestone planset is reviewed internally by the Owner and then comments are addressed by the design team prior to release for other uses. Subsidiary plansets will have comments addressed in the next submittal version.

7.2.2 Design Engineering Specialties

There are several parts of the design that require specialized expert input to be properly designed. Although many engineering firms have broad knowledge it is rare that all aspects of the design can be accomplished by just one team. The structural engineering is a key aspect of the project to be approached by a licensed structural engineer. In the case of this project it may be more efficient to hire two separate structural engineers, one for the water bearing structures and one for the buildings. A firm specializing in electrical power, instrumentation, and controls is expected to finalize the design of all the electronic components of the Project including the SCADA system, backup power, site security, communications, and lighting. An HVAC company will be called upon to inform the design of the building heating and cooling systems. And finally a design engineering firm focusing on air supply systems will design the blowers and air distribution systems for the Project.

7.2.3 Specifications

Appendix A2 contains a list of the expected technical specifications for the proposed treatment plant described in this Report. This list is basically an excerpt of the full table of contents for the specifications portion of the bid documents of the full design. Technical specifications give detailed requirements for the product quality and construction and assembly results that become part of the agreement with the Contractor for the Project. Many districts have sets of standard specifications that can cover some of the general requirements that occur in their jurisdictions. But every project requires that the standard specs be revised to meet the specific project requirements and additional sections be written for unique parts of the project not covered by the standards. This list is to demonstrate the depth and level of effort expected during the design process and help guide stakeholders to informed decisions going forward. When a project goes to bid all the detail of the work is contained in the drawings and specifications. Anything not stated is ambiguous and up to the Contractor's discretion.

7.3 Permitting

Project permitting can be accomplished before, during, or after bidding. It can be performed by the Owner, Contractor, Engineer, or an outside consultant. It often requires a fair amount of coordination effort and time. For this reason SUSP Engineering recommends as much permitting be done prior to bidding as possible by the Owner or a consultant on the Owner's behalf. The environmental permitting process is complete and the CEQA documents are filed at the State. The project will still require a building permit from Riverside County and a generator operating permit from Southern California Air Quality Management District (SCAQMD). The proposed plant may also necessitate an operating permit update with the State Water Resources Control Board. The electrical engineer has reported that the power currently serving the site is sufficient for the proposed plant and will not need a new or adapted service drop from Southern California Edison (SCE). This will preclude needing permitting, design, or coordination with SCE which often takes over a year.

7.3.1 State Board Operating Permit

The IWD plant operates under a permit issued by the Santa Ana Region State Water Quality Control Board. The permit known as Order No. R8-2015-0028 stipulates the amount and quality of water leaving the plant among other things. One condition of the permit is that the discharger, IWD, file a 'Report of Waste Discharge' at least 140 days prior to making a material change in the "character, location, or volume" of the discharge (effluent from the plant). One of the material changes listed as material changes is "C. significantly changing the method of treatment". While the proposed plant does not change the method of treatment from a process perspective and does not expand capacity or service area, it may be considered a change from a regulatory perspective. It is recommended that IWD reach out to their regulator and get their perspective on the permit amendments and process of amendment that may be required for this Project. If required, the amendment should not impact the start date of construction but will be needed to bring the new process online.

7.3.2 Building Permit

The construction of the new plant including two buildings meant for occupancy will require a County of Riverside building permit. This permit will require submittal of drawings to the County. It may require a new conditional use permit (CUP) for the site. The permit can take many months to process due to County manpower shortages. It is recommended that the permit be applied for prior to bidding so that delays in issuance not impact the construction schedule after a notice to proceed is granted. The application for permit should be started as soon as plans are complete enough for the County to review them. A dedicated team whether SUSP Engineering or the Owner should diligently shepherd the application from submittal to issuance with the Owner paying all fees as requested to minimize the impact on the schedule and keep the process moving forward. It is not recommended to overlap the permit process with construction since permit amendments to the drawings are possible and will result in change orders and delays. Bidding the project during permitting is possible but can result in increased costs to administer bids and delays to project start.

7.3.3 AQCD Permit

The operating permit for the generator is issued by the SCAQCD. For simple backup power of a stationary generator as planned in this case, the permit is reportedly straight forward as long as use is limited to emergencies and scheduled maintenance only. The recommended course of action is to have the Contractor or Owner obtain the permit during construction. If the Contractor is selected to get this permit, it will need to be added to the contract deliverables.

7.4 Grant Funding Application

With the completion of this Report, the funding application to the State can be completed for the IWD WWTP Project and submitted. The construction application to the Clean Water State Revolving Fund (CWSRF) will then enter a queue for processing. Decisions typically take 1 to 2 years from application to award announcement plus some additional months to formalize a funding agreement. The goal of the application is to obtain grant funds for all or part of the Project construction. If partial funds are granted, additional amounts can usually be included as low cost loans. If noted in the application, construction awards can retroactively fund an agency's engineering costs for planning and design efforts.

IWD may elect to apply to the Federal government through the USDA Rural Utilities Service (RUS). These applications vary slightly in requirements and can also result in grants or loans. The RUS application can proceed concurrently with the State application. Much of the required documentation has already been produced for the CWSRF application.

8.0 PROJECT IMPLEMENTATION

8.1 Project Schedule

The Project design, including specifications and plans, is expected to be finalized by the end of the third quarter of 2025. While the funding application is being processed, the required permits can be started with the relevant agencies. After funding is secured, a bidding round will be followed by contractor selection. Formalizing an agreement. is expected to take up to three weeks.

CEQA compliance monitoring and construction administration tasks will begin and continue concurrently to construction tasks. It is expected that the construction will take approximately two years to complete including the following subtasks:

- Submittals are expected to take up to six months.
- Site preparation, including mobilization, will take up to 90 days.
- Construction of the two bioreactor tanks, air supply, and RAS/WAS pump station will take seven months.
- Construction of the control building and generator will take approximately six months.
- Construction of the splitter box, flume, and influent mains and manholes will take up to four months.
- Construction of the equalization lift station and sludge settling tank will take up to six months.

These are the critical path items that need to occur in order to keep the Project progress on schedule. The schedule is ambitious, equipment lead times and unexpected delays could extend the completion date. A critical factor will be securing construction funding, this process is known to take some time, even up to two years. A well qualified contractor with experience in WWTP infrastructure will be essential to meeting Project goals satisfactorily.

8.2 Construction Cost

The estimated cost to construct the Project is $9,908,000. The preliminary level construction cost estimate is included as Appendix G. It reflects reasoned assessment of what it would cost to build the proposed Project today. There is a 30 percent contingency associated with the cost to acknowledge the unknowns and detailing yet undone that are cannot be ascertained by an estimate at this project stage. The effect of inflation has been much more pronounced in the construction industry, especially industrial construction like this, than in the macroeconomy. This estimate takes into account inflation that has already occurred, about 50 percent in the last five years, according to the State's preferred construction estimating scaler West Coast ENR Construction Index. Future construction cost inflation cannot be estimated accurately in a time defined by such recent volatility. It may turn out that costs level off due to some economic slowing or that they continue to escalate under any condition due to heavy nationwide investment in industrial construction expected to last for the next 5 to 10 years.