Water Reclamation Facility - Master Plan

Master Plan
Executive Summary

FINAL / June 2024

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Abbreviations

AADF	annual average daily flow
City	City of Visalia
CIP	capital improvement program
CV-SALTS	Central Valley Salinity Alternative for Long-Term Sustainability
IMLR	internal mixed liquor return
MBR	membrane bioreactor
MCL	maximum contaminant level
mgd	million gallons per day
MLSS	mixed liquor suspended solids
No.	number
PFAS	per- and polyfluoroalkyl substances
PWWF	peak wet weather flow
RAS	return activated sludge
R&R	rehabilitation and replacement
scfh	standard cubic feet per hour
SRT	solids retention time
TM	technical memorandum
TWAS	thickened waste activated sludge
UV	ultraviolet
UVT	ultraviolet transmittance
WRF	Water Reclamation Facility

EXECUTIVE SUMMARY

ES.1 Introduction

The Master Plan evaluates the long-term capacity of the City of Visalia's (City) Water Reclamation Facility (WRF) using a biological process model. This sets the basis for developing the framework for improvements required to meet the WRF's long-term (20-year) needs. The biological process model was calibrated to the existing and current flow/loadings data, and then used to determine capacity deficiencies based on the projected future flows/loads, which were developed using annual growth projections. Capacity expansion projects were developed for the identified treatment processes with capacity deficiencies. A long-term capital improvement program (CIP) was developed as well.

ES.2 Background and Purpose

The City's WRF treats domestic and industrial wastewater from the City, as well as wastewater from the Goshen Community Services District. Due to the Central Valley Water Boards's adoption of the updated Water Discharge Requirements, which increased regulation on processed wastewater discharge into Mill Creek, major upgrades were implemented to divert discharge from Mill Creek. These upgrades, which were constructed in 2017, included membrane bioreactor (MBR) treatment facilities, a new digester, sludge handling facilities, and disinfection facilities to support continued discharge to the Tulare Irrigation District for agricultural uses, along with reuse at the golf course. This project made various improvements resulting in the ability to produce Title 22 compliant recycled water. It was not intended to increase plant capacity, but rather to provide process equipment to support the more stringent wastewater effluent quality requirements. Improvements made to the treatment system were designed around an annual average daily flow (AADF) of 22 million gallons per day (mgd); however, to save overall costs, some of the equipment was sized to handle an AADF of 18 mgd.

In recent years, industrial loads have significantly increased. Furthermore, an increase in water conservation efforts in residential wastewater within the City and Goshen have happened which have caused increased influent concentrations. These increased influent concentrations have had a direct impact on the WRF, which is operating near its maximum capacity when it comes to influent biochemical oxygen demand and total suspended solids. These elevated loading concentrations are putting excessive stress on some of the treatment processes and leading to disruptions and disturbances.

The Facility Plan was the first step to evaluate the current capacity of the WRF as well as the condition of the assets to develop the framework for improvements required to meet the WRF's near-term needs. The Master Plan takes it a step farther and evaluates the long-term capacity of the WRF to develop a roadmap for long-term improvements.

ES.3 Technical Memorandum 1 – Long-Term Process Performance Evaluation

This technical memorandum (TM) is an extension of Facility Plan TM 1, which provides an overview of the City's WRF, summarized historical and projected near term influent flows and loads, a plant-wide performance assessment and development of a calibrated biological process model, near term capacity needs, and capital improvement projects through 2030. This TM uses the same methodology to develop long term flow and load projections, capacity needs, and capital improvement projects from 2030 through 2044. If more information is needed on the methodology or near-term findings, see TM 1 – Near-Term Process Performance Evaluation in the Facility Plan.

In order to determine the WRF's current total capacity, a process model was used to determine the flow and loading on each treatment process using data from the plant. The model was then used to compare real-life impacts to the treatment process, and capacity ratings were used to determine if the plant could meet the projected 2044 flows.

The results of the analysis indicated that the WRF would have capacity deficiencies in the following areas:

- **MBR System:** Under the current operating conditions the MBR system is projected to reach treatment capacity at an AADF of 16.3 mgd.
- **Ultraviolet (UV) Disinfection System:** The firm capacity of the UV disinfection system will be reached at a peak wet weather flow (PWWF) of 37 mgd after the near-term expansion.
- **Anaerobic Digestion:** After completing the recommended near-term upgrades in TM 1 of the Facility Plan, the firm capacity of the anaerobic digestors will be reached at an AADF of 18.1 mgd.
- **Digester Gas Flare System:** The installed capacity of the biogas flare system will be reached at an AADF of 18.2 mgd.
- **Dewatering Screw Press:** After completing the recommended near-term upgrades in TM 1 of the Facility Plan, the firm capacity of the dewatering screw presses will be reached at an AADF of 17.6 mgd. The solid loading capacity is the limiting capacity criteria.

Six projects were identified to address these capacity issues, which are discussed TM 4 – Long-Term Project Descriptions.

ES.4 Technical Memorandum 2 – Regulatory Review

This TM presents a review of current and future regulatory requirements that may impact the City's wastewater, water reuse, and biosolids treatment and discharge. In addition, it presents a strategic plan developed to serve as a guide to adapt to the possibility of these changes.

ES.4.1 Wastewater and Recycled Water Strategic Plan Recommendations

There is a range of strategies that may be employed for addressing regulatory concerns. Source control, scientific evidence, state and national regulatory advocacy, permit changes, and treatment optimization/upgrades are all options available for preparing and responding to regulatory compliance challenges. Participation in policy development and pilot studies may provide regulatory relief for specific constituents based on scientific evidence and development of information for improved decision-making by regulators. The possible response strategies are described within the following categories:

- **Source Control** – Monitoring collection systems, identifying and eliminating pollutant sources, establishing local limits, revising sewer use ordinances, working with manufacturers on product reformulation, and supporting/enacting product bans.
- **Regulatory Advocacy** – Development of policies and regulations to provide attainable regulatory solutions that are also protective of the environment and public health.
- **Permit Changes** – Conducting scientific studies to evaluate impacts of discharges on the environment, developing site specific objectives, conducting mixing zone/dilution studies, modeling groundwater travel times and flow directions, and conducting antidegradation analyses to allow use of available assimilative capacity.
- **Treatment** – Optimization of existing facilities, modification of existing facilities, or additional treatment to reduce or remove constituents to comply with effluent limitations.

The compliance concerns and recommended strategies to address them are presented in Table ES.1. The City should continue to participate in Central Valley Salinity Alternative for Long-Term Sustainability (CV-SALTS) and track the development of maximum contaminant levels (MCLs) that could be applied to groundwater discharges.

Table ES.1 Summary of Regulatory Concerns and Potential Strategies

End Use	Regulatory Concerns	Potential Strategies to Address Concerns
Land Discharge	Nitrate and Total Nitrogen	Permit Changes, Treatment
	Salinity	Source Control, Permit Changes, Treatment
	MCLs	Source Control, Regulatory Advocacy, Permit Changes, Treatment
Potable Reuse	PFAS	Source Control, Regulatory Advocacy, Treatment through purification

Notes:
PFAS - per- and polyfluoroalkyl substances.

ES.4.2 Biosolids Strategic Plan Recommendations

The WRF stabilizes their solids through anaerobic digestion and air drying. The solids produced are classified as Class B. However, recent pathogen testing indicates the solids' pathogen concentrations meet the requirements to be classified as Class A.

The WRF is in Tulare County, where Class B biosolids land application is currently banned, requiring hauling to other counties. CalRecycle, through SB 1383, is currently attempting to overturn the Class B biosolids ban in Tulare county. If they achieve that, the following are recommended:

- Evaluate local biosolids beneficial use options.
- Consider further testing of the biosolids to determine if they can reliably meet Class A through pathogen testing and attempt to obtain Class A designation for the biosolids.

As described in the Facility Plan TM 3, the high-level cost evaluation for Class A solids processing alternatives identified that advanced digestion alternatives may be cost-competitive relative to an expansion of conventional mesophilic digestion. These alternatives could be evaluated further in a biosolids master plan.

The evaluation in the Facility Plan TM 3 also identified that technologies with the potential to treat PFAS in biosolids, such as pyrolysis and gasification, have very high capital costs and are cost prohibitive. Thus, these technologies should only be considered if potential future PFAS limits require them. Gasification and pyrolysis usually follow thermal drying of solids; however, the City could investigate whether these processes can receive air-dried biosolids, which may result in substantial cost savings. Alternatively, the City could investigate regional partnerships for processing biosolids through an advanced thermal process, given these technologies benefit from economies of scale.

Given the myriad of potential future regulatory changes that may impact the City's future biosolids management, Carollo recommends conducting a biosolids master plan to do a more detailed analysis of solids processing and biosolids beneficial use alternatives and develop a plan to adapt to these potential future changes.

ES.5 Technical Memorandum 3 – Existing Facilities

This TM summarizes the existing treatment facilities at the City's WRF. The WRF existing facilities are capable of processing and treating liquid wastewater, biosolids, and digester gas streams. Liquid wastewater entering the WRF is treated via preliminary, primary, secondary, and tertiary treatment processes. Solids are collected at various stages of the treatment train and undergo a series of solids handling processes prior to disposal. Gas streams that are generated from within the plant are treated via an onsite gas purification system and flared. The descriptions of the existing facilities were obtained from the conformed 2014 Water Conservation Plant Upgrades design drawings and the 2018 Operations and Maintenance Manual, which includes the latest upgrade project completed in 2017.

ES.6 Technical Memorandum 4 – Long-Term Project Descriptions

This TM summarizes projects that are recommended for implementation between 2030 and 2044 based on the capacity analysis summarized in TM 1.

ES.6.1 Membrane Bioreactor Capacity Expansion

As described in TM 1, the MBR system does not have sufficient capacity to treat the projected average daily maximum month load and maintain the current design criteria of a 10-day solids retention time (SRT) and mixed liquor suspended solids (MLSS) concentration not exceeding 12,000 milligrams per liter. However, instead of building additional aeration tanks to reduce the MLSS concentration, operation of the MBR system could be adjusted to use an 8-day SRT, which is the lower end of target SRTs, to increase the capacity of the MBR system.

In addition to adjusting operations, the capacities of the return activated sludge (RAS) pumps, blowers, internal mixed liquor return (IMLR) pumps, and membrane cassettes need to be increased to ensure the MBR system can meet performance requirements.

It is recommended to operate the system at an 8-day SRT to reduce the MLSS concentration in the MBR system. It is also recommended to add the extra RAS pump, aeration blower, and additional membrane cassettes to increase capacity to the MBR system. By making this operational change and equipment installations, additional aeration tanks would not be needed. Lastly, the IMLR pumps' total capacity should be increased to ensure the total nitrogen limit is met and the City's effluent helps meet groundwater quality goals. These improvements should be made by 2033 to avoid exceeding the capacity of the MBR system.

ES.6.2 UV Disinfection System Capacity Expansion

After the near-term expansion project is completed, the UV disinfection system will have a firm capacity of 37 mgd (6 duty banks + 1 standby bank). However, this is not sufficient to meet the projected 2044 PWWF of 42.8 mgd. Furthermore, the projected PWWF is estimated to exceed the UV system's firm capacity in 2038. Therefore, the UV system must be expanded and brought online by 2038.

Even though the historical ultraviolet transmittance (UVT) data indicates the system is operating at a higher UVT than the original design criteria of 65 percent, UVT can vary over time, so it is recommended to revisit re-rating the UV system with the UVT data available during preliminary design. For planning purposes, it was conservatively assumed that the UV system would be expanded to meet the projected 2044 PWWF. It is recommended to construct a new third UV channel and bring it online by 2038.

ES.6.3 Anaerobic Digestion Capacity Expansion

The near-term anaerobic digestion capacity expansion project will include a new Digester No. 9 that is the same size and design as Digester No. 8. However, this additional digester does not provide sufficient firm capacity to meet minimum criteria for the projected design year flows.

Both Digester Nos. 8 and 9 have dedicated storage within them, decreasing the available active digestion capacity. It is recommended to remove the capacity out of these digesters and construct a tank with three days of storage to regain digestion capacity. Also, a new digester the same size as Digester Nos. 8 and 9 will need to be constructed to increase capacity for the projected flows. The new digester and sludge storage tank should be online by 2037. It is also recommended to convert the existing dewatering pump station to a sludge storage pump station and construct a new dewatering feed pump station. With the addition of the 3-day sludge storage tank, a fourth pump should be installed in the reserved space north of Digester No. 8 and four pumps should be installed at the new dewatering feed pump station.

ES.6.4 Biogas Flare Capacity Expansion

The current flare system's capacity of 21,250 standard cubic feet per hour (scfh) is not enough to meet the projected 2044 digester gas flows. A capacity of about 25,000 scfh is needed to flare the projected flows. It is recommended to expand the flaring capacity by replacing the existing flare with a higher capacity flare. This should be completed by 2037.

ES.6.5 Dewatering Capacity Expansion

After the near-term dewatering capacity expansion project is completed, the WRF will have three screw presses. This provides sufficient capacity for the near-term flows and creates the necessary redundancy required for this process. However, looking toward the 20-year horizon, these screw presses will not be enough to handle the 2044 AADF.

Additionally, if a 3-day sludge storage tank is added as discussed above, the screw presses will need to be able to dewater sludge in the new storage tank in 4 days, assuming that operation is halted over a 3-day weekend. This can be achieved by running four screw presses at a time, meaning the redundant screw press would also run. Therefore, a new screw press must be installed to expand the dewatering capacity for critical redundancy as well as for dewatering the full sludge storage tank.

It is recommended to add a fourth screw press with the same capacity as the existing screw presses by 2036 to provide additional capacity and redundancy for the dewatering system as well as construct a new dewatering pump station with four pumps.

ES.7 Technical Memorandum 5 – Long-Term Capital Improvement Program

The long-term CIP identifies capacity related projects, which are described in TM 4, required at the WRF between 2030 and 2044. Cost estimates and an implementation schedule were developed for each project.

ES.7.1 Cost Estimates

Total project cost estimates for each project are summarized in Table ES.2. These cost estimates are at a planning level and limited to capital costs. They do not include operations and maintenance costs.

Table ES.2 Total Project Capital Cost for Recommended Projects

Project	Cost (1)
MBR Capacity Expansion	$14,750,000
UV Disinfection System Capacity Expansion	$7,830,000
Anaerobic Digestion Capacity Expansion	$56,950,000
Biogas Flare Capacity Expansion	$7,000,000
Dewatering Capacity Expansion	$6,210,000
Total	$92,740,000

Notes:

(1) The costs are presented in 2024 dollars. Note that capital costs presented are for planning purposes. These costs do not include mid-point escalation or bid market allowance. Current market conditions suggest large rates of cost escalation and high rates of variance in construction bidding. It is suggested that an escalation rate and bid market allowance be added to capital costing efforts as project development becomes more refined. Total project costs include factors for estimating contingency, sales tax, general conditions, and contractor overhead and profit as well as 25 percent allowance for engineering, legal, administration, and permitting costs.

Total rehabilitation and replacement (R&R) costs as well as annual R&R costs that span the 20-year planning horizon are presented in Table ES.3.

Table ES.3 Rehabilitation and Replacement Costs for 20-Year Planning Horizon

Element	Cost
R&R Cost(1)	$53,000,000
Annual R&R Cost First 2024-2034(2)	$2,270,000
Annual R&R Cost Second 2034-2044(3)	$3,030,000

Notes:
(1) Total R&R costs reflect 35 percent of the total project costs in the 20-year CIP and are presented in 2024 dollars.
(2) The annual R&R costs are based on 15 percent of the total capital project costs distributed across the first half of the planning horizon. This approach was used because a majority of the plant was upgraded approximately seven years ago, so it is expected that minimal R&R will be needed during the first half of the planning horizon.
(3) The annual R&R costs are based on 20 percent of the total capital project costs distributed across the second half of the planning horizon. This approach was used because it is expected that more R&R projects will be needed in the second half of the planning horizon.

ES.7.2 Project Implementation

The implementation timing, determined by when the plant needs additional capacity, and the project duration assign each project a start and completion date. The recommended implementation schedule for the projects can be seen in Figure ES.1.

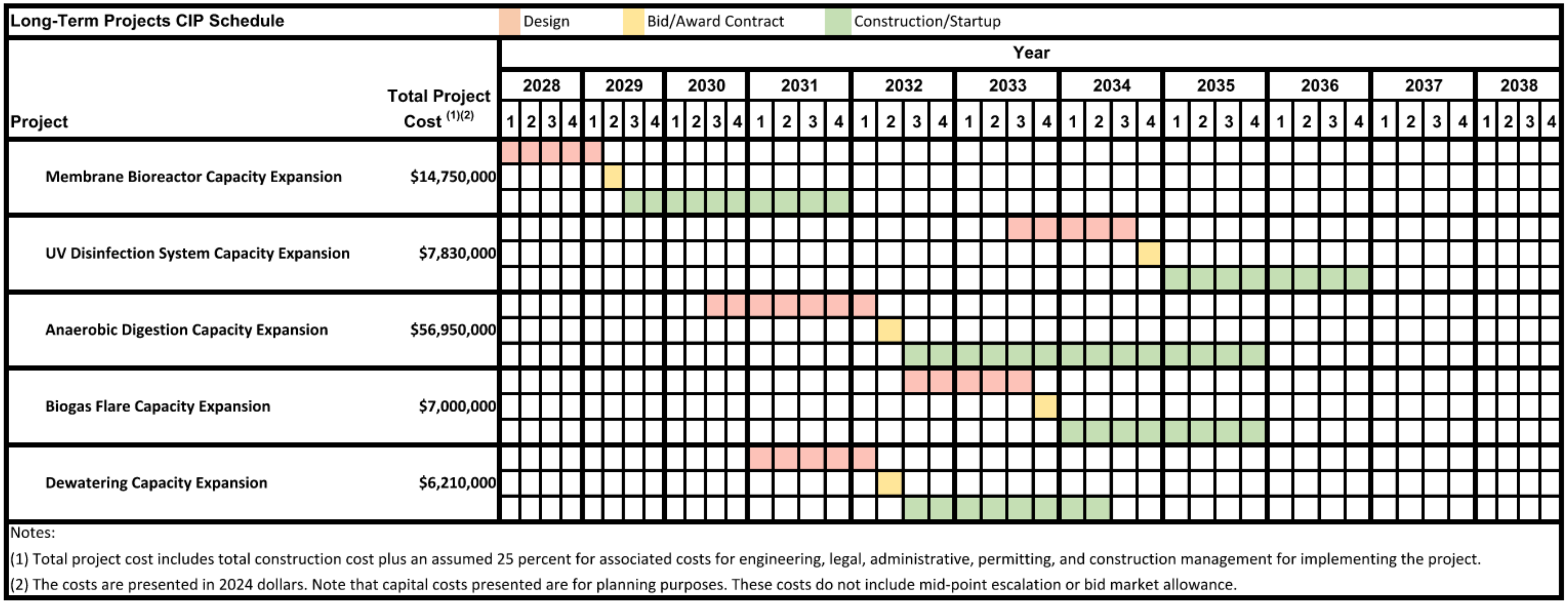
ES.7.3 20-Year CIP Implementation

The project implementation plan includes an overall schedule of the CIP and projected cash flow requirements for implementing the CIP. These projects would be implemented as needed to meet flow and load requirements rather than at set dates. The recommended implementation for each project is shown in Table ES.4.

In addition to the outlined capital projects, a biosolids master plan, digester gas use study, new facility plan, and new master plan were added to the CIP. It is recommended that the biosolids master plan and digester gas use study be conducted after the near-term digester capacity expansion project is completed. See TM 3 – Environmental Opportunities in the Facility Plan for more information on these studies. The new facility plan and master plan should be completed within 10 years.

While this Master Plan included projects that increased treatment capacities to meet the projected 2044 flows and loads, the City requested that process areas be evaluated for when 80 percent of the capacity was exceeded to trigger when the process area should be evaluated for expansion. Reviewing the capacity analysis, several process areas were identified to have their 80 percent capacity exceeded during the 20-year planning horizon. A planning study for each of these process areas was included in the CIP the year after it hit 80 percent capacity. If the rated capacity of the process area was expected to be exceeded within two years past the 20-year planning period, then ballpark estimates for design and construction costs were added to the CIP. However, project descriptions were not developed for these cases, and they should be thoroughly evaluated during the next master plan in 10 years. If the rated capacity of the process area was not exceeded for several years after the 20-year planning period, then no additional design or construction costs were included in the CIP. These projects should also be evaluated during the next master plan in 10 years.

The costs for these planning studies and design/construction activities can be seen in Table 5.4.



Long-Term Projects CIP Schedule 🟧 Design 🟨 Bid/Award Contract 🟩 Construction/Startup

Project	Total Project Cost (1)(2)	Year																																									
		2028				2029				2030				2031				2032				2033				2034				2035				2036				2037				2038			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Membrane Bioreactor Capacity Expansion	**$14,750,000**	🟧	🟧	🟧	🟧	🟧																																							
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UV Disinfection System Capacity Expansion	**$7,830,000**																							🟧	🟧	🟧	🟧	🟧																	
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Anaerobic Digestion Capacity Expansion	**$56,950,000**											🟧	🟧	🟧	🟧	🟧	🟧	🟧																											
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Dewatering Capacity Expansion	**$6,210,000**													🟧	🟧	🟧	🟧	🟧																											
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Notes:

(1) Total project cost includes total construction cost plus an assumed 25 percent for associated costs for engineering, legal, administrative, permitting, and construction management for implementing the project.

(2) The costs are presented in 2024 dollars. Note that capital costs presented are for planning purposes. These costs do not include mid-point escalation or bid market allowance.

Figure ES.1 Long-Term Projects CIP Schedule

Table ES.4 20-Year Capital Improvement Program Summary

Project	Total Project Cost	CIP Cost							
		2024	2025	2026	2027	2028	2029-2033	2034-2038	2039-2043
Near-Term Projects Costs(1)									
TWAS Pump Replacements	$630,000	$630,000	-	-	-	-	-	-	-
Dewatering Capacity Expansion – Near Term	$4,650,000	$930,000	$3,720,000	-	-	-	-	-	-
Sludge Drying Bed Capacity Expansion	$10,350,000	$2,070,000	$5,520,000	$2,760,000	-	-	-	-	-
Digester Dewatering Pond Addition	$6,110,000	$1,220,000	$3,260,000	$1,630,000	-	-	-	-	-
Anaerobic Digestion Capacity Expansion – Near Term	$34,990,000	$3,500,000	$6,999,000	$13,995,000	$10,496,000	-	-	-	-
UV Disinfection System Capacity Expansion – Near -Term	$2,010,000	-	$400,000	$1,610,000	-	-	-	-	-
Subtotal	$58,740,000	$8,350,000	$19,899,000	$19,995,000	$10,496,000	-	-	-	-
Long-Term Projects Costs(1)									
MBR System Capacity Expansion	$14,750,000	-	-	-	-	$1,967,000	$12,783,000	-	-
UV Capacity Expansion – Long Term	$7,830,000	-	-	-	-	-	$523,000	$7,307,000	-
Anaerobic Digestion Capacity Expansion – Long Term	$56,950,000	-	-	-	-	-	$30,916,000	$26,034,000	-
Biogas Flare Capacity Expansion	$7,000,000	-	-	-	-	-	$1,400,000	$5,600,000	-
Dewatering Capacity Expansion – Long Term	$6,210,000	-	-	-	-	-	$4,968,000	$1,242,000	-
Subtotal	$92,740,000	-	-	-	-	$1,967,000	$50,590,000	$40,183,000	-
Studies and Predesign Activities(2)									
Biosolids Master Plan	$500,000.00	-	-	-	-	$500,000.00	-	-	-
Biogas Master Plan	$300,000.00	-	-	-	-	$300,000.00	-	-	-
Facility/Master Plan Update	$1,000,000.00	-	-	-	-	-	$500,000.00	$500,000.00	-
Grit Tanks	$500,000.00	-	-	-	-	-	-	-	$500,000.00
Primary Sedimentation Tanks	$500,000.00	-	-	-	-	-	-	$500,000.00	-
MBR System	$1,000,000.00	-	-	-	-	-	-	$1,000,000.00	-
UV Disinfection	$500,000.00	-	-	-	-	-	-	$500,000.00	-
Gravity Belt Thickeners	$500,000.00	-	-	-	-	-	-	$-500,000.00	-
Anerobic Digestion	$1,000,000.00	-	-	-	-	-	-	$1,000,000.00	-
Sludge Drying Bed	$500,000.00	-	-	-	-	-	-	$500,000.00	-
Subtotal	$6,300,000.00	-	-	-	-	$800,000.00	$500,000.00	$4,500,000.00	$500,000.00
Design/Construction(2)									
Primary Sedimentation Tanks	$32,000,000.00	-	-	-	-	-	-	-	$32,000,000.00
MBR System	$155,000,000.00	-	-	-	-	-	-	$2,500,000.00	$152,500,000.00
UV Disinfection	$7,830,000.00	-	-	-	-	-	-	-	$7,830,000.00
Gravity Belt Thickeners	$22,000,000.00	-	-	-	-	-	-	-	$22,000,000.00
Anerobic Digestion	$56,950,000.00	-	-	-	-	-	-	$8,136,000.00	$48,814,000.00
Sludge Drying Bed	$10,350,000.00	-	-	-	-	-	-	-	$10,350,000.00
Subtotal	$284,130,000.00	-	-	-	-	-	-	$10,636,000.00	$273,494,000.00
R&R Costs(3)									
R&R	$53,000,000	$2,270,000	$2,270,000	$2,270,000	$2,270,000	$2,270,000	$11,350,000	$15,150,000	$15,150,000
CIP Total	$494,910,000.00	$10,620,000.00	$22,169,000.00	$22,265,000.00	$12,766,000.00	$5,037,000.00	$62,440,000.00	$70,469,000.00	$289,144,000.00

Notes:

TWAS - thickened waste activated sludge.

(1) The costs are presented in 2024 dollars. Note that capital costs presented are for planning purposes. These costs do not include mid-point escalation or bid market allowance. Current market conditions suggest large rates of cost escalation and high rates of variance in construction bidding. It is suggested that an escalation rate and bid market allowance be added to capital costing efforts as project development becomes more refined. Total project costs include factors for estimating contingency, sales tax, general conditions, and contractor overhead and profit as well as 25 percent allowance for engineering, legal, administration, and permitting.

(2) As stated in Section 5.5, the City requested that future master plans be included in the CIP as well process areas be evaluated for when 80 percent of the capacity was exceeded to trigger when the process area should be evaluated for expansion. A planning study for process areas whose 80 percent capacity was exceeded was included in the CIP the year after it hit 80 percent capacity. If the rated capacity of the process area was expected to be exceeded within two years past the 20-year planning period, then ballpark estimates for design and construction costs were added to the CIP. If the rated capacity of the process area was not exceeded for several years after the 20-year planning period, then no additional design or construction costs were included in the CIP.

(3) Total R&R costs reflect 35 percent of the total project costs.

ES.8 Summary and Recommendations

This Master Plan outlines key long-term project recommendations and identifies improvements for the WRF. As described above, it is recommended to complete the following projects within the next 20 years to maintain adequate firm treatment capacity to meet projected flows and loads.

- Membrane Bioreactor Capacity Expansion (complete by 2033): Operate the system at an 8-day SRT to reduce the MLSS concentration in the MBR system. Add an RAS pump, aeration blower, and additional membrane cassettes. Upsize the IMLR pumps and piping to increase return flows in the aeration basins.
- UV Disinfection System Capacity Expansion (complete by 2038): Construct a new UV channel and install additional UV modules and associated electrical equipment to increase the firm capacity of the UV system.
- Anaerobic Digestion Capacity Expansion (complete by 2037): Remove storage from Digester Nos. 8 and 9 and construct a dedicated storage tank that can store three days’ worth of sludge. Add a new digester with the same dimensions as Digester Nos. 8 and 9. This will increase the digestion capacity and allow the plant to meet the required SRT for Class B biosolids if the largest digester – either Digester Nos. 8, 9, or 10 – needs to be taken offline, providing necessary redundancy to the digestion system. Convert the existing dewatering feed pump station to a sludge storage pump. A fourth pump should be installed in the reserved in the space north of Digester No. 8.
- Biogas Flare Capacity Expansion (complete by 2037): Install a higher capacity flare and upsize piping to handle the higher projected flows.
- Dewatering Capacity Expansion (complete by 2036): Install a fourth screw press with the same capacity as the existing screw presses to provide critical redundancy. Construct a new dewatering feed pump station with four pumps.

Water Reclamation Facility - Master Plan

TECHNICAL MEMORANDUM 1

Long-Term Process Performance Evaluation

FINAL / June 2024

Water Reclamation Facility - Master Plan

TECHNICAL MEMORANDUM 1

Long-Term Process Performance Evaluation

FINAL / June 2024

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Contents

TM 1 LONG-TERM PROCESS PERFORMANCE EVALUATION

Tables

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Abbreviations

AADF	average annual daily flow
AB	aeration basin
ADMML	average day maximum month load
BOD	biochemical oxygen demand
COD	chemical oxygen demand
C	Celsius
ft^2	square feet
IMLR	internal mixed liquor return
$lb/ft^2/yr$	pounds per square foot/per year
MBR	membrane bioreactor
MG	million gallons
mgd	million gallons per day
mg/L	milligrams per liter
MLSS	mixed liquor suspended solids
ppd	pounds per day
PWWF	peak wet weather flow
RAS	return activated sludge
scfh	standard cubic feet per hour
scfm	standard cubic feet per minute
SRT	sludge retention time
TM	technical memorandum
TN	total nitrogen
TSS	total suspended solids
TWAS	thickened waste activated sludge
UV	ultraviolet
UVT	ultraviolet transmittance
WRF	Water Reclamation Facility

TM 1 LONG-TERM PROCESS PERFORMANCE EVALUATION

1.1 Introduction

In recent years, there has been a significant increase in industrial loads, along with increased water conservation efforts in residential wastewater within the City of Visalia and Goshen. The increased concentrations of wastewater have had a direct impact on the facility which is operating near its maximum capacity when it comes to influent biochemical oxygen demand (BOD) and total suspended solids (TSS). These elevated loadings are putting excessive stress on some of the treatment processes and leading to disruptions and disturbances.

This technical memorandum (TM) is an extension of TM 1 – Near-Term Process Performance Evaluation of the Facility Plan, which provides an overview of the Visalia Water Reclamation Facility (WRF), summarized historical and projected near term influent flows and loads, a plant-wide performance assessment and development of a calibrated biological process model, near term capacity needs, and capital improvement projects through 2030. This TM uses the same methodology to develop long term flow and load projections, capacity needs, and capital improvement projects from 2030 through 2044. If more information is needed on the methodology or near-term findings see TM 1 – Near-Term Process Performance Evaluation in the Facility Plan.

1.2 Long-term Flow and Load Projections

Using the same methodology to develop the near-term flow and load projections in TM 1 – Near-Term Process Performance Evaluation in the Facility Plan, the projected 2044 flows and loads are shown in Table 1.1. Projections of the future flows and loads are shown in Figure 1.1 and Figure 1.2, respectively. The average annual flow for 2044 is projected to increase to 21.4 million gallons per day (mgd), which is 8.9 mgd more than the current 2023 average.

Table 1.1 Flow and Load Projections Summary

Condition	Baseline Period(1)	2044 (20-year Horizon)(2)
Average Annual		
Flow, mgd	11.9	21.4
BOD, mg/L	539	656
BOD, ppd	54,000(3)	117,000(3)
COD, mg/L	1,251	1,402
COD, ppd	124,000(3)	250,000(3)
TSS, mg/L	715	910
TSS, ppd	71,000(3)	161,000(3)

Condition	Baseline Period(1)	2044 (20-year Horizon)(2)
Maximum Month		
Flow, mgd	12.4	22.3
BOD, ppd	73,000	152,000
COD, ppd	175,000	320,000
TSS, ppd	111,000	237,000
Peak Wet Weather		
Flow, mgd	23.3	42.8

Notes:
COD - chemical oxygen demand; mg/L - milligrams per liter; ppd - pounds per day.
(1) Baseline period ranges from August 2020 to April 2023
(2) Wastewater concentrations, flows, loads and peaking factors are projected using average data from August 2020 to April 2023 (baseline period).
(3) Influent loading rates are rounded to the nearest thousandth.

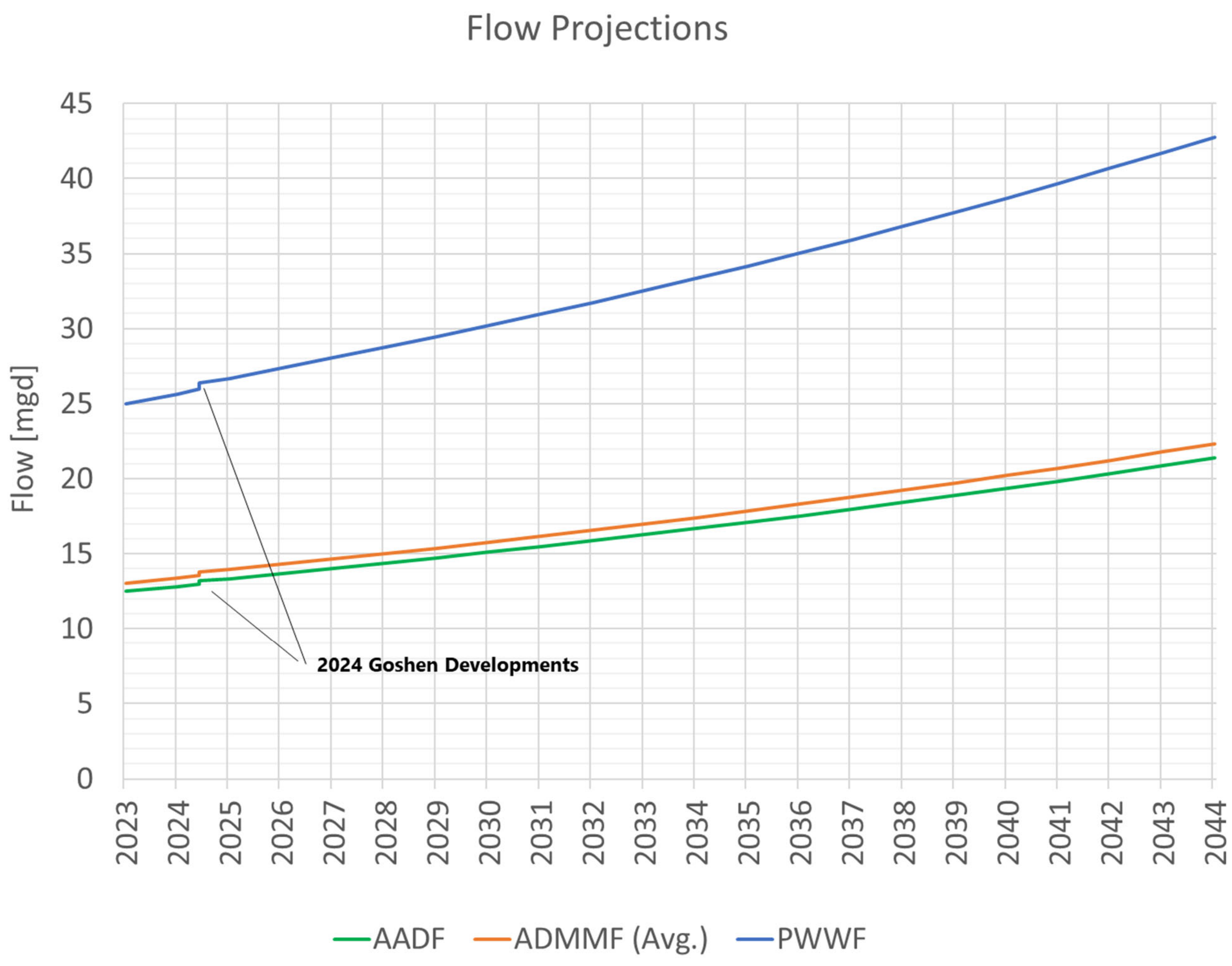

Figure 1.1 Influent Flow Projections for 2023 to 2044

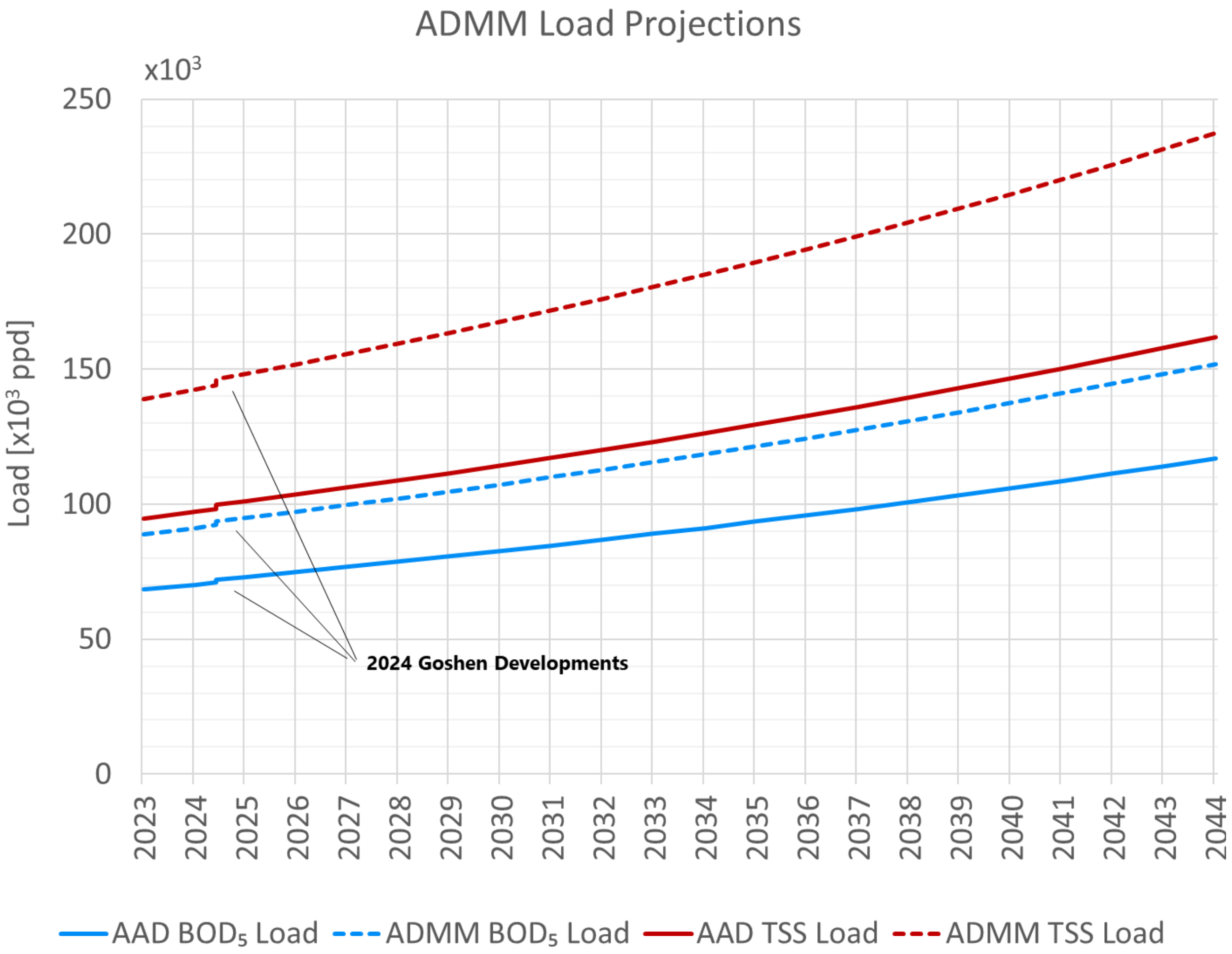

Figure 1.2 BOD and TSS Load Projections for 2023 to 2044

1.3 Capacity Analysis

The 2044 long-term process capacity evaluation of the Visalia WRF is based on the previously calibrated process model and the recommended capacity criteria, reported in Table 5 of *TM1 - Near-Term Process Performance* in the Facility Plan. The process model includes primary clarifiers, membrane bioreactor (MBR) system, gravity belt filters, anaerobic digesters, and dewatering screw presses.

The projected 2044 sludge production is estimated based on the solids loading coming from the primary and secondary sludge lines. The equivalent average annual daily flow (AADF) and peak wet weather flow (PWWF) capacity of each process unit are estimated based on when their individual design capacity criteria are reached. These are then compared to the 2044 AADF and PWWF projections to assess the need for capacity expansion. Figure 1.3 shows the comparison between 2044 flow projections (dashed horizontal lines) in conjunction with the estimated equivalent influent flows capacities of each process. Equipment and processes designed for PWWF criteria (e.g., influent pumps) were only assessed in terms of firm capacity, with the largest unit out of service. For processes designed for both AADF and PWWF (e.g., secondary treatment) both the AADF and PWWF capacities are shown. The capacities resulting from the recommended near-term expansions (discussed in TM 1 - Near-Term Process Performance in the Facility Plan) are also shown in Figure 1.3.

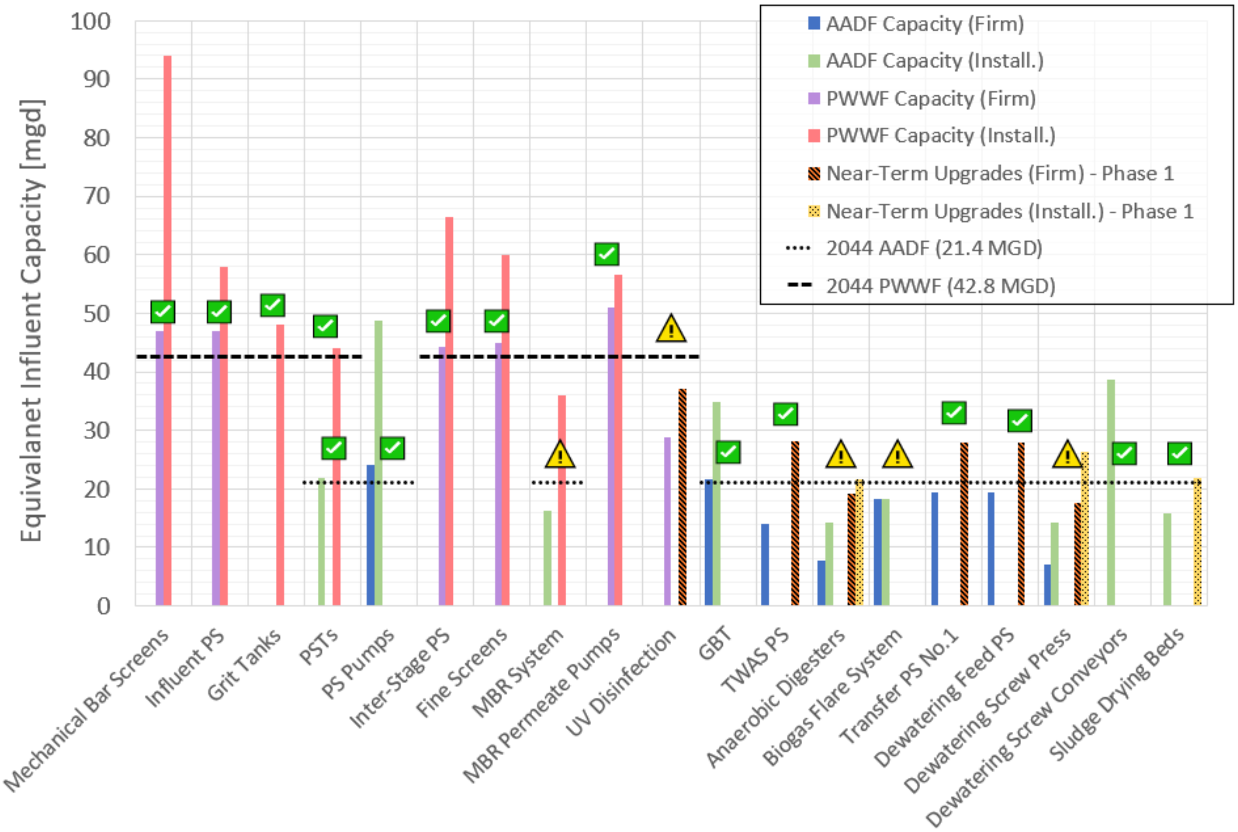

Figure 1.3 Unit Process Capacities and 2044 AADF and PWWF Projections

The ability for each process to meet the 2044 flow/load projections is denoted by a green check symbol. A warning symbol is adopted to indicate when projected flows/loads exceed the capacities of the individual processes.

Table 1.2 presents the estimated capacity for each unit process at the Visalia WRF.

Table 1.2 Unit Process Capacities

Process	Controlling Condition	Capacity (mgd)	2044 Projected Flow (mgd)	Capacity Deficit (mgd)	Year of Capacity Exceedance
Mechanical Bar Screens	PWWF	47(1)	42.8	-	-
Influent Pump Station	PWWF	46.9(1)	42.8	-	-
Grit Removal	PWWF	48(2)	42.8	-	-
Primary Clarification	AADF PWWF	21.9(2) 44(2)	21.4 42.8	-	-
Inter-Stage Pump Station	PWWF	44.4(1)	42.8	-	-
Fine Screens	PWWF	45(1)	42.8	-	-

Process	Controlling Condition	Capacity (mgd)	2044 Projected Flow (mgd)	Capacity Deficit (mgd)	Year of Capacity Exceedance
MBR System	AADF PWWF	16.3(2)(4) 36(2)(4)	21.4 42.8	-5.1(4) -6.8(4)	2033
Membrane Tank Permeate Pumps	PWWF	50.9(1)	42.8	-	-
UV Disinfection	PWWF	37(2)(3)	42.8	-5.8	2038
Anaerobic Digestion	AADF	18.1(3)	21.4	-3.3	2037
Biogas Flare	AADF	18.2(2)	21.4	-3.2	2037
Sludge Transfer Pumps	AADF	27.8(1)(3)	21.4	-	-
Dewatering Feed Pumps	AADF	27.8 (1)	21.4	-	-
Sludge Dewatering	AADF	17.6(1)(3)	21.4	-3.8	2036
Sludge Drying Beds	AADF	21.8(3)	21.4	-	-

Notes:
SRT - sludge retention time; TWAS - thickened waste activated sludge; UV - ultraviolet.
(1) Firm capacity: largest unit out of service.
(2) Total capacity: all units in service.
(3) Recommended process improvements and capacity expansions from TM 1 - Near-Term Process Performance of the Facility Plan, which includes a 5 percent and 3.5 percent TWAS and primary sludge thickening, respectively.
(4) MBR treatment capacity with a 10-day SRT.

As shown in Figure 1.3, to provide enough capacity to treat the 2044 flows and loads projections, upgrades of different process steps are required.

- **MBR System:** Under the current operating conditions the MBR system is projected to reach treatment capacity at an AADF of 16.3 mgd.
- **UV Disinfection System:** The firm capacity of the UV disinfection system will be reached at a PWWF of 37 mgd after the near-term expansion.
- **Anaerobic Digestion:** After completing the recommended near-term upgrades in *TM1 - Near-Term Process Performance* of the Facility Plan, the firm capacity of the anaerobic digestors will be reached at an AADF of 18.1 mgd.
- **Digester Gas Flare System:** The installed capacity of the biogas flare system will be reached at an AADF of 18.2 mgd.
- **Dewatering Screw Press:** After completing the recommended near-term upgrades in *TM1 – Near-Term Process Performance* of the Facility Plan, the firm capacity of the dewatering screw presses will be reached at an AADF of 17.6 mgd. The solid loading capacity is the limiting capacity criteria.

The first recommended long-term project would be to install additional sludge-drying beds by approximately 2032 to meet future dewatered solids loadings. Under the current design criteria of 10-day SRT, the MBR system will reach treatment capacity in 2033. Expanding the capacities of the RAS and IMLR systems and lowering the SRT of the system would expand the capacity of the MBR system to meet the long-term capacity requirements. Additional required solids treatment projects are to install an additional screw press (2036), an additional digester (2037), and the expansion of the digester gas flare system (2037). The UV disinfection process will require additional capacity by 2038.

Table 1.2 provides a summary of the capacities of the Visalia WRF's processes. The controlling conditions denote the design criteria used for the specific process. The capacities of the individual processes are compared to the 2044 AADF and PWWF projections, along with the equivalent capacity deficit. The expected year of capacity exceedance is also listed.

1.3.1 Membrane Bioreactor System

The recommended design criteria for MBR systems in TM 1 – Near-Term Process Performance in the Facility Plan includes operating at a SRT of 10 days. For the near-term process performance evaluation, a 10-day SRT simulation of the MBR system ensures sufficient biological treatment capacity, while maintaining mixed liquor suspended solids (MLSS) concentrations in the membrane tanks below the recommended design threshold of 12,000 mg/L.

When simulating the 2044 average daily maximum month load (ADMML) analysis, the solids concentrations in the membrane tanks of the MBR system surpassed the recommended design maximum threshold of 12,000 mg/L. At solids concentrations higher than the design threshold, the flux rate of the membranes can be negatively impacted.

Additional simulations were performed over a range of SRTs to assess the feasibility to lower the MLSS concentration in the membrane tank.

For the 2044 ADMML projections, sufficient capacity can be achieved by lowering the SRT to eight days, while still providing sufficient biological treatment capacity to treat the primary effluent organic and nitrogen loads and meeting regulatory effluent limits using the existing aeration basins (ABs). This alternative avoids the need for additional volume of the ABs, thus requiring only the four existing ABs. The 2044 simulations were assessed under average-temperature conditions (24 degrees Celsius [C]), and for low-temperature conditions (22 degrees C).

However, to ensure sufficient capacity, several equipment upgrades are recommended:

- **Additional RAS Pump**: The maximum firm capacity of the existing RAS pumps is 78 mgd (3+1, 26 mgd each). To maintain MLSS concentrations of the membrane tanks below the 12,000 mg/L threshold, the RAS pumps flow capacity needs to be increased before 2044. Therefore, the installation of an additional RAS pump is recommended, which would provide a firm capacity of 104 mgd (4+1). This recommendation is in line with the original design plan for the 22 mgd expansion.
- **Additional AB Blower**: The maximum firm capacity of the existing blower group is approximately 31,000 standard cubic feet per minute (scfm) (4+1, 7,769 scfm each). To meet the projected 2044 airflow requirements of approximately 35,000 scfm the addition of another blower is recommended to reach a firm capacity of 38,845 scfm (five on duty and one on standby). This recommendation is in line with the original design plan for the 22 mgd expansion.
- **IMLR Pump Flow Capacity Increase**: The max capacity of the existing four IMLR pumps is 89 mgd. To accommodate long-term future loads and lower effluent nitrate to achieve total nitrogen (TN) concentrations below the 10mg$_{\text{TN-N}}$/L effluent limit, an increase in the IMLR flow rate to 160 mgd is recommended.
- **Membrane Tank Upgrades**: Increase the membrane area per train. This can be achieved by adding a 52-module cassette in each train (from 8 to 9 cassettes), with 7 existing cassettes fully populated (48 modules), 1 partially populated existing cassette (46 modules) and 1 fully populated new cassette

(52 modules). This configuration is slightly different from the original 22 mgd design expansion since the higher packing density currently available for the new MBR cassettes allows to achieve the required membrane surface with only one cassette per train. This adjustment allows the system to operate under AADF conditions of 15 gallons per day per square foot with one membrane tank out of service.

In summary, the proposed upgrades ensure the system's performance without the need for additional tankage. Operating at an eight-day SRT, along with the outlined enhancements, enables the MBR system to meet design criteria and handle varying operational conditions effectively.

1.3.2 UV Disinfection

The original design criteria of the UV disinfection process assume a 65 percent ultraviolet transmittance (UVT) with a design dose of 80 millijoules per square centimeter. After reviewing of the plant operating data, the lower 10th percentile of the UVT indicated a value of 72 percent, indicating that the system was overperforming with respect to the original design criteria. However, the original 65 percent UVT value was assumed when estimating the long-term capacity requirements of the UV disinfection system since a higher UVT would decrease the conservatism of the planning effort, and UVT can vary over time. A minimum temperature of 18 degrees C was also used as a conservative design criterion. These assumptions were selected to account for variability in feed water constituents of the MBR system’s effluent that can impact UVT performance (e.g., colloids, turbidity, etc.). For the long-term improvements to the UV disinfection process, it is recommended to add a new UV channel to increase the UV system’s firm capacity to be able to meet the projected PWWF.

1.3.3 Anaerobic Digestion System and Ancillary Equipment

After the near-term improvements have been implemented, the anaerobic digestion system will have sufficient firm capacity until approximately 2037. Near-Term TWAS pumps upgrades are assumed to provide a flow capacity of 100 gallons per minute and are sized to overcome the pressure losses required to pump a 5 percent TWAS stream to the digesters. Although the installed capacity of all nine units in service provides enough treatment capacity until approximately 2044, the firm capacity without the largest digester (i.e., No. 8 or No. 9) is projected to be insufficient to treat 2044 solids loadings. Therefore, assuming digester No. 9 has the same volume allocated to storage as No. 8, an additional active digester volume of 2.24 million gallon (MG) is required to ensure enough firm capacity through 2044, with a total installed and firm capacity of 8.13 MG and 5.9 MG, respectively.

1.3.4 Biogas Flare System

The 2044 projected digester gas volumetric flows will exceed the current rated capacity of the biogas flare system (21,250 standard cubic feet per hour [scfh]). To provide sufficient flaring capacity the flaring system should be expanded to provide an overall treatment capacity of 25,000 scfh.

1.3.5 Dewatering System

The capacity of the dewatering system is not sufficient to meet the projected 2044 sludge flows and loads. A fourth screw press should be installed to provide sufficient firm capacity to meet the projected sludge flows and loads.

Water Reclamation Facility - Master Plan

TECHNICAL MEMORANDUM 2

Regulatory Review and Strategic Plan

FINAL / June 2024

Water Reclamation Facility - Master Plan

TECHNICAL MEMORANDUM 2

Regulatory Review and Strategic Plan

FINAL / June 2024

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TM 2 REGULATORY REVIEW AND STRATEGIC PLAN

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Abbreviations

AB	Assembly Bill
AGR	agricultural supply
AL	action level
AOP	advanced oxidation process
AWTO	advanced water treatment operator
BAC	biological activated carbon
Basin Plan	Water Quality Control Plan for the Tulare Lake Basin
BOD	biochemical oxygen demand
C	Celsius
Carollo	Carollo Engineers
City	City of Visalia
CIWQS	California Integrated Water Quality System
CV-SALTS	Central Valley Salinity Alternatives for Long-Term Sustainability
CWA	Clean Water Act
DBP	disinfection byproduct
DDW	Division of Drinking Water
deg.	degrees
DiPRRA	direct potable reuse responsible agency
DPR	direct potable reuse
DWQ	Division of Water Quality
EC	electrical conductivity
EPA	United States Environmental Protection Agency
ESCP	enhanced source control program
F	Fahrenheit
ft	feet
GWR	groundwater recharge
HA	Health Advisories
HFPO-DA (GenX)	hexafluoropropylene oxide dimer acid
IAP	Independent Advisory Panel
IND	industrial service supply
IPR	indirect potable reuse
LRV	log removal value
µmhos/cm	micromhos per centimeter
max.	maximum
MBR	membrane bioreactor
MCL	maximum contaminant level

MCLG	maximum contaminant level goals
mg/kg	milligram of pollutant per kilogram of solids (dry basis)
mg/L	milligrams per liter
mgd	million gallons per day
MPN/100 mL	most probable number per 100 milliliters
MUN	municipal and domestic supply
MW	monitoring well
N	nitrogen or nitrate
ng/L	nanogram per liter
NL	notification level
NOA	Notice of Applicability
NPDES	National Pollutant Discharge Elimination System
NTU	nephelometric turbidity units
P&O	Prioritization and Optimization
PFAS	per- and polyfluoroalkyl substances
PFBS	perfluorobutanesulfonic acid
PFHxS	perfluorohexane sulfonate
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
PHG	Public Health Goal
PRO	industrial process supply
PS	primary sludge
PSRP	Processes To Significantly Reduce Pathogens
RAS	return activated sludge
REC-1	water contact recreation
REC-2	non-contract water recreation
RL	response level
RO	reverse osmosis
RWA	raw water augmentation
RWQCB	Regional Water Quality Control Board
SB	Senate Bill
SDWA	Safe Drinking Water Act
sMCL	secondary maximum contaminant level
SO_4	sulfate
SWA	surface water augmentation
SWRCB	California State Water Resource Control Board
TCLP	Toxicity Characterization Leaching Procedure

TDS	total dissolved solids
THP	thermal hydrolysis process
TID	Tulare Irrigation District
Title 22	California Code of Regulations, Title 22
TM	technical memorandum
TOC	total organic carbon
TPAD	temperature phased anaerobic digestion
TS	total solids
TSS	total suspended solids
TWA	treated water augmentation
Type 1	disinfected tertiary-treated recycled water
Type 2	undisinfected secondary-treated recycled water
UV	ultraviolet
WAS	waste activated sludge
WDR	waste discharge requirement
WQO	water quality objective
WRF	Water Reclamation Facility
WRRF	water resource recovery facilities
WWTP	wastewater treatment plant

TM 2 REGULATORY REVIEW AND STRATEGIC PLAN

2.1 Introduction

This technical memorandum (TM) presents a review of current and future regulatory requirements that may impact the City of Visalia's (City's) wastewater, water reuse, and biosolids treatment and discharge. In addition, it presents a strategic plan developed to serve as a guide to adapt to the possibility of these changes.

2.2 Wastewater Regulations

At the federal level, the United States Environmental Protection Agency (EPA) establishes and enforces federal regulations that govern the City's wastewater facilities. The EPA develops and enforces federal rules and regulations that set national standards that protect human health and the environment. Most of the regulations that apply to wastewater effluent are based on the implementation of the Clean Water Act (CWA). In California, the Porter-Cologne Act provides the structure for implementing the CWA and regulating discharges to surface waters and groundwater. The Porter-Cologne Act established a structure of Regional Water Quality Control Boards (RWQCBs) that set policies and develops Basin Plans to assign specific water quality objectives and beneficial uses for waterbodies within their specific boundaries in California. The California State Water Resource Control Board (SWRCB) develops and establishes statewide policies, regulations and general orders for the protection of water quality, regulates drinking water, administers California's water rights system, supports and coordinates the efforts of nine RWQCBs.

Other state agencies with jurisdiction or involvement in water quality regulation in California include the Division of Drinking Water (DDW), which is a division of the SWRCB and is responsible for drinking water regulations and water reclamation criteria (water recycling). At the local level, the RWQCBs are responsible for ensuring federal and state water quality requirements are met within their region. They set water quality objectives, issue waste discharge requirements (WDRs) and National Pollutant Discharge Elimination System (NPDES) permits, determine compliance with those requirements, and take appropriate enforcement action. The Central Valley RWQCB (Region 5) is responsible for the region where the City is located.

2.2.1 Regulatory Review

2.2.1.1 Basin Plan Requirements and CV-SALTS

RWQCB's set beneficial uses for water bodies and establish water quality objectives that are assigned to protect those beneficial uses. These beneficial uses and water quality objectives are used to identify waterbody impairments and objectives that must be met by discharges to the waterbodies. The Central Valley RWQCB adopted a Water Quality Control Plan for the Tulare Lake Basin (Basin Plan) that designates beneficial uses, establishes narrative and numerical water quality objectives (WQOs), and contains implementation plans and policies for protecting waters of the basin. The RWQCB issues WDRs that implement the Basin Plan requirements.

The City's Water Reclamation Facility (WRF) lies within the Kaweah Basin of the Tulare Lake Basin. The beneficial uses of underlying groundwater as set forth in the Basin Plan are: municipal and domestic supply (MUN); agricultural supply (AGR); industrial service supply (IND); industrial process supply (PRO); water contact recreation (REC-1); and non-contact water recreation (REC-2). To protect these beneficial uses the Basin Plan establishes narrative WQOs for chemical constituents, tastes and odors, and toxicity in groundwater. It also prescribes a numeric WQO for total coliform organisms. The designation of the groundwater as MUN requires that chemical constituents in the groundwater basin must at least meet the maximum contaminant levels (MCLs) established under California Code of Regulations, Title 22 (Title 22) for potable use.

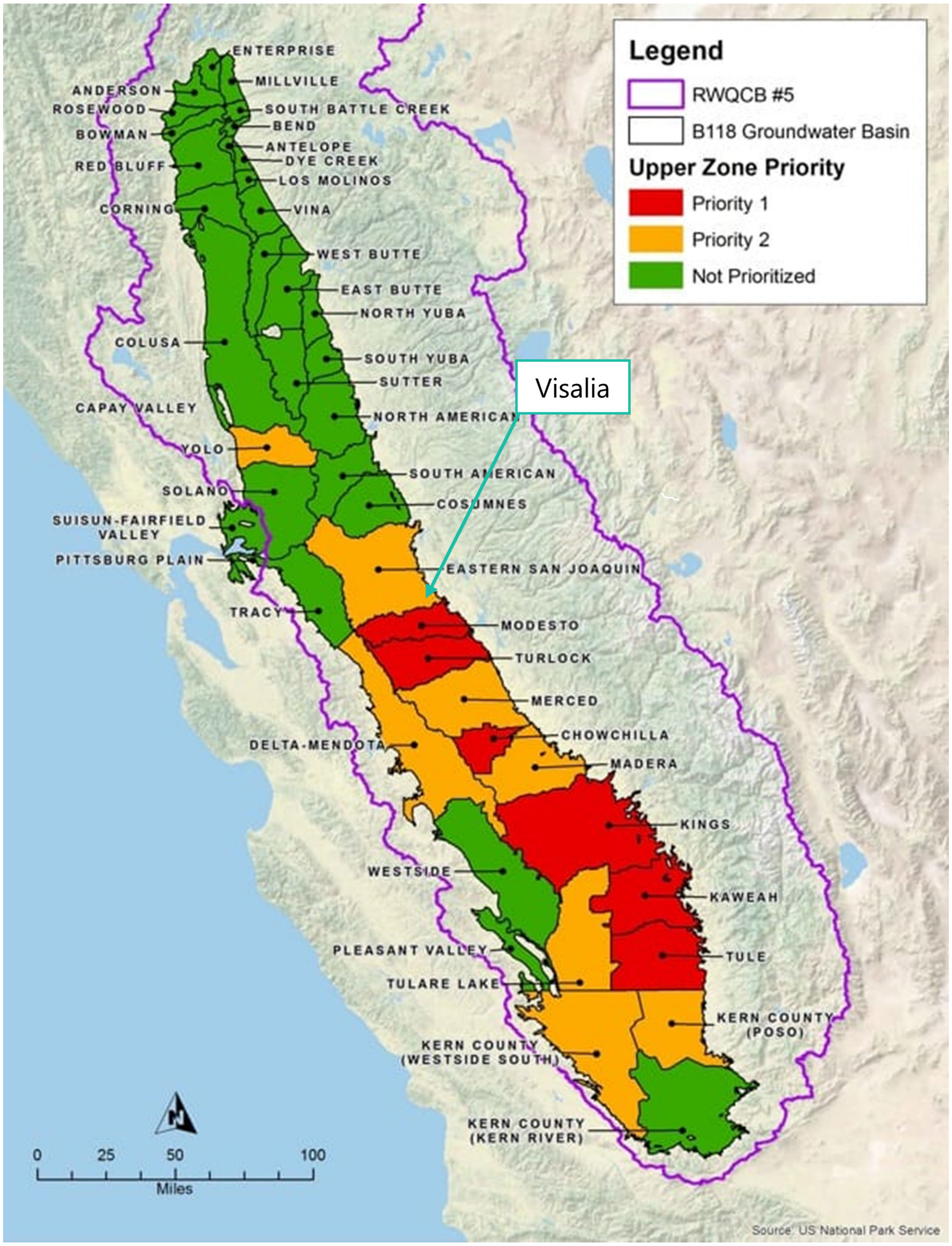
There has been recognition for many years that one of the biggest challenges facing the Tulare Lake Basin is the increase in salinity in groundwater. The Basin Plan establishes several salt management requirements, including: controlling incremental salt increases; establishing maximum limits on electrical conductivity (EC), chloride and boron; and requiring monitoring of groundwater to assess quality. The City monitors groundwater quality through a network of 18 monitoring wells in both the upper and lower aquifers.

The Central Valley RWQCB is developing Basin Plan amendments to incorporate new programs for addressing ongoing salt and nitrate accumulation in the Central Valley. These programs would change how the RWQCB issues permits for discharges of salt and nitrate. The stakeholder-led Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS) initiative has been coordinating efforts to implement new salt and nitrate management strategies.

The City is located in the Kaweah Management Zone, which is a Priority 1 (highest priority) basin for the Nitrate Control Plan from CV-SALTS, as shown in Figure 2.1. CV-SALTS is a regional program that aims to reduce salt and nutrient accumulation in the Central Valley basin to protect sources of groundwater used for drinking water and reduce impacts to agricultural land and habitats. To address these impacts, a Nitrate Program and a Salts Control Program have been established.

The Nitrate Control Program applies to land discharges only. Two regulatory pathways are available to dischargers for the Nitrate Control Program under CV-SALTS: individual permitting (Pathway A) or joining a management zone (Pathway B). Since the City is in a Priority 1 management zone and received a Notice to Comply in 2020, it chose Pathway B, joining a management zone project.

For the Salts Control Program, a similar structure was implemented with a Conservative Permitting Pathway (individual permit) or an Alternative Permitting Pathway (participate in the Prioritization and Optimization [P&O] Study). The City is participating in the P&O study. The plan is currently on Phase 1: P&O Study, which started in late 2019 and will last about 10 to 12 years.



Source: US National Park Service

Figure 2.1 Central Valley Salt and Nutrient Management Plan (CV-SALTS) Nitrate Management Zones Map

2.2.1.2 Current Regulations

The City is currently regulated by WDRs Order No. R5-2018-0046 for land discharges. The City previously had an NPDES permit for surface water discharges to Mill Creek, but this discharge point is no longer used. In 2017 the City upgraded its WRF to a membrane bioreactor (MBR) and ultraviolet (UV) disinfection facility that can produce tertiary treated effluent. The City's WDRs were updated to account for the higher level of treatment, with new limits that are performance based (used to ensure the WRF is operated correctly and able to meet tertiary standards). The upgrade of the WRF also provided a facility that both nitrifies and denitrifies, thereby producing an effluent that can meet the Basin Plan standards for nitrogen and nitrate. The process flow diagram for the upgraded treatment facility is shown in Figure 2.2.

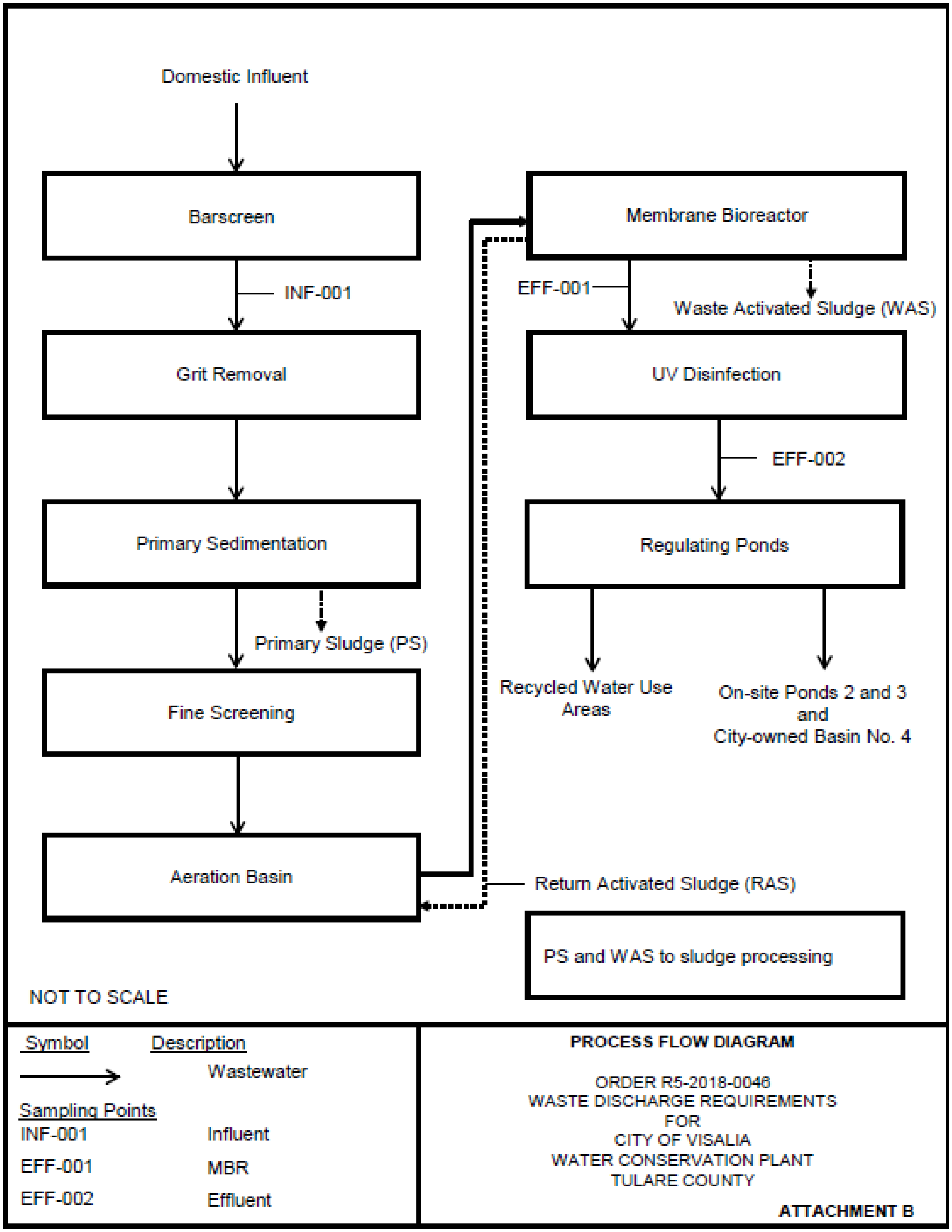


Figure 2.2 The City's WRF Treatment Process

Table 2.1 presents the discharge effluent limitations the WRF must meet per Order No. R5-2018-0046 as well as how the WRF is actually performing. As shown in Table 2.1, the new WRF is performing well and based on data collected between January 2018 and March 2023, meeting all monthly average requirements. During the same time period, the daily maximum values have been exceeded three times, twice for biochemical oxygen demand (BOD) in 2022 and once for Total Coliform in 2020. In general, the WRF produces high quality effluent.

Table 2.1 Effluent Limitations and Actual Concentrations

Constituent	Units	Special Condition	Monthly Average		Daily Maximum	
		Permit Limit	Permit Limit	Effluent Data	Permit Limit	Effluent Data
BOD	mg/L	---	10	3.3(1)	20	23(2)(7)
TSS	mg/L	---	10	1.3(1)	20	16(2)
Total Nitrogen (as N)	mg/L	---	10	5.4(1)	---	18(2)
Chloride	mg/L	---	175	56(3)	---	97(4)
Boron	mg/L	---	1	0.20(3)	---	0.28(4)
EC(5)	µmhos/cm	1,000 max.	---	510(3)	---	780(4)
Total Coliform	MPN/100 mL	2.2 – 7-day median	23 in 30-day period	<2.0(1)	240	1,600(2)
Turbidity	NTU	0.2 as daily average(6)	---	0.03(3)	0.5 at any time	0.40(4)

Notes:
max. - maximum; mg/L - milligrams per liter; MPN/100 mL - most probable number per 100 milliliters; NTU - nephelometric turbidity units; TSS - total suspended solids; µmhos/cm - micromhos per centimeter.
(1) Data represents the average monthly average from January 1, 2018, to May 31, 2023.
(2) This represents the maximum concentration reached during the January 2018 to May 2023 period.
(3) Data represents the average monthly average from January 1, 2020, to December 31, 2023.
(4) This represents the maximum concentration reached during the January 2020 to December 2023 period.
(5) The 12-month rolling average EC of the discharge shall not exceed the 12-month flow-weighted average EC of the source water plus 500 µmhos/cm or a maximum of 1,000 µmhos/cm, whichever is more stringent. When source water is from more than one source, the EC shall be a flow-weighted average of all sources.
(6) For 95 percent of the time.
(7) The second highest exceedance was 22 mg/L.

The WDRs also requires that the WRF shall not contribute to the groundwater exceeding the greater of natural background quality or Nitrate (as N) of 10 mg/L, Total Coliform Organisms of 7-day median of 2.2 MPN/100 mL or any primary or secondary MCLs established in Title 22.

Recent groundwater quality was obtained from California Integrated Water Quality System (CIWQS) for October 2018-October 2023. Table 2.2 presents representative samples of groundwater data from wells downstream of the percolation ponds. In general, this data demonstrates that the WRF's effluent is not degrading the groundwater quality with most constituents under or right around the WDR limits. Furthermore, some background wells farther away from the percolation ponds actually had worse water quality than those wells near the percolation ponds, reinforcing that the WRF's discharge does not adversely impact groundwater quality. See Figure 2.3 for the discharge areas and monitoring well locations.

Table 2.2 Recent Groundwater Quality(1)

Parameter	Unit	Limit	Monitoring Well Concentrations(2)					
			MW-R	MW-J1	MW-J2	MW-J3	MW-Q	MW-P
Chloride	mg/L	175(3)	63.5	33.8	72.7	9.3	36.3	56.8
Depth to Groundwater	feet	---	101.4	100.7	109.6	168.0	103.5	102.7
EC at 25 deg. C	µmhos/cm	1,000(3)	791.7	390.0	666.7	128.3	510.0	683.3
Groundwater Elevation	ft	---	184.0	178.6	169.6	111.2	163.2	163.7
Nitrate, Total (as N)	mg/L	10(3)	10.0	4.7	8.3	0.3	1.7	2.8
Nitrogen, Total (as N)	mg/L	10(3)	11.4	5.6	9.6	2.5	2.4	5.4
Sulfate, Total (as SO_4)	mg/L	250(4)-500(5)	35.5	26.0	35.8	5.1	30.2	53.3
TDS	mg/L	500(4)-1,000(5)	510.0	285.0	408.3	131.0	321.7	450.0

Notes:

C - Celsius; deg. - degrees; ft - feet; MW - monitoring well; TDS - total dissolved solids.

(1) Groundwater monitoring data was obtained from CIWQS. This data includes the following sampling periods: October 2018, April 2019, October 2019, April 2020, October 2020, and October 2023. Not every well was sampled for each sampling period.

(2) Concentrations are the average of samples that were included in the dataset.

(3) The City's WDR limit.

(4) Title 22 recommended secondary MCL.

(5) Title 22 upper secondary MCL.

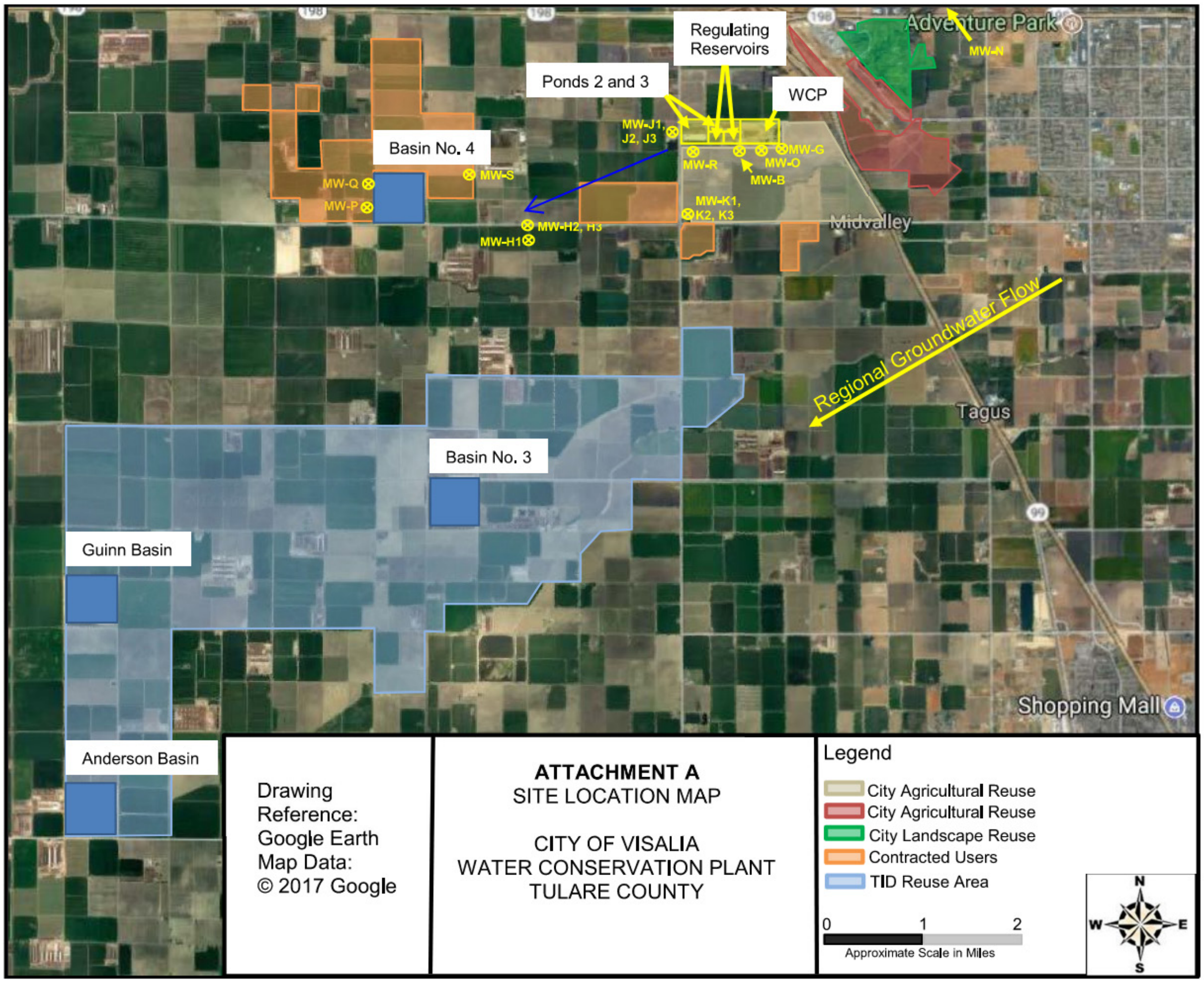


Figure 2.3 Areas of Discharge and Monitoring Well Locations

The WDR establishes two categories of effluent and recycled water that the WRF will produce and discharge: Type 1 (disinfected tertiary-treated recycled water) and Type 2 (undisinfected secondary-treated recycled water). The City is only allowed to produce and discharge Type 2 effluent in the event of a malfunction or planned maintenance of the UV disinfection system. If a Type 2 discharge occurs, the City must inform the Central Valley Water Board staff within 24 hours, and the duration of a Type 2 discharge is limited to the time required to respond to any malfunction or planned maintenance.

The City is allowed to discharge to City-owned ponds and lands and nearby contracted lands. Recycled water uses include City-owned farmland, irrigation via Tulare Irrigation District, and for local landscape irrigation within the City. Approved uses are shown in Table 2.3, and discharge areas are shown above in Figure 2.3.

Table 2.3 Approved Discharge Locations

Description	Acreage/Storage	Approved Effluent Type
City farmland	996 acres	Type 1 or 2(1)(2)
On-site Pond 2	84 acre-feet	Type 1 or 2(1)
On-site Pond 3	304 acre-feet	Type 1 or 2(1)
City-owned Basin No. 4	1,287 acre-feet	Type 1 or 2(1)
Potential contracted land	2,525 acres	Type 1 or 2(1)
TID	10,700 acres	Type 1
City-owned farmland near the airport	664 acres	Type 1
Landscape Reuse	253 acres	Type 1

Notes:
TID - Tulare Irrigation District.
(1) Type 2 undisinfected secondary effluent is only allowed to be discharged in the event of malfunction or planned maintenance.
(2) Type 2 discharge can only be applied to 250 acres of City-owned land (fiber and fodder) previously authorized by WDRs Order R5-2014-0076 and 168 acres of City-owned land (fiber and fodder) previously authorized by WQ 2016-0068-R5001.

2.2.2 Future Regulations for Land Discharges

Since the City is located in the Central Valley, it is subject to the requirements of the CV-SALTS program. CV-SALTS' primary focus is on the impact of salinity and nitrate levels in the groundwater basins. The WRF's new MBR treatment process allows the City to meet the nitrate and total nitrogen requirements. The City will need to continue to evaluate options for managing salts through consideration of source waters that are low in salts, pretreatment and source control efforts, and potentially salt removal facilities in the future.

Additionally, because the groundwater basin is a drinking water source, all MCLs apply to the groundwater. It will be important for the City to monitor both the effluent and the groundwater to assess if the effluent is contributing to exceedances of MCLs in the groundwater basin. As more constituents of emerging concern (such as per- and polyfluoroalkyl substances [PFAS] compounds) are regulated by MCLs, it is possible that the City's effluent could be a source of contamination to the groundwater basin. Compliance with any MCL should be in the groundwater, down gradient of the land disposal areas, and incorporating groundwater mixing. However, source control and/or treatment to remove emerging contaminants in the final effluent waste stream may be required in the future. See Section 2.3.3.1 for a discussion on PFAS.

2.3 Recycled Water Regulations

At the federal level, the EPA developed the 2012 Guidelines for Water Reuse to provide national guidance on water reuse regulations and practices in order to facilitate further development of water reuse and to support states, tribes, and other authorities in their development of water reuse guidelines and regulations. Water reuse in California falls under the jurisdiction of the SWRCB. Within the SWRCB, DDW is responsible for protecting public health, and RWQCBs are responsible for protecting the environment with respect to water. Title 22 codifies criteria developed by DDW for non-potable uses and potable uses of recycled water.

2.3.1 Non-Potable Reuse Regulations and Current Permit

The City is currently enrolled under Water Quality Order WQ 2016-0068-DDW, Water Reclamation Requirements for Recycled Water Use (hereafter, General Order). In June 2016, the SWRCB adopted the General Order to consistently regulate the use of recycled water for non-potable uses. Under the City's Notice of Applicability (NOA) for the General Order, the City is the Recycled Water Program Administrator and is allowed to distribute recycled water and operate a recycled water program. Section 2.2.1.2 above discusses the types (Type 1 and Type 2) of recycled water discharge and where these discharges are approved (see Table 2.3 above).

Additionally, the City and TID have an exchange agreement in which for every two units of recycled water the City gives to TID, TID will send one unit of freshwater to the City for groundwater recharge. In 2018 DDW accepted the final amendment from the 2011 Title 22 Engineering Report.

2.3.2 Potable Reuse Regulations

Title 22 codifies criteria developed by DDW for indirect potable reuse (IPR) of recycled water by groundwater recharge (GWR) and surface water augmentation (SWA) as well as direct potable reuse (DPR).

2.3.2.1 IPR via GWR Regulations

GWR, a form of IPR, has been practiced successfully since the 1970s. Final regulations have been in place for GWR since 2014; although, regulations existed in draft form prior to that for almost 40 years.[1] GWR can take two forms: (1) surface spreading which entails percolating tertiary effluent or purified recycled water through spreading basins, and (2) direct injection, which entails injecting purified recycled water directly into an aquifer.

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[1] SWRCB (2018) Regulations Related to Recycled Water. Sacramento, California. https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/lawbook/rwregulations.pdf.

2.3.2.2 IPR via SWA Regulations

In 2018, DDW finalized its regulations for IPR via SWA. SWA entails augmenting an existing drinking water reservoir with purified water, and later treating that water at a water treatment plant prior to serving it to customers. Regulatory considerations for SWA consider many of the same elements as GWR, but also include new requirements to account for the lack of experience with this type of project and the complexities introduced by the use of a surface water reservoir.

2.3.2.3 DPR Regulations

The EPA has developed regulatory recommendations for DPR on the national level, and New Mexico, Texas, Colorado, and Arizona have developed regulatory guidance for DPR within their respective states. Regulations for DPR in California were finalized in December of 2023. Prior to that, Assembly Bill 574 was signed into law in October 2017 and required DDW to develop raw water augmentation (RWA), which adds purified water upstream of a drinking water treatment facility, regulations by December 2023. Since then, DDW published a proposed framework and a second edition framework stating that they intend both RWA and treated water augmentation (TWA), which adds purified water directly into an existing drinking water distribution system, to be regulated under one uniform regulation published in 2023.[2] In August 2021, DDW published Addendum version 8-17-2021 to A Framework for Direct Potable Reuse,[3] which provided the second draft of regulations as they might be housed within a new Article under the Surface Water Treatment chapter of Title 22. Expert panel comments and DDW responses were completed in June 2022.[4] In February 2023, a meeting with DDW and the DPR working group of WateReuse California established an updated anticipated timeline of release and adoptions of DPR regulations. In June 2023, the updated draft regulations were released with a 45-day public comment period. After review and update, the DDW adopted the regulations in December 2023. DPR regulations will be formally complete after the Office of Administrative Law reviews and publishes them, likely to occur in spring of 2024.

The DPR regulations contain extensive requirements for treatment, monitoring, source control, reporting, and more. The framework remains similar to what has been promulgated for IPR, i.e., GWR and SWA, but many of the requirements have been made more stringent, and new elements have been introduced. The key elements of the regulations are defined below, with a comparison summary of GWR, SWA, and DPR regulations in Table 2.4. With these regulations in place, DPR could be viable option for the City. In order to see if DPR is beneficial to the City, further analysis is required.

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[2] SWRCB (2019a). A Proposed Framework for Regulating Direct Potable Reuse in California, Second Edition. Prepared by the State of California Water Resources Control Board DDW, August 2019.

[3] SWRCB (2021). A Proposed Framework for Regulating Direct Potable Reuse in California, 2nd Edition Addendum: Early Draft of Anticipated Criteria. August 17, 2021.

[4] SWRCB (2022). DDW Response to “Expert Panel Preliminary Findings, Recommendations, and Comments on the Draft DPR Criteria (dated August 17, 2021)” in the Memorandum of Findings Submitted by NWRI dated March 14, 2022. June 2022.

2.3.3 Future Requirements

In summary, regulations are now established for all forms of non-potable and potable reuse. The City is already in compliance with requirements under Title 22 for non-potable reuse. As summarized in Table 2.4, the requirements for potable reuse are extensive and high levels of treatment are required. Given that the State is requiring reverse osmosis as part of the purification process required for potable reuse, the disposal of the waste product (reverse osmosis concentrate) would be problematic for the City given the lack of an ocean outfall or a way to deal with the salty waste. There are also significant technical, managerial, and financial requirements for implementing DPR that would be hard to achieve for a smaller utility. At this point, it is mainly larger utilities that are seriously considering DPR.

The main concern for future requirements for reuse is related to emerging contaminants.

Table 2.4 Summary Comparison of Key Regulatory Requirements for GWR, SWA, and DPR

	GWR	SWA	DPR – TWA or RWA
Project Structure and Interagency Coordination	▪ Main entity is project sponsor.	▪ Involves both a WWTP and a public water system. ▪ Joint Plan required.	▪ DiPRRA is the public water agency responsible for project. ▪ Joint Plan required.
Source Control	Requires industrial pretreatment and pollutant source control program including: ▪ Assessment of the fate of site-specific chemicals through the wastewater and recycled water treatment systems. ▪ Monitoring and investigation of chemical sources. ▪ Outreach program to minimize discharge of chemicals into the feed water.	Requires industrial pretreatment and pollutant source control program including: ▪ Assessment of the fate of site-specific chemicals through the wastewater and recycled water treatment systems. ▪ Monitoring and investigation of chemical sources. ▪ Outreach program to minimize discharge of chemicals into the feed water.	▪ Requires ESCP. ▪ All elements of source control as needed for IPR. ▪ Quantitative evaluation of chemicals discharged to collection system. ▪ Online monitoring that may indicate a chemical peak resulting from an illicit discharge. ▪ Coordination with the pretreatment program for notification of discharges above allowable limits. ▪ Monitoring of local surveillance programs to determine when community outbreaks of disease occur. ▪ Form a source control committee and institute a continuous improvement process for the program.
Feed Water Monitoring	None.	None.	▪ Prior to operation, 24 months of monthly feed water monitoring for regulated contaminants (i.e., those with an MCL), priority pollutants, NLs, a specific list of solvents, DBPs, and DBP precursors.
Pathogen Control (required log reduction credits)	▪ 12-log enteric virus. ▪ 10-log Giardia. ▪ 10-log Cryptosporidium.	▪ 12 to 14-log enteric virus. ▪ 10 to 12-log Giardia. ▪ 10 to 12-log Cryptosporidium.	▪ 20-log enteric virus. ▪ 14-log Giardia. ▪ 15-log Cryptosporidium.
Treatment Train	▪ RO + UV/AOP required.	▪ RO + UV/AOP required.	▪ Ozone/BAC + RO + UV/AOP required in this order. ▪ Alternatives clause is included stating that an alternative treatment train may be allowed if written approval is received from the SWRCB, the DiPRRA conducts public meetings and receives public comments, and the proposed train is reviewed by an IAP.
Chemical Control	▪ Maximum recycled water TOC contribution of 0.5 mg/L. ▪ Must meet all current drinking water standards, including MCLs, DBPs, and ALs. Quarterly monitoring.	▪ Maximum recycled water TOC contribution of 0.5 mg/L. ▪ Must meet all current drinking water standards, including MCLs, DBPs, and ALs. Quarterly monitoring.	▪ Must consist of at least three separate treatment processes, using diverse treatment mechanisms, for chemical reduction. ▪ Maximum effluent TOC contribution of 0.5 mg/L; additional more stringent TOC thresholds with response actions. ▪ Must meet all current drinking water standards, including MCLs, DBPs, and Als. Monthly monitoring. ▪ Control of 1-hour chemical spike. ▪ Continuous monitoring of nitrate and nitrite in RO permeate.
Additional Monitoring	▪ Quarterly sampling in recycled water and downgradient groundwater wells for priority pollutants, unregulated chemicals, and NLs.	▪ Quarterly sampling in recycled water for priority pollutants, unregulated chemicals, and NLs. ▪ 24 months of monthly sampling for sMCLs, TOC, nitrogen, and others at multiple locations in reservoir to be augmented. Additional monthly monitoring for at least the first 24 months of operations.	Monitoring required in feed water, directly after oxidation process, and finished water for: ▪ Monthly: All MCLs, sMCLs, NLs, priority toxic pollutants, ALs, DBPs and DBP precursors, and specified solvents. ▪ Quarterly: Chemicals known to cause cancer or reproductive issues for at least three years. ▪ Weekly monitoring of nitrate, nitrite, perchlorate, and lead in the finished water only. ▪ Additional quarterly monitoring for chemicals identified by the DiPRRA in coordination with the SWRCB.
Environmental Buffer	▪ Minimum aquifer retention time of 2 months.	▪ Initial minimum reservoir hydraulic retention time of 6 months; potential to reduce down to 2 months with additional pathogen control. ▪ Initial minimum reservoir dilution of 10:1, one LRV of pathogen treatment added if dilution is <100:1.	▪ Additional 2 log reduction credit for continuous blending, continuous mixing in a surface reservoir, and GWR.
Response Time	▪ Minimum aquifer retention time of 2 months	None.	▪ The system must be designed to meet certain response time requirements to ensure that diversion and/or shutoff can occur in the event of a failure to meet the pathogen and/or chemical control requirements. ▪ If failure is identified, the system must divert or shut off before 10 percent of the off-spec water reaches the diversion or shutoff point.
Operations	None.	None.	▪ Grade 5 AWTO required on site at all times, with some exceptions for remote operations allowed. ▪ All facility operators must be AWTO certified.
Plans	▪ Engineering Report. ▪ Operations Optimization Plan.	▪ Joint Plan. ▪ Engineering Report. ▪ Operations Plan. ▪ Plan to address impacts to water treatment plant and distribution system.	▪ Joint Plan. ▪ Water Safety Plan. ▪ Engineering Report. ▪ Operations Plan. ▪ Pathogen and Chemical Control Point Monitoring and Response Plan. ▪ Monitoring Plan. ▪ Corrosion Control and Stabilization Plan. ▪ Additional Reporting (climate change).
Reporting	▪ Annual compliance reporting.	▪ Annual compliance reporting.	▪ Monthly compliance reporting.

Notes:
AL - action level; AOP - advanced oxidation process; AWTO - advanced water treatment operator; BAC - biological activated carbon; DBP - disinfection byproduct; DiPRRA - direct potable reuse responsible agency; ESCP - enhanced source control program; IAP - Independent Advisory Panel; LRV - log removal value; NL - notification level; RO - reverse osmosis; sMCL - secondary maximum contaminant level; TOC - total organic carbon; WWTP - wastewater treatment plant.

2.3.3.1 PFAS

DDW has issued NLs and Response Levels (RLs) for perfluorobutanesulfonic acid (PFBS), perfluorooctanoic acid (PFOA), perfluorooctane sulfonate (PFOS), and perfluorohexane sulfonate (PFHxS). The Office of Environmental Health Hazard Assessment released a first and second draft of Public Health Goals (PHGs) for PFOA and PFOS in July 2021 and July 2023, respectively. Establishing a PHG is the first step towards adopting drinking water MCLs. The PFOS and PFOA MCL rulemaking process began in 2023 with adoption of final MCLs anticipated in 2025. The MCLs would apply to discharges to receiving waters with the MUN or GWR beneficial use.

The current California drinking water advisory values are presented in Table 2.5.

Table 2.5 California PFAS Drinking Water Advisory Values

Compound	NL (issued)	RL (issued)	PHG (proposed)
PFOA	5.1 ng/L	10.0 ng/L	0.007 ng/L (cancer health protection)
PFOS	6.5 ng/L	40 ng/L	1.0 ng/L (cancer health protection)
PFBS	500 ng/L	5,000 ng/L	--
PFHxS	3 ng/L	20 ng/L	--

Notes:
ng/L - nanograms per liter.

The Safe Drinking Water Act (SDWA) authorizes the EPA to issue Health Advisories (HA) for contaminants that are not subject to National Primary Drinking Water Regulations. HAs primarily serve as information to drinking water systems and officials responsible for protecting public health when emergency spills or other contamination situations occur. The EPA has issued interim updated drinking water HAs for PFOA and PFOS and final HAs for PFBS and hexafluoropropylene oxide dimer acid (HFPO-DA [GenX]). In chemical and product manufacturing, GenX chemicals are considered a replacement for PFOA and PFBS is considered a replacement for PFOS.

On March 14, 2023, the EPA released proposed PFAS National Primary Drinking Water Regulations. The proposed regulations establish legally enforceable MCLs and non-enforceable health-based maximum contaminant level goals (MCLG) for six PFAS compounds (PFOA, PFOS, perfluorononanoic acid [PFNA], PFBS, GenX, and PFHxS) as well as monitoring, public notification, and treatment requirements. The proposed regulations were published in the Federal Register on March 29, 2023, and the 60-day public comment period ended on May 30, 2023. The EPA will now consider the comments received and finalize the regulations. When final, the regulatory requirements will be implemented under the authority of the SDWA and applied to operation of public drinking water systems nationwide. It is anticipated that DDW and the Regional Water Board will incorporate the requirements for operation of facilities that produce recycled water for potable purposes. The proposed MCLs and MCLGs are shown in Table 2.6. The individual MCLs are based on concentrations that can be reliably measured using EPA Draft Method 1633. Compliance with the Hazard index will be determined by dividing the result of each PFAS compound by its assigned Health Based Factor and calculating the sum of the resulting fractions.

Table 2.6 EPA Proposed MCLs and MCLGs

Compound	Proposed MCLG	Proposed MCL
PFOA	0.0 ng/L	4.0 ng/L
PFOS	0.0 ng/L	4.0 ng/L
PFNA (health based factor = 10 ng/L)	1.0 (unitless) Hazard Index	
PFHxS (health based factor = 9 ng/L)		
PFBS (health based factor = 2,000 ng/L)		
HFPO-DA/GenX (health based factor = 10 ng/L)		

2.4 Wastewater and Recycled Water Strategic Plan Recommendations

There is a range of strategies that may be employed for addressing regulatory concerns. Source control, scientific evidence, state and national regulatory advocacy, permit changes, and treatment optimization/upgrades are all options available for preparing and responding to regulatory compliance challenges. Participation in policy development and pilot studies may provide regulatory relief for specific constituents based on scientific evidence and development of information for improved decision-making by regulators. The possible response strategies are described within the following categories:

- **Source Control** – Monitoring collection systems, identifying and eliminating pollutant sources, establishing local limits, revising sewer use ordinances, working with manufacturers on product reformulation, and supporting/enacting product bans.
- **Regulatory Advocacy** – Development of policies and regulations to provide attainable regulatory solutions that are also protective of the environment and public health.
- **Permit Changes** – Conducting scientific studies to evaluate impacts of discharges on the environment, developing site specific objectives, conducting mixing zone/dilution studies, modeling groundwater travel times and flow directions, and conducting antidegradation analyses to allow use of available assimilative capacity.
- **Treatment** – Optimization of existing facilities, modification of existing facilities, or additional treatment to reduce or remove constituents to comply with effluent limitations.

The compliance concerns and recommended strategies to address them are presented in Table 2.7. The City should continue to participate in CV-SALTS and track the development of MCLs that could be applied to groundwater discharges.

Table 2.7 Summary of Regulatory Concerns and Potential Strategies

End Use	Regulatory Concerns	Potential Strategies to Address Concerns
Land Discharge	Nitrate and Total Nitrogen	Permit Changes, Treatment
	Salinity	Source Control, Permit Changes, Treatment
	MCLs	Source Control, Regulatory Advocacy, Permit Changes, Treatment
Potable Reuse	PFAS	Source Control, Regulatory Advocacy, Treatment through purification

2.5 Biosolids Regulations

2.5.1 Introduction

The WRF processes primary solids and thickened waste activated sludge in mesophilic anaerobic digesters. The digested biosolids are then dewatered in screw presses and dried in drying beds. Based on the 2020 to 2023 data, typical solids concentrations are 16 percent total solids (TS) for the dewatered biosolids and 81 to 90 percent TS for the dried biosolids. After drying, the solids are stored in a stockpile. The City contracts with a third party, Denali, for hauling and beneficial use of the dried biosolids via bulk agricultural land application in Merced and Madera counties. The City occasionally landfills their biosolids.

This section describes current and potential future regulatory requirements pertaining to solids treatment and biosolids end use. It also provides an adaptable plan for the City to address possible future regulatory requirements.

2.5.2 Regulatory Review

2.5.2.1 Current Federal Regulations

40 CFR Part 503: Standards for the Use or Disposal of Sewage Sludge

At the federal level, 40 CFR Part 503 governs the use or disposal of sewage sludge. The rule establishes biosolids quality standards based on three parameters: pathogen reduction, vector attraction reduction, and pollutant (metals) concentrations. Depending on the pathogen reduction process, biosolids are categorized as Class A or Class B. 40 CFR Part 503 also provides guidance on best practices for land application of biosolids, specifies site restrictions for each type of biosolids, and sets the requirements for monitoring, recordkeeping, and reporting.

Per 40 CFR Part 503, mesophilic anaerobic digestion and air drying are both classified as Processes to Significantly Reduce Pathogens (PSRP), both of which produce Class B biosolids.

To produce Class B biosolids using mesophilic anaerobic digestion, the following conditions must be met:

- To achieve the pathogen reduction requirement, solids must be digested at mesophilic temperature for a minimum of 15 days.
- To achieve the vector attraction reduction requirement, a minimum volatiles solids reduction of 38 percent must be achieved through the anaerobic digestion process.

To produce Class B biosolids using air drying, the following conditions must be met:

- To achieve the pathogen reduction requirement, solids must be dried for a minimum of three months with the average daily ambient temperature above 0 deg. C (32 deg. Fahrenheit [F]) for two of the three months.
- To achieve the vector attraction reduction requirement, digested solids must be dried to at least 75 percent TS and undigested solids must be dried to at least 90 percent TS.

The City currently meets the requirements for Class B biosolids through both anaerobic digestion and air drying. The anaerobically digested solids, prior to air drying, qualify as Class B. The air-dried solids, given that their solids content is over 75 percent TS, also qualify as Class B. However, if the City did not digest their solids upstream of air drying, a solids content of at least 90 percent TS would be required, which may be difficult to achieve based on historical performance data.

Some air-drying facilities obtain Class A designation by conducting ongoing testing of fecal pathogens. The City tested their dried biosolids stockpiles in 2021 and 2022 for pathogens and found that the pathogen concentrations met the limits required to be classified as Class A.

The City regularly measures pollutant (metal) concentrations in their dried biosolids stockpiles. 40 CFR Part 503 requires that biosolids used for bulk agricultural application have pollutant concentrations below the ceiling concentration limits in Table 1 of 503.13. Table 2.8 lists the historical pollutant concentrations measured in the City's dried biosolids relative to the ceiling concentration limits. As shown, the City's historical pollutant concentration limits are far below the ceiling concentration limits.

Table 2.8 Biosolids Pollutant (Metal) Concentrations and Limits

Pollutant	Units	Ceiling Concentration(1)	Sep 2023	May 2023	Mar 2023	Jan 2023	Oct 2022
Arsenic	mg/kg dry	75	<4.4	<0.85	<9.9	6	3.9
Cadmium	mg/kg dry	85	<0.43	<0.083	0.39	<0.98	Non detect
Copper	mg/kg dry	4,300	181	130	167	156	248
Lead	mg/kg dry	840	30	17	23	19	54
Mercury	mg/kg dry	57	0.42	0.4	0.39	0.61	1
Molybdenum	mg/kg dry	75	10	7.3	8.2	9	11
Nickel	mg/kg dry	420	17	15	18	15	18
Selenium	mg/kg dry	100	3.5	6.9	5.7	<14	1.5
Zinc	mg/kg dry	7,500	691	499	586	584	778

Notes:
mg/kg dry – milligram of pollutant per kilogram of solids (dry basis).
(1) Ceiling Concentration limits from 40 CFR Part 503.13 Table 1.

40 CFR Part 258 Criteria for Municipal Solid Waste Landfills

When the City occasionally landfills their biosolids, they must also comply with the criteria established in 40 CFR Part 258, which governs the disposal of sewage sludge classified as solid waste. The main requirement for landfilling of sludge is that it must meet the Paint Filter Liquids Test (EPA Method 9095A) and the Toxicity Characterization Leaching Procedure (TCLP) test. The paint filter test determines the presence of free liquids in a sample. Dried biosolids, such as in the case of the City's biosolids, typically pass this test. The TCLP determines whether the sewage sludge is hazardous.

2.5.2.2 Current State of California Regulations

SWRCB's General Order

At the State level, beneficial use of biosolids is primarily regulated by the SWRCB Division of Water Quality (DWQ) and RWQCBs through the SWRCB's General Order No. 2004-12-DWQ. The Biosolids General Order goes beyond the requirements of 40 CFR Part 503 for land application of Class B biosolids by requiring additional biosolids testing, soil testing, and groundwater sampling.

The SWRCB and the RWQCBs generally recognize that Class A, Exceptional Quality biosolids products such as heat dried pellets, compost, and liquid product from thermo-chemical hydrolysis are commercial products and their use is not regulated by the SWRCB. In these cases, the California Department of Food and Agriculture has the authority to license these products as fertilizers.

Notably for the City, the General Order prohibits land application of biosolids with solids concentrations greater than 50 percent. However, this limitation can be overcome by obtaining a WDR permit instead of a permit under the General Order.

Senate Bill 1383

Senate Bill (SB) 1383 is expected to be a strong driver to land apply rather than landfill biosolids. SB 1383 requires the reduction of short-lived climate pollutants (including methane) to achieve statewide greenhouse gas reduction targets by 2030. To do this, it requires 50 percent diversion of organic waste (including sludge, digestate, and biosolids) from landfills by 2020 relative to 2014 levels and 75 percent diversion by January 1, 2025. As of January 1, 2022, use of biosolids as alternative daily cover at landfills is considered disposal. In addition, to promote the beneficial use of biosolids, SB 1383 allows CalRecycle to overturn counties' overly restrictive biosolids ordinances.

Assembly Bill 901

Assembly Bill (AB) 901 requires increased biosolids recycling and disposal reporting requirements as of Spring 2019. AB 901 requires increased tracking and reporting of organic waste recycling and disposal (including sludge, biosolids, and digestate). Waste, recycling, and compost facilities, as well as exporters, brokers, and transporters of recyclables or compost are required to submit information directly to CalRecycle on the types, quantities, and destinations of materials that are disposed of, sold, or transferred inside or outside of the state.

2.5.2.3 Current Local Regulations

County Ordinances

While regulations at the federal and state level allow land application of Class B biosolids; at the county level, many counties in California have instituted land application ordinances that limit land application of Class B biosolids. As shown in Figure 2.4, Class B land application is banned in Tulare county, where Visalia is located, as well as most of the surrounding counties, including Fresno, Kings, Kern, and San Luis Obispo. This leads to long hauling distances and correspondingly costly hauling rates since Class B biosolids need to be hauled to far-away counties for beneficial use. The City currently land applies their biosolids in Merced and Madera counties. CalRecycle is currently in the process of reaching out to Tulare, Sutter, Stanislaus, and San Joaquin counties in an attempt to change their overly restrictive ordinances. Of relevance to the City, these negotiations may lead to Class B land application being allowed in Tulare County in the future.

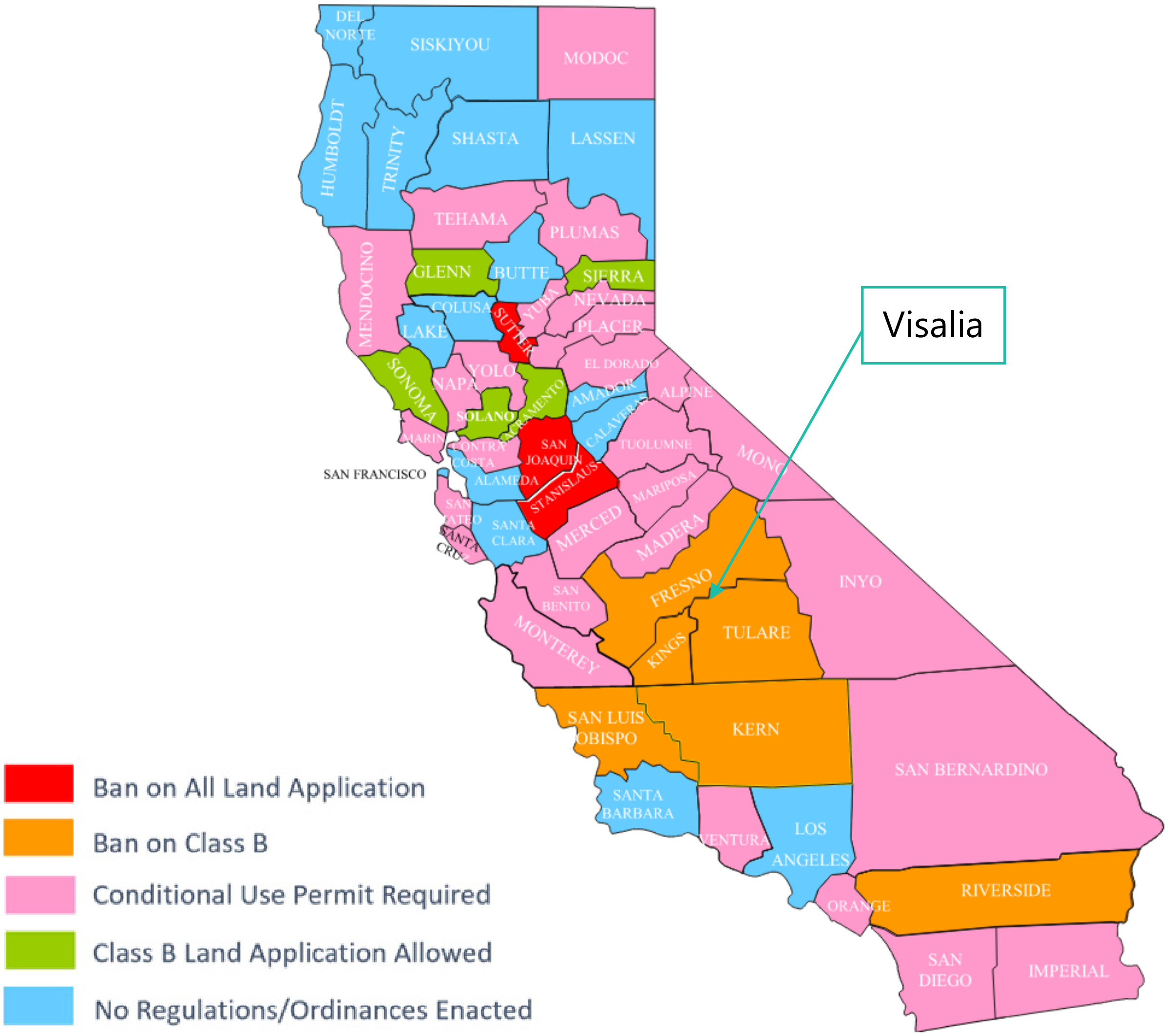

Figure 2.4 County Land Application Ordinances in California

CV-SALTS

As mentioned above, the City is located in a Priority 1 (highest priority) area of CV-SALTS, a regional program that aims to reduce salt and nitrogen accumulation in the Central Valley basin. Refer to Section 2.2.1.1 – Basin Plan Requirements and CV-SALTS above for more information on this program.

Depending on the findings from the nitrate and salts control programs, described above, salt and nutrient management restrictions may apply which may limit land application of biosolids, since biosolids contain salts and nutrients.

2.5.2.4 Future Regulatory Considerations

At the federal level, biosolids regulations are well established. In contrast, several recently implemented and anticipated state regulations may impact the future of biosolids land application in California, with some regulatory drivers potentially promoting land application and others potentially limiting land application.

The following recently implemented state-level regulations may promote biosolids land application:

- SB 1383 (2016, effective 2022):
  - Expected to incentivize co-digestion of organics at water resource recovery facilities (WRRF) and beneficial use of biosolids and biogas.
  - Expected to increase competition for anaerobic digestion and composting capacity.
  - May overturn overly restrictive county ordinances.
- Several climate initiatives may promote land application for its fertilizer offset and carbon sequestration benefits:
  - Healthy Soils Initiative (2016).
  - Executive Order N-82-20 (2020).
  - AB 284 (2021).
  - SB 27 (2021).

The following expected future federal and local limits on emerging contaminants may hinder biosolids land application:

- Potential limits on PFAS:
  - The SWRCB recently issued an order (WQ 2020-0015-DWQ) that requires wastewater treatment plants with AWDF over 5 million gallons per day (mgd) to sample 31 PFAS analytes in biosolids starting March 2023. Limits may be set based on findings from SWRCB sampling and analysis.
  - If stringent PFAS concentration limits are established for biosolids, this could drive wastewater agencies to either landfill biosolids or implement emerging, advanced thermal technologies, such as gasification and pyrolysis (if proven to remove/destroy PFAS compounds).
- Potential limits on microplastics:
  - SB 1263 mandates a Statewide Microplastics Strategy to protect coastal waters.
  - May require testing (although there are no standard methods for biosolids to date).
  - Limits may be established based on the findings from the testing.

2.5.3 Biosolids Strategic Plan Recommendations

The WRF stabilizes their solids through anaerobic digestion and air drying. The solids produced are classified as Class B. However, recent pathogen testing indicates the solids' pathogen concentrations meet the requirements to be classified as Class A. In most cases, the dried biosolids are beneficially used through bulk agricultural land application in Merced and Madera counties. Occasionally, the biosolids are landfilled.

The WRF is in Tulare County, where Class B biosolids land application is currently banned, requiring hauling to farther counties. In addition, the City is facing increased third party biosolids hauling and end-use rates. CalRecycle, through SB 1383, is currently attempting to overturn the Class B biosolids ban in Tulare county. If they achieve that, the City may benefit from evaluating local biosolids beneficial use options, which would reduce their hauling costs. In addition, the City may consider further testing their biosolids to determine if they can reliably meet Class A through pathogen testing and attempt to obtain Class A designation for their biosolids. Class A designation would allow the City to beneficially use their biosolids locally, even if the Class B ban remains, and would expand the potential beneficial use options beyond bulk agricultural land application. Class A biosolids can be used in bulk agricultural land application for any type of crop and in commercial and residential landscaping, parks, nurseries, golf courses, etc.

As described in TM 3 – Environmental Opportunities in the Facility Plan, the high-level cost evaluation for Class A solids processing alternatives identified that advanced digestion alternatives, such as thermal hydrolysis process (THP) and batch temperature phased anaerobic digestion (TPAD), may be cost-competitive relative to an expansion of conventional mesophilic digestion, while providing additional benefits including production of Class A biosolids, reduced solids quantities, and increased biogas production. These alternatives could be evaluated further later in a biosolids master plan.

The evaluation in TM 3 – Environmental Opportunities in the Facility Plan also identified that technologies with the potential to treat PFAS in biosolids, such as pyrolysis and gasification, have very high capital costs and are cost prohibitive. Thus, these technologies should only be considered if potential future PFAS limits require them. Gasification and pyrolysis usually follow thermal drying of solids; however, the City could investigate whether these processes can receive air-dried biosolids, which may result in substantial cost savings. Alternatively, the City could investigate regional partnerships for processing biosolids through an advanced thermal process, given these technologies benefit from economies of scale.

Given the myriad of potential future regulatory changes that may impact the City's future biosolids management, Carollo recommends conducting a biosolids master plan to do a more detailed analysis of solids processing and biosolids beneficial use alternatives and develop a plan to adapt to these potential future changes.

Water Reclamation Facility – Master Plan

TECHNICAL MEMORANDUM 3

Existing Facilities

FINAL / June 2024

Water Reclamation Facility – Master Plan

TECHNICAL MEMORANDUM 3

Existing Facilities

FINAL / June 2024

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TM 3 EXISTING FACILITIES

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Abbreviations

BOD	biochemical oxygen demand
Carollo	Carollo Engineers
City	City of Visalia
cu ft	cubic feet
GBT	gravity belt thickener
GCSD	Goshen Community Services District
µm	micrometers
MBR	membrane bioreactor
MG	million gallons
mgd	million gallons per day
mm	millimeter
MW	megawatt
No.	number
RAS	return activated sludge
RPGS	Renewable Power Generation System
TID	Tulare Irrigation District
TM	technical memorandum
TSS	total suspended solids
TWAS	thickened waste activated sludge
UV	ultraviolet
WAS	waste activated sludge
WDR	Water Discharge Requirements
WRF	Water Reclamation Facility

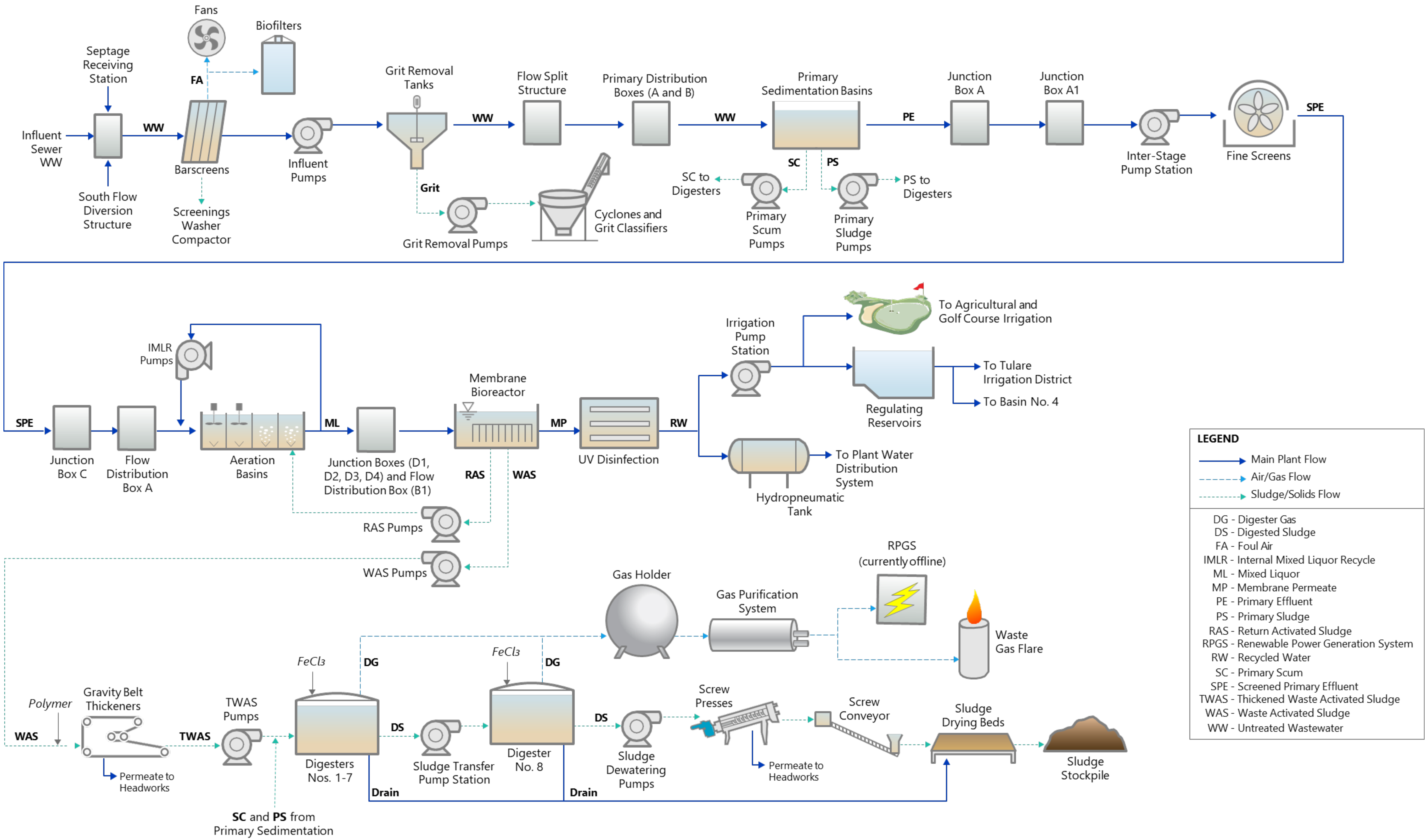
TM 3 EXISTING FACILITIES

3.1 Introduction

This technical memorandum (TM) summarizes the existing treatment facilities at the Visalia Water Reclamation Facility (WRF). It is important to note that this TM does not contain information on the condition of the existing WRF assets. For discussion of the condition assessment, refer to Facility Plan TM 2.

The WRF provides wastewater services to the City of Visalia (City) and the Goshen Community Services District (GCSD), supplying Title 22 tertiary treated recycled water for irrigation and plant-wide operational reuse purposes. Originally built in 1966, the WRF has undergone multiple expansions and improvements. The most recent WRF upgrades were completed in 2017. Figure 3.1 illustrates the current process flow diagram, and Figure 3.2 shows the existing WRF site layout. Per the latest Waste Discharge Requirements (WDR) Order (R5-2018-0046), the WRF is permitted a discharge of up to 18 million gallons per day (mgd) for dry weather monthly average daily flow.

The WRF existing facilities are capable of processing and treating liquid wastewater, biosolids, and digester gas streams. Liquid wastewater entering the WRF is treated via preliminary, primary, secondary, and tertiary treatment processes. Solids are collected at various stages of the treatment train and undergo a series of solids handling processes prior to disposal. Gas streams that are generated from within the plant are treated via an onsite gas purification system and flared. The following sections of this TM describe these WRF liquid, solid, and gas treatment processes in greater detail. The descriptions of the existing facilities were obtained from the 2014 WRF Upgrade design drawings and the Operations and Maintenance Manual, which includes latest upgrade project completed in 2017.



Current Process Flow Diagram was developed using the process flow diagram presented in the Operation and Maintenance Manual for Visalia WRF, which was developed in November 2018 by Parsons.

Figure 3.1 Visalia Water Reclamation Facility Current Process Flow Diagram

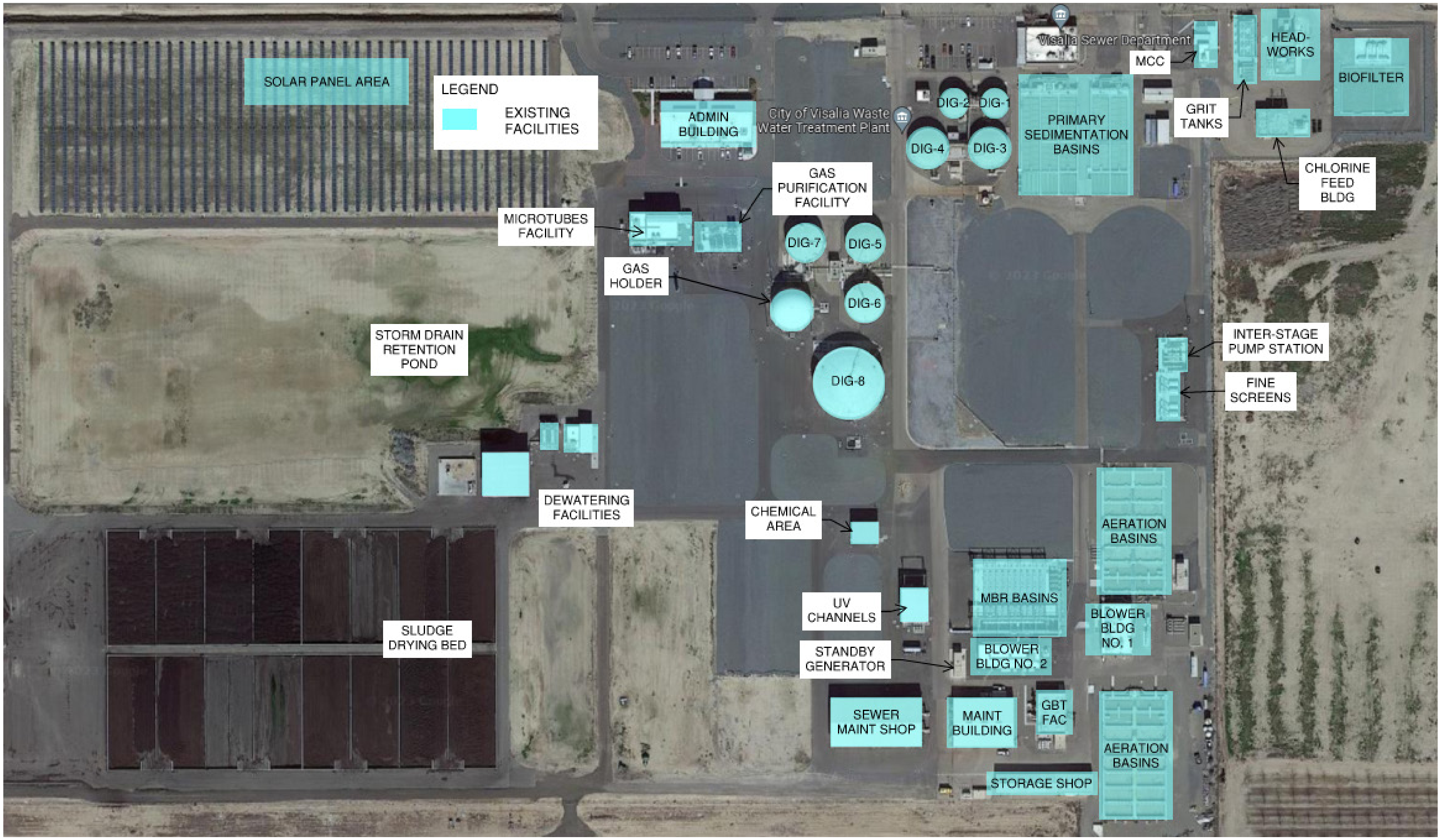


Figure 3.2 Existing Site Layout

3.2 Preliminary Treatment

The WRF preliminary treatment system consists of two Parshall flumes, mechanical bar screens, screenings conveyance, influent pumping, grit removal, and grit conveyance. Raw sewage from a number of influent sources (collection system, septage receiving station, etc.) enters the WRF through the headworks structure where it undergoes screening and grit removal. The wastewater first passes through two Parshall flumes that measure the amount of influent flow entering the WRF. Each Parshall flume has a capacity of 47 mgd. Two mechanical bar screens, each with a capacity of 47 mgd, are used to remove coarse solids, such as rocks, trash, and other large materials. The screened materials are conveyed and transferred to a compactor before disposal.

After screening, the Influent Pumping Station, consisting of six submersible non-clog pumps, lifts the wastewater from the influent wet wells to the grit removal system. The grit removal system includes four vortex grit removal tanks, four grit pumps, and two classifiers. The grit pumps transfer all the settled grit collected from the grit removal tanks to the classifiers before disposal. Additionally, foul air emitted from the headworks structure is collected and delivered to biofilters for gas treatment. The effluent from the grit removal system is conveyed to the primary flow split structure where wastewater continues on to the primary treatment process.

3.3 Primary Treatment

After preliminary treatment, the Primary Flow Split Structure distributes flow to the primary treatment system. The primary treatment system consists of two primary distribution boxes, five rectangular primary sedimentation basins, three primary sludge grinders, four primary sludge pumps (two duty and two standby), two primary scum grinders, and two primary scum pumps. Preliminary effluent is distributed to the primary distribution boxes and primary sedimentation tanks where the heavier solids sink to the bottom of the basins and the lighter solids float. Each basin has a volume of 0.35 million gallons (MG) and is equipped with sludge and scum collection mechanisms. Primary sludge and primary scum are collected, grinded, and pumped to the digesters. The primary sedimentation process removes portions of total suspended solids (TSS), biochemical oxygen demand (BOD), and scum from the wastewater. Without chemical addition, the primary sedimentation basin removal rates for BOD and TSS are typically 30 to 35 percent and 60 to 65 percent, respectively. The primary effluent is conveyed to the Inter-Stage Pump Station and fine screens before secondary treatment.

3.4 Secondary Treatment

Prior to secondary treatment, the Inter-Stage Pump Station pumps the primary effluent from the primary sedimentation basins to the fine screens. This pump station is equipped with a self-cleaning trench-type wet well and three pumps (two duty and one standby) with a firm capacity of 44 mgd. The pumps are required when the plant influent flow exceeds 13 mgd. Downstream of the Inter-Stage Pump Station, the fine screens receive the primary effluent and remove small particles (2 millimeters [mm] in diameter or larger) from the wastewater. Each of the four fine screens is equipped with screenings washing-dewatering-and compact units. This fine screening process prevents damage to the membranes in the membrane bioreactor (MBR) system.

After fine screening, the primary effluent flows to the MBR system, which consists of four aeration basins and ten membrane tanks. The aeration basins contain three anoxic zones and three oxic zones for effective organic and nitrogen removal. Each aeration basin has a volume of 1.15 MG and is equipped with mixers in the anoxic zones and fine bubble diffusers in the oxic zones. For denitrification, four mixed liquor pumps return mixed liquor from the end of the aeration basins back to the first anoxic zone. Each membrane tank has a volume of 53,860 gallons and consists of eight cassettes of vertical hollow fiber membranes. The fiber membrane pores have a nominal size of 0.04 micrometers (μm), effectively removing small solids, protozoa, bacteria, and most viruses. The MBR system produces a high quality permeate that is conveyed to the tertiary treatment process for disinfection.

The accumulated solids from the secondary treatment processes are collected and conveyed via the return activated sludge (RAS) and waste activated sludge (WAS) pumps. The RAS/WAS Pump Station has four RAS pumps and two WAS pumps. RAS is returned to the first oxic zones of the aeration basins, and WAS is pumped to the gravity belt thickeners (GBTs) for solids handling processing.

3.5 Tertiary Treatment

The membrane permeate from the MBR system is sent to the ultraviolet (UV) disinfection system consisting of an influent channel, two UV channels, an effluent channel, box, and sampler. UV radiation inactivates the pathogens and microorganisms in the water to ensure that recycled water Title 22 disinfection requirements are met. The UV system contains twenty duty modules and four standby modules and has an average flow capacity of 18 mgd and a peak flow capacity of 28.8 mgd. The disinfected tertiary recycled water can then be distributed via the Recycled Water Distribution System or the Plant Water Distribution System for water reuse applications.

3.6 Water Distribution Systems

3.6.1 Recycled Water Distribution System

Following disinfection, tertiary effluent recycled water is discharged into the effluent distribution box where water can be stored in regulating ponds, travel to the Basin Number (No.) 4 distribution box, or sent to the Recycled Water Pipeline Pump Station. The two regulating ponds can each hold about 14 MG of recycled water. The Basin No. 4 distribution box can distribute flow to Basin No. 4 and to the Tulare Irrigation District (TID). The Recycled Water Pipeline Pump Station can pump tertiary effluent offsite for multiple water reuse purposes, such as for irrigating agriculture, a golf course, and a park. Table 3.1 lists the Visalia WRF discharge locations.

Table 3.1 Visalia Water Reclamation Facility Discharge Locations

Description	Acreage/Storage
City farmland	996 acres
On-site Pond 2	84 acre-feet
On-site Pond 3	304 acre-feet
City-owned Basin No. 4	1,287 acre-feet
Potential contracted land	2,525 acres
TID	10,700 acres
City-owned farmland near the airport	664 acres
Landscape Reuse	253 acres

3.6.2 Plant Water Distribution System

In addition to the Recycled Water Distribution System, the Plant Water Distribution System receives tertiary effluent from the UV disinfection system for water reuse purposes within the WRF. The Plant Water Distribution System consists of a hydropneumatics tank, three plant water pumps, and an air compressor. The hydropneumatic tank has a capacity of 10,000 gallons and stores recycled water until it is used within the plant, such as washdown and operation of screens, basins, tanks, and pumps. The water level in the hydropneumatic tank is controlled by the tank air pressure system.

3.7 Solids Handling

The sludge handling processes include sludge thickening, digestion, dewatering, and drying. WAS from the activated sludge process is thickened by the sludge thickening system, which includes two gravity belt thickeners, two belt washwater pumps, two thickened sludge pumps, and three polymer feed and metering units. Before entering the GBTs, polymer is added into the WAS feed stream to enhance solids retention and produce a more concentrated thickened waste activated sludge (TWAS). The residual water that drains through the gravity belt is collected and recycled back to the headworks for treatment.

Following sludge thickening, TWAS, primary scum, and primary sludge are pumped and distributed to Digesters No. 1 through No. 7 for stabilization. Two pumps in the Sludge Transfer Pump Station transfer the digested sludge from these digesters to Digester No. 8 to complete the digestion process. The anaerobic digesters at the WRF are designed to operate in mesophilic mode and stabilize the solids to a degree more suitable for dewatering and offsite disposal. Each digester has a circular fixed cover and is constructed of reinforced concrete. Digesters No. 1 through No. 7 have a combined capacity of approximately 3.39 MG, and Digester No. 8 has a total capacity of about 2.23 MG. Currently, part of Digester No. 8's capacity is reserved for 0.55 MG of storage, while the other 1.38 MG is available for digestion. Also, digester gas is produced and treated within the WRF. Ferric chloride is added to the digesters to precipitate hydrogen sulfide and assist with the gas purification system.

After completion of the digestion process, digested sludge is pumped to two screw presses that remove additional water from the sludge and produces a sludge cake optimal for drying and disposal. Polymer is added upstream of the screw presses for flocculation, enhancing the dewaterability of the sludge. The drained water (centrate) is recycled back to the headworks for treatment. Once the digested sludge cake has been dewatered, it is transported to onsite sludge drying beds for additional drying and ultimately disposed by either land application at an approved facility or used as landfill alternative cover.

3.8 Digester Gas Treatment

Digester gas is a byproduct of the anaerobic digestion process and is capable of being used for energy recovery applications. At the WRF, a Renewable Power Generation System (RPGS) was installed to generate electrical power and recover waste heat using a 1 megawatt (MW) internal combustion engine. However, the City has not been able to use the RPGS due to permitting reasons.

Digester gas is first stored in a 100,000 cubic feet (cu ft) gas holder and then conveyed to the gas treatment system. The gas treatment system, consisting of hydrogen sulfide removal vessels, booster blowers, moisture/particulate filters, siloxane removers, and a fuel blending system, is designed to remove undesired compounds providing a cleaner gas to meet the requirements for the engine generators. The digester gas is then burned via the waste gas flare system.

Water Reclamation Facility - Master Plan

TECHNICAL MEMORANDUM 4

Long-Term Project Descriptions

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Water Reclamation Facility - Master Plan

TECHNICAL MEMORANDUM 4

Long-Term Project Descriptions

FINAL / June 2024

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TM 4 LONG-TERM PROJECT DESCRIPTIONS

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Abbreviations

AADF	annual average daily flow
ADMM	average daily maximum month
City	City of Visalia
ft	feet
ft^2	square feet
HRT	hydraulic retention time
IMLR	internal mixed liquor return
lb VS/cf-day	pounds of volatile solids per cubic foot per day
MBR	membrane bioreactor
MCC	motor control center
mJ/cm^2	millijoules per square centimeter
mg/L	milligrams per liter
MG	million gallons
mgd	million gallons per day
MLSS	mixed liquor suspended solids
No.	number
PWWF	peak wet weather flow
RAS	return activated sludge
scfh	standard cubic feet per hour
SRT	solids retention time
TM	technical memorandum
TS	total solids
UV	ultraviolet
UVT	ultraviolet transmittance
VSLR	volatile solids loading rate
WRF	Water Reclamation Facility

TM 4 LONG-TERM PROJECT DESCRIPTIONS

4.1 Introduction

This technical memorandum (TM) summarizes projects that are recommended for implementation within the next 20 years based on the capacity analysis summarized in TM 1 – Long-Term Process Performance Evaluation. These long-term projects are required to reliably treat 20-year projected flows and loads. This TM is not a comprehensive overview of all long-term projects that are required at Visalia's Water Reclamation Facility (WRF).

The long-term projects are:

- Membrane Bioreactor (MBR) Capacity Expansion.
- Ultraviolet (UV) Disinfection Capacity Expansion.
- Anaerobic Digestion Capacity Expansion.
- Biogas Flare Capacity Expansion.
- Dewatering Capacity Expansion.
- Sludge Drying Capacity Expansion.

Long-term projects can be seen on the site plan shown in Figure 4.1. For each project, this TM summarizes the project background and drivers, basis of design, and recommended improvements. Project costs for the recommended projects are summarized in TM 5 – Long-Term Capital Improvement Program.

4.2 Membrane Bioreactor Capacity Expansion

4.2.1 Background

As described in TM 1 – Long-Term Process Performance Evaluation, the MBR system does not have sufficient capacity to treat the projected average daily maximum month (ADMM) load and maintain the current design criteria of a 10-day solids retention time (SRT) and mixed liquor suspended solids (MLSS) concentration not exceeding 12,000 milligrams per liter (mg/L). However, instead of building additional aeration tanks to reduce the MLSS concentration, operation of the MBR system could be adjusted to use an 8-day SRT, which is the lower end of target SRTs, to increase the capacity of the MBR system.

In addition to adjusting operations, the capacities of the return activated sludge (RAS) pumps, blowers, internal mixed liquor return (IMLR) pumps, and membrane cassettes need to be increased to ensure the MBR system can meet performance requirements.

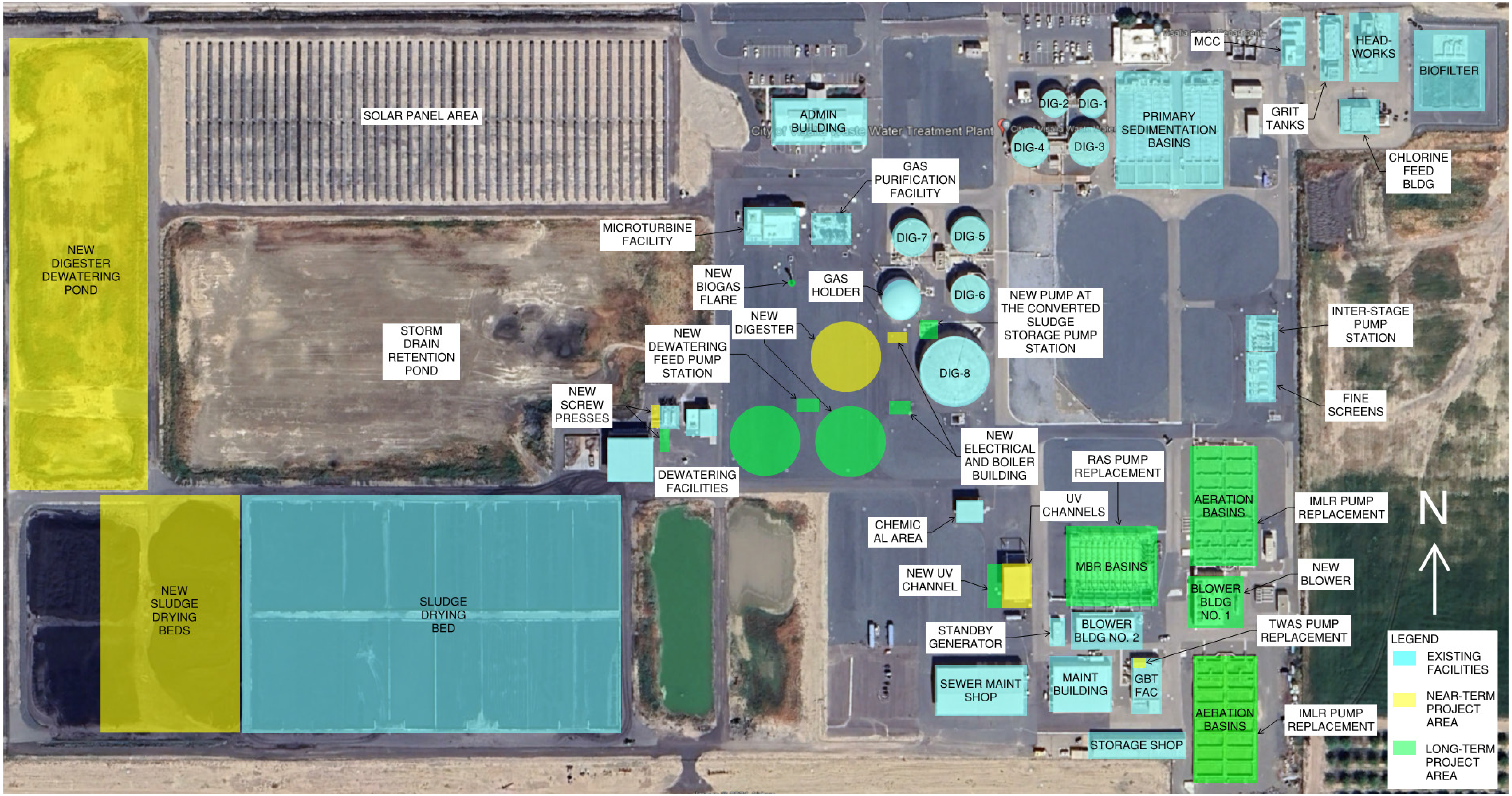

Figure 4.1 Site Layout of Recommended Projects

4.2.2 Basis of Design

The current MBR system does not have sufficient capacity to meet the future 2044 flows and loads. Therefore, operations need to be adjusted to increase the capacity of the aeration tanks as mentioned above, and an additional RAS pump, aeration blower, and membrane cassettes need to be added. The additional RAS pump and aeration blower should match the existing equipment. The membrane cassette expansion would include a 52-module cassette with 430 square feet (ft^2) per module per train. This expansion differs slightly from the 2017 Operations and Maintenance Manual due to what is currently offered for the ZeeWeed 500D, but the additional membrane surface area is the same and is compatible with the City of Visalia's (City's) existing system. The existing MBR system has space reserved for installation of all these pieces of equipment.

The total nitrogen limit for the system is 10 mg/L for the average monthly concentration. Furthermore, the groundwater quality goal for nitrate is to be less than 10 mg/L. It was determined that the anoxic zones have sufficient denitrification capacity. Therefore, a higher flowrate of IMLR is possible, and the four IMLR pumps should be upsized from a total capacity of 89 million gallons per day (mgd) to 160 mgd.

4.2.3 Recommendations

It is recommended to operate the system at an 8-day SRT rather than a 10-day SRT to reduce the MLSS concentration in the MBR system. It is also recommended to add the extra RAS pump, aeration blower, and additional membrane cassettes to increase capacity to the MBR system. By making this operational change and equipment installations, additional aeration tanks would not be needed. Lastly, the IMLR pumps' total capacity should be increased from 89 mgd to 160 mgd to ensure the total nitrogen limit is met and the City's effluent helps meet groundwater quality goals. Depending on the long-term organic load fractionation, additional external carbon (MicroC 2000 or methanol) dosing could be considered for further reducing nitrogen concentration. These improvements should be made by 2033 to avoid exceeding the capacity of the MBR system.

The MBR Capacity Expansion would include the following:

- Addition of one RAS pump.
- Addition of one aeration blower.
- Installation of additional membrane cassettes and modules.
- Installation of higher capacity IMLR pumps.
- Change in operations to have an SRT of 8 days instead of 10 days.
- Associated piping, valves, and appurtenances.
- Installation of associated electrical and instrumentation equipment.

4.3 UV Disinfection Capacity Expansion

4.3.1 Background

After the near-term expansion project is completed, the UV disinfection system will have a firm capacity of 37 mgd (6 duty banks + 1 standby bank). However, this is not sufficient to meet the projected 2044 peak wet weather flow (PWWF) of 42.8 mgd. Furthermore, the projected PWWF is estimated to exceed the UV system's firm capacity in 2038. Therefore, the UV system must be expanded and brought online by 2038.

4.3.2 Basis of Design

The UV system must have a firm capacity to treat the PWWF. With the projected 2044 PWWF at 42.8 mgd, the UV system needs to expand its capacity to meet the firm capacity requirement.

4.3.3 Alternatives Analysis

The existing UV system channels will no longer have any space available for installing additional modules after completion of the near-term expansion project. Therefore, three alternatives were developed for expanding the capacity of the UV system and are listed below.

4.3.3.1 Re-rate the Existing Ultraviolet System

The existing UV system was designed based on an ultraviolet transmittance (UVT) of 65 percent, but historical data shows that the UVT is higher than 65 percent. Increasing the design UVT would increase the rated capacity of the existing system. Increasing the design UVT from 65 to 68 percent would re-rate the existing UV system to have sufficient capacity for the projected 2044 PWWF.

4.3.3.2 Construct a New Third Ultraviolet Channel

A new UV channel with five duty banks and one standby bank could be constructed to increase the UV system's capacity. This configuration would include 12 new UV modules, two modules per bank. With a UVT of 65 percent and a minimum dose of 80 millijoules per square centimeter (mJ/cm^2), the expansion would increase the current UV system's firm capacity by 14.4 mgd, resulting in a total firm capacity of 43.2 mgd. Additional piping would be needed to route water to and from this new UV channel as well.

4.3.3.3 Replace the Existing Ultraviolet System with Different Equipment

Different equipment could be installed in the existing UV channels. However, after analyzing this further, it was determined that with the higher 2044 PWWF, this was not feasible. Significant structural modifications would be required since other UV systems would not fit in the existing channels with the higher flow. Therefore, this alternative is not recommended.

4.3.4 Recommendations

Even though the historical UVT data indicates the system is operating at a higher UVT than the original design criteria of 65 percent, UVT can vary over time, so it is recommended to revisit re-rating the UV system with the UVT data available during preliminary design. Therefore, for planning purposes, it was conservatively assumed that the UV system would be expanded to meet the projected 2044 PWWF. As mentioned above, using different equipment in the existing channel structure is not feasible, so it was assumed that a new third UV channel would be constructed and brought online by 2038. This channel could be an external channel or further analysis can be done to evaluate if it's possible to build the third channel between the two existing channels. Additionally, with higher flows, the headloss limit in the channels could be exceeded. This should be checked, and structural modifications, such as raising the floor upstream of the banks, should be made if this occurs.

The UV Disinfection System Capacity Expansion improvements would include the following:

- Construction of a new third channel for UV modules that includes space for seven banks. It is assumed for planning purposes that six banks would be initially installed. This should be verified during preliminary design of the UV system expansion.
- Installation of UV modules and associated vendor provided stepdown transformers and power supply units.
- Yard piping, including piping from the MBR system.
- Installation of associated electrical and instrumentation equipment.

4.4 Anaerobic Digestion Capacity Expansion

4.4.1 Background

The near-term anaerobic digestion capacity expansion project will include a new Digester Number (No.) 9 that is the same effective capacity as Digester No. 8. However, this additional digester does not provide sufficient firm capacity to meet minimum criteria for the projected design year flows as described in TM 1 – Long-Term Process Performance Evaluation.

4.4.2 Basis of Design

The long-term anaerobic digestion capacity expansion will need to provide at least 15 days of SRT at design year 2044 max month flows with the largest digester out of service. To provide three days of storage – which would allow the City to halt operations over a long weekend – at the projected 2044 max month sludge production, the sludge storage volume needed is at least 1.0 million gallons (MG).

This alternatives analysis used a digester feed of 5 percent total solids (TS) and 3.5 percent TS for the thickened waste activated sludge and primary sludge thickness, respectively, and a maximum volatile solids loading rate (VSLR) of 0.2 pounds of volatile solids per cubic foot per day (lb VS/cf-day). The total capacity, including the sludge storage volume in Digester Nos. 8 and 9, of the existing digesters (Digester Nos. 1-8) and the new Digester No. 9 is about 7 MG, which was used to determine the additional digestion capacity needed.

4.4.3 Alternatives Analysis

Three alternatives were analyzed for expanding the capacity of the anaerobic digestion system and are listed below.

4.4.3.1 Construct Two Additional Digesters

Both Digesters No. 8 and No. 9 have almost 30 percent of their volume allocated to sludge storage instead of active digestion capacity, resulting in a total storage volume of 1.1 MG. This is because Digester No. 8 was originally designed with storage to accommodate halting operations over the weekend, and if Digester No. 8 is out of service, Digester No. 9 provides redundancy, including storage capabilities. This storage volume is about 15,000 gallons more than the minimum required 2044 sludge storage volume. The internal storage volume in the two digesters could remain to meet the sludge storage requirement, but the additional digestion capacity required would be 2.24 MG. To meet this additional digestion capacity needed, two digesters need to be constructed and brought online by 2037.

4.4.3.2 Construct One Additional Digester and One Sludge Storage Tank

As stated above, both Digester No. 8 and No. 9 have almost 30 percent of their volume allocated to sludge storage instead of active digestion capacity. Reallocating this sludge storage volume to active digestion capacity and providing a separate sludge storage tank would reduce the additional digestion capacity needed for 2044 down to 1.69 MG. Therefore, one digester the size of Digester No. 8 and No. 9, 1.94 MG, and a separate 1.13 MG sludge storage tank could be constructed.

The major advantage of constructing a separate sludge storage tank is that the current configuration, which sends sludge to the smaller digesters (Digester Nos. 1-7) first and then to Digester No. 8 (and Digester No. 9 after the near-term project), could be changed to a configuration with all the digesters being fed directly. With this configuration, the volume in Digester No. 8 is needed to meet the 15-day SRT requirement. This configuration is because only Digester No. 8 has piping that goes to the dewatering process area. Thus, the smaller Digesters No. 1-7 are running at lower SRTs and the City has experienced issues with souring digesters. Having a separate sludge storage tank would eliminate the need to transfer sludge from the smaller digesters to Digester Nos. 8 and 9 and allow all digesters to be fed directly, which would reduce the hydraulic loading to the smaller digesters and allow them to be operated at a 15-day SRT.

Another advantage of separating sludge storage from active digesters is that the sludge in storage does not need to be heated whereas the sludge in storage in active digesters is heated. Therefore, a separate sludge tank would result in energy savings from the reduced heating demand.

4.4.3.3 Retrofit Digesters to High Solids Digestion System

Assuming a minimum design SRT of 15 days and a maximum VSLR of 0.2 lb VS/cf-day, the existing digestion system is currently limited by the hydraulic loading rate. The digester can be transitioned from a hydraulic limitation to an organic limitation by increasing the feed solids concentration. Depending on the feed solids volatile solids concentration, the transition from hydraulic to organic limitation generally occurs around a feed solids concentration of 6 percent TS. It is often difficult for mechanical thickening systems to increase the feed solids concentration beyond this level.

In typical anaerobic digestion (like the City's digesters), the solids hydraulic retention time (HRT) is equal to SRT. A high solids digestion system uses recuperative thickening to decouple the HRT and SRT and may allow digesters to operate at higher VSLRs. There is some evidence that high solids digesters can be stable indefinitely at 0.25 lb VS/cf-day, but more research is needed to confirm that this VSLR is possible in a range of operational conditions.

A recuperative thickening system would consist of progressing cavity pumps, inline grinders, polymer feed and mixing equipment, flocculation tank, and one recuperative thickener per digester installed on a slab at grade next to the digester that it serves. Solids would be removed from the digester, conveyed through the thickener, and thickened solids returned to the same digester. Filtrate from the thickener would return to the headworks.

To meet the 2044 digestion capacity requirement, three medium digesters (Digesters No. 3-7) would need to be recuperatively thickened, assuming recuperative thickening reaches 6 percent TS. Since not all digesters would be thickened, the operational complexity of the digestion system would increase since different digesters would be operated at different solids concentrations.

The increased solids concentration inside of the digester is generally too high for pump mixing, draft tubes, linear motion, and gas mixing. Therefore, any digester using recuperative thickening would need to be retrofitted with a new mixing system designed to mix thicker digester solids. In general, due to the age of the existing digesters, any tank being retrofitted would require replacing the covers and significant seismic upgrades to accommodate the new roof-mounted mixing system. For these reasons, converting the existing digesters to high solids digesters is not recommended.

4.4.4 Recommendations

It is recommended to construct a new digester, Digester No. 10, the same size as Digester Nos. 8 and 9, and a new sludge storage tank with a 1.13 MG capacity. The new digester and sludge storage tank should be online by 2037. The new design criteria for the three large digesters and sludge storage capacity are shown below in Table 4.1. The new digester would allow the plant to meet the required SRT for Class B biosolids with either Digester Nos. 8, 9, or 10 offline for the 2044 ADMM sludge loading projections. It is also recommended to convert the existing dewatering pump station to a sludge storage pump station and construct a new dewatering feed pump station, which is discussed more in Section 4.6.

Table 4.1 Design Criteria for the Large Digester and Sludge Storage Tank

Parameter	Value
Digester Nos. 8, 9, 10	
Operating Volume of Digesters (excluding cone depth), each	1.94 MG
Sludge Storage Tank	
Sludge Volume (excluding cone depth)	1.13 MG
Side Water Depth	30 ft
Diameter	80 ft

Notes:
Abbreviations: ft - feet.

The Anaerobic Digestion Capacity Expansion improvements would include the following:

- Construction of a new digester.
- Construction of a new sludge storage tank.
- Digester and sludge storage tank mixing systems, including a mixing pump and associated piping, valves, and appurtenances.
- Digester heating system, including a sludge recirculation pump, hot water pump, heat exchanger, and associated piping, valves, and appurtenances.
- Digester feed transfer pumps and associated piping, valves, and appurtenances.
- Yard piping, including digester feed, digested sludge, hot water return/supply, and digester gas.

- New pump in the reserved space north of Digester No. 8 for converted sludge storage pump station.
- New electrical and boiler building, with a new boiler to expand the capacity of the main hot water loop and new motor control center (MCC) to power all of the equipment associated with this project.

4.5 Biogas Flare Capacity Expansion

4.5.1 Background

With the projected flows, the existing flare system's capacity will not be sufficient. The biogas flare capacity is expected to be exceeded in 2037.

4.5.2 Basis of Design

This project would include the expansion of the biogas flare system. The existing flare has a capacity of 21,250 standard cubic feet per hour (schf). The expansion needs to increase the capacity of the biogas flare system by about 3,750 scfh, resulting in a capacity of about 25,000 scfh.

4.5.3 Recommendations

It is recommended to expand the flaring capacity by replacing the existing flare with a higher capacity flare and a redundant flare. This should be completed by 2037. The Biogas Flare Capacity Expansion improvements would include the following:

- A new, higher capacity flare system.
- Upsizing digester gas piping for higher flows.
- Yard piping from the gas holder to bypass the gas purification system.
- Installation of associated electrical and instrumentation equipment.

4.6 Dewatering Capacity Expansion

4.6.1 Background

After the near-term dewatering capacity expansion project is completed, the WRF will have three screw presses. This provides sufficient capacity for the near-term flows and creates the necessary redundancy required for this process. However, looking toward the 20-year horizon, these screw presses will not be enough to handle the 2044 annual average daily flow (AADF).

Additionally, if a 3-day sludge storage tank is added as discussed above, the screw presses will need to be able to dewater the new storage tank in 4 days, assuming that operation is halted over a 3-day weekend. This can be achieved by running four screw presses at a time, meaning the redundant screw press would also run in this scenario. Therefore, a new screw press must be installed to expand the dewatering capacity for critical redundancy as well as for dewatering the full sludge storage tank.

4.6.2 Basis of Design

As mentioned above, the WRF does not have sufficient firm capacity in the dewatering system for the 2044 AADF. This project would include the addition of a fourth screw press to provide additional dewatering capacity to allow the plant to operate three screw presses with a fourth on standby, providing the necessary redundancy required.

To empty the sludge storage tank after a long weekend, it was assumed that all four units would run 24 hours for four days. By using the redundant screw press for this operation, sufficient capacity is available to handle the higher flows going to the screw presses with the additional flow from the sludge storage tank.

4.6.3 Recommendations

It is recommended to add a fourth screw press with the same capacity as the existing screw presses by 2036 to provide additional capacity and redundancy for the dewatering system; this should be installed south of the existing screw presses. With the addition of the 3-day sludge storage tank, it is recommended to install a fourth pump in the reserved space north of Digester No. 8 and include four pumps at the new dewatering feed pump station.

The dewatered cake conveyors have sufficient capacity and do not need to be replaced. With only one polymer storage tank in use, about 20 days of storage at the projected 2044 sludge flows is available, so additional polymer storage was not included with this project either.

The Dewatering Capacity Expansion improvements would include the following:

- One new screw press, flocculation tanks, and sludge grinders with the same capacity as the existing units.
- New concrete base slab and support columns for the screw presses.
- Construction of the elevated platform for the new screw press.
- New dewatering feed pumps.
- Necessary piping, valves, and appurtenances for the new screw press.
- Installation of associated electrical and instrumentation equipment.
- A new vendor control panel would be installed in the field, and a new cable will be routed through the existing conduit.

Water Reclamation Facility - Master Plan

TECHNICAL MEMORANDUM 5

Long-Term Capital Improvement Program

FINAL / June 2024

Water Reclamation Facility - Master Plan

TECHNICAL MEMORANDUM 5

Long-Term Capital Improvement Program

FINAL / June 2024

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TM 5 LONG-TERM CAPITAL IMPROVEMENT PROGRAM

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Abbreviations

AACE	Association for the Advancement of Cost Engineering
Carollo	Carollo Engineers
CIP	capital improvement program
City	City of Visalia
E.L.A.P.	engineering, legal, administrative, and permitting
ENR CCI	Engineering News-Record Construction Cost Index
M	million
MBR	membrane bioreactor
R&R	rehabilitation and replacement
TM	technical memorandum
TWAS	thickened waste activated sludge
UV	ultraviolet
WRF	Water Reclamation Facility

TM 5 LONG-TERM CAPITAL IMPROVEMENT PROGRAM

5.1 Introduction

This technical memorandum (TM) presents the long-term capital improvement program (CIP) for the City of Visalia's (City) Water Reclamation Facility (WRF) and a summary of the associated capital costs. The CIP presents an estimate of the City's capital expenses over the next 20 years to address recommended capacity-related improvements to the WRF.

5.2 Key Findings and Recommendations

The long-term CIP identifies capacity related projects required at the WRF between 2030 and 2044, which are described in TM 4 – Long-Term Project Descriptions and listed below:

- Membrane Bioreactor (MBR) Capacity Expansion.
- Ultraviolet (UV) Disinfection Capacity Expansion.
- Anaerobic Digestion Capacity Expansion.
- Biogas Flare Capacity Expansion.
- Dewatering Capacity Expansion.

Figure 5.1 shows an annual cash flow basis for the CIP based on the assumed implementation date for each project. This cash flow analysis is provided as a preliminary tool to assess impacts on the City's resources over time.

5.3 Cost Estimate

5.3.1 General Cost Assumptions

The cost estimates were prepared in accordance with the guidelines of the AACE International (the Association for the Advancement of Cost Engineering, 18R-97) for a Class 5 estimate. The AACE Cost Estimate Classification System includes five total estimate classes. Class 5 estimates are appropriate for planning projects before more definitive information, such as detailed designs, is available. Class 5 estimates are typically prepared for any number of strategic business planning purposes, including, but not limited to, project screening, evaluating resource needs and budgeting, and long-range capital planning as is being performed in this Master Plan. Class 5 estimates have wide accuracy ranges. Typical accuracy ranges for Class 5 estimates are -20 to -50 percent on the low side, and +30 to +100 percent on the high side. These ranges vary based on the technological complexity of the project, the availability and accuracy of appropriate reference information, and the inclusion of an appropriate contingency determination.

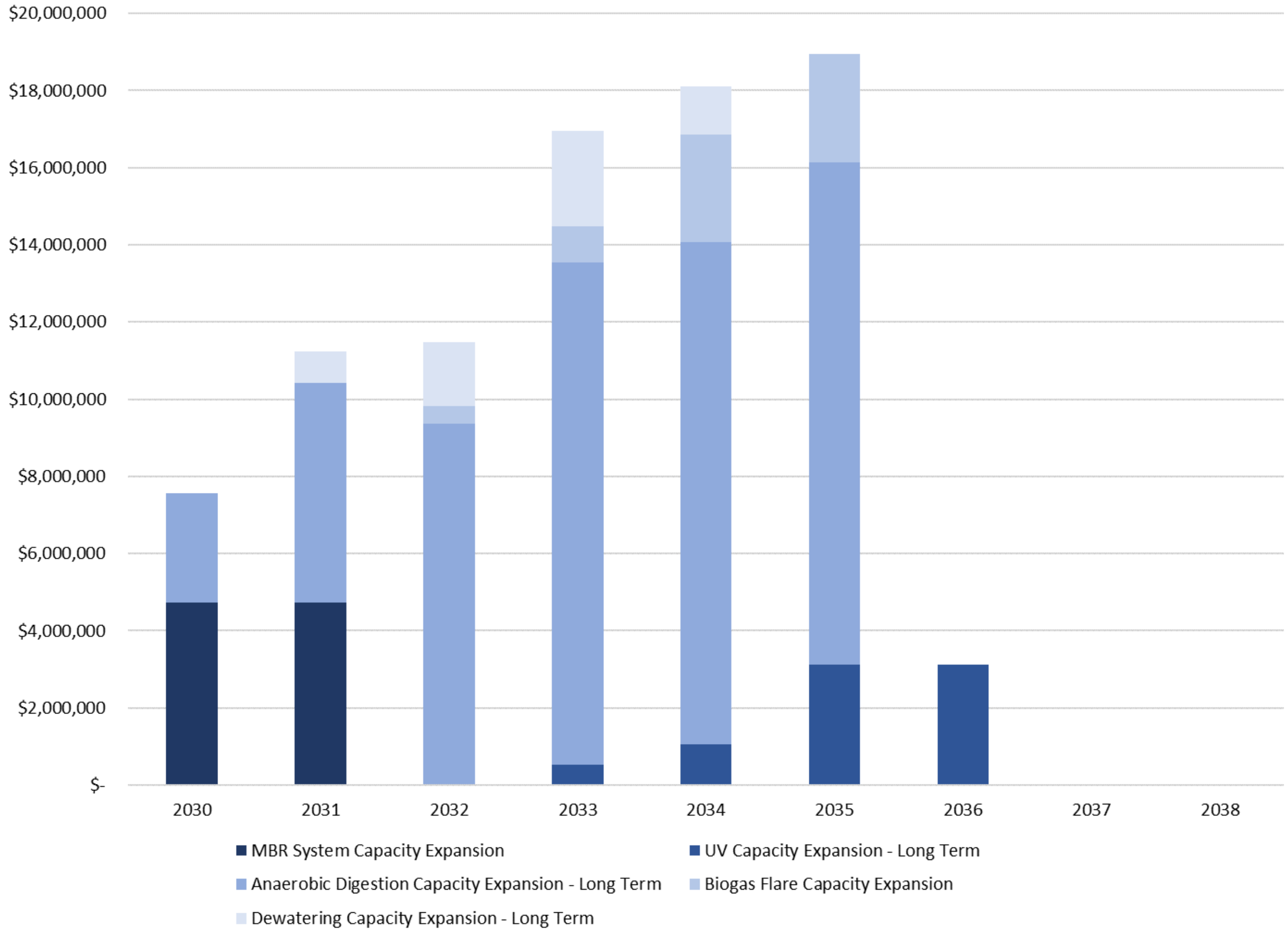


Figure 5.1 Long-Term Projects CIP Cash Flow

Construction cost estimates account for both direct and indirect costs. Direct costs include materials, labor, construction equipment required for installation, and subcontractor costs. Indirect costs include contractor general conditions, contractor overhead and profit, sales tax, and an estimating contingency.

Direct construction costs for all improvements were estimated using various references. Where possible, the costs from design estimates or construction bid tabs were used. Other cost sources included reference projects, the R.S. Means price catalog, cost curves, and vendor quotes. Costs used from design estimates, construction bid tabs, or reference projects were adjusted for location using R.S. Means location factors and for inflation using the appropriate Engineering News-Record Construction Cost Index (ENR CCI). Indirect construction costs were estimated as a percentage of the direct construction cost based on experience and industry-wide standards.

The total project cost was estimated for each project as the total construction cost plus an additional allowance for overall project costs including engineering, legal, administration, permitting costs, etc. Table 5.1 summarizes the overall approach for developing capital cost estimates.

Table 5.1 Capital Cost Estimating Approach

Item	Cost Formula
Total Direct Cost = A	
Estimating Contingency	B = 30 percent of A
Sales Tax (1)	C = 8.5 percent of half of A + B
General Conditions (2)	D = 10 percent of A + B + C
Contractor Overhead and Profit	E = 25 percent of A + B + C + D
Total Construction Cost = A + B + C + D + E	
Engineering, legal, administrative, and permitting (E.L.A.P) costs for implementing the project	E.L.A.P. = 25 percent of Total Construction Cost
Total Project Capital Cost = Total Construction Cost + E.L.A.P.	

Notes:
(1) Sales tax is assumed to be applied to 50 percent of the total direct cost (Item A) with estimating contingency (Item B).
(2) General Conditions accounts for mobilization/demobilization and costs incurred for project management, bonds and insurance, and temporary facilities and utilities.

5.3.2 Project Capital Costs

The total project cost estimates for each project are summarized in Table 5.2. The estimate is at a planning level and includes capital costs only. Rehabilitation and replacement (R&R) costs are discussed in the next section.

Table 5.2 Total Project Capital Cost for Recommended Projects

Project	Cost (1)
MBR Capacity Expansion	$14,750,000
UV Disinfection System Capacity Expansion	$7,830,000
Anaerobic Digestion Capacity Expansion	$56,950,000
Biogas Flare Capacity Expansion	$7,000,000
Dewatering Capacity Expansion	$6,210,000
Total	$92,740,000

Notes:
(1) The costs are presented in 2024 dollars. Note that capital costs presented are for planning purposes. These costs do not include mid-point escalation or bid market allowance. Current market conditions suggest large rates of cost escalation and high rates of variance in construction bidding. It is suggested that an escalation rate and bid market allowance be added to capital costing efforts as project development becomes more refined. Total project costs include factors for estimating contingency, sales tax, general conditions, and contractor overhead and profit as well as 25 percent allowance for engineering, legal, administration, and permitting costs.

5.3.3 Rehabilitation and Replacement Costs

Total R&R costs as well as annual R&R costs that span the 20-year planning horizon are presented in Table 5.3.

Table 5.3 R&R Costs for 20-Year Planning Horizon

Element	Cost
R&R Cost (1)	$53,000,000
Annual R&R Cost First 2024-2034(2)	$2,270,000
Annual R&R Cost Second 2034-2044(3)	$3,030,000

Notes:
(1) Total R&R costs reflect 35 percent of the total project costs and are presented in 2024 dollars.
(2) The annual R&R costs are based on 15 percent of the total capital project costs distributed across the first half of the planning horizon. This approach was used because a majority of the plant was upgraded approximately seven years ago, so it is expected that minimal R&R will be needed during the first half of the planning horizon.
(3) The annual R&R costs are based on 20 percent of the total capital project costs distributed across the second half of the planning horizon. This approach was used because it is expected that more R&R projects will be needed in the second half of the planning horizon.

5.4 Project Implementation

This section discusses the estimated project durations as well as when the projects should be implemented.

5.4.1 Project Durations

Implementation activities for the recommended projects include predesign planning, design, bidding and award, construction, commissioning, and environmental permitting. Project durations were estimated under the following assumptions:

- Smaller-sized projects (those less than $1.0 million [M]) can be completed in two years or less, with one year for planning, design, and bidding, and one year for construction and startup.
- Medium-sized projection (those between $1.0M and $10M) can be completed in two to three years, with one year for planning, design, and bidding, and one to two years for construction and startup.
- Larger-sized projects (those greater than $10M) can be completed in three to five years, with one to two years for planning, design, and bidding, and two to three years for construction and startup.

5.4.2 Implementation Schedule

Plant capacity defines not only the need for the projects, but also implementation timing. The implementation timing, determined by when the plant needs additional capacity, and the project duration assigns each project a start and completion date. The recommended implementation schedule for the long-term projects can be seen below in Table 5.2. Project timing and phasing was based on the criticality of the improvements on treatment process reliability.

5.5 20-Year Project Implementation Plan

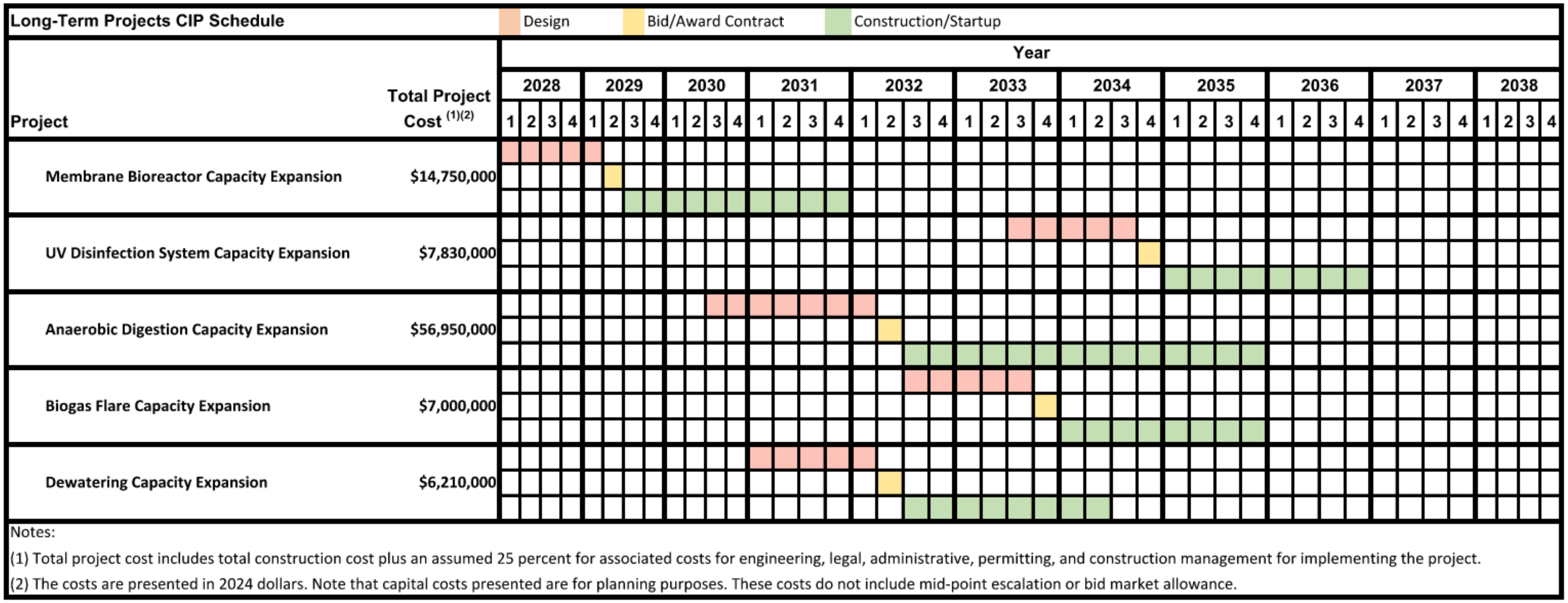
The project implementation plan includes an overall schedule of the CIP and projected cash flow requirements for implementing the CIP. These projects would be implemented as needed to meet flow and load requirements rather than at set dates. The recommended implementation for each project is shown in Table 5.4.

In addition to the outlined capital projects, a biosolids master plan, digester gas use study, new facility plan, and new master plan were added to the CIP. It is recommended that the biosolids master plan and digester gas use study be conducted after the near-term digester capacity expansion project is completed. See TM 3 – Environmental Opportunities in the Facility Plan for more information on these studies. The new facility plan and master plan should be completed within 10 years.

While this Master Plan included projects that increased treatment capacities to meet the projected 2044 flows and loads, the City requested that process areas be evaluated for when 80 percent of the capacity was exceeded to trigger when the process area should be evaluated for expansion. Reviewing the capacity analysis, several process areas were identified to have their 80 percent capacity exceeded during the 20-year planning horizon. A planning study for each of these process areas was included in the CIP the year after it hit 80 percent capacity. If the rated capacity of the process area was expected to be exceeded within two years past the 20-year planning period, then ballpark estimates for design and construction costs were added to the CIP. However, project descriptions were not developed for these cases, and they should be thoroughly evaluated during the next master plan in 10 years. If the rated capacity of the process area was not exceeded for several years after the 20-year planning period, then no additional design or construction costs were included in the CIP. These projects should also be evaluated during the next master plan in 10 years.

The costs for these planning studies and design/construction activities can be seen in Table 5.4.

The projected cash flow presented in Figure 5.3 is based on the recommended CIP and the implementation schedule shown in Figure 5.2 and in the Facility Plan's TM 5 – Near-Term Capital Improvement Program. The cash flow analysis is provided as a preliminary tool to assess impacts on the City's resources over time.



Long-Term Projects CIP Schedule

🟥 Design 🟨 Bid/Award Contract 🟩 Construction/Startup

Project	Total Project Cost (1)(2)	Year																																											
		2028				2029				2030				2031				2032				2033				2034				2035				2036				2037				2038			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Membrane Bioreactor Capacity Expansion	$14,750,000	🟥	🟥	🟥	🟥	🟥																																							
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UV Disinfection System Capacity Expansion	$7,830,000																							🟥	🟥	🟥	🟥	🟥																	
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Anaerobic Digestion Capacity Expansion	$56,950,000											🟥	🟥	🟥	🟥	🟥	🟥	🟥																											
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Biogas Flare Capacity Expansion	$7,000,000																			🟥	🟥	🟥	🟥	🟥																					
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Dewatering Capacity Expansion	$6,210,000													🟥	🟥	🟥	🟥	🟥																											
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Notes:

(1) Total project cost includes total construction cost plus an assumed 25 percent for associated costs for engineering, legal, administrative, permitting, and construction management for implementing the project.

(2) The costs are presented in 2024 dollars. Note that capital costs presented are for planning purposes. These costs do not include mid-point escalation or bid market allowance.

Figure 5.2 Long-Term Projects CIP Schedule

Table 5.4 Master Plan CIP

Project	Total Project Cost	CIP Cost							
		2024	2025	2026	2027	2028	2029-2033	2034-2038	2039-2043
Near-Term Projects Costs(1)									
TWAS Pump Replacements	$630,000	$630,000	-	-	-	-	-	-	-
Dewatering Capacity Expansion – Near Term	$4,650,000	$930,000	$3,720,000	-	-	-	-	-	-
Sludge Drying Bed Capacity Expansion	$10,350,000	$2,070,000	$5,520,000	$2,760,000	-	-	-	-	-
Digester Dewatering Pond Addition	$6,110,000	$1,220,000	$3,260,000	$1,630,000	-	-	-	-	-
Anaerobic Digestion Capacity Expansion – Near Term	$34,990,000	$3,500,000	$6,999,000	$13,995,000	$10,496,000	-	-	-	-
UV Disinfection System Capacity Expansion – Near -Term	$2,010,000	-	$400,000	$1,610,000	-	-	-	-	-
Subtotal	$58,740,000	$8,350,000	$19,899,000	$19,995,000	$10,496,000	-	-	-	-
Long-Term Projects Costs(1)									
MBR System Capacity Expansion	$14,750,000	-	-	-	-	$1,967,000	$12,783,000	-	-
UV Capacity Expansion – Long Term	$7,830,000	-	-	-	-	-	$523,000	$7,307,000	-
Anaerobic Digestion Capacity Expansion – Long Term	$56,950,000	-	-	-	-	-	$30,916,000	$26,034,000	-
Biogas Flare Capacity Expansion	$7,000,000	-	-	-	-	-	$1,400,000	$5,600,000	-
Dewatering Capacity Expansion – Long Term	$6,210,000	-	-	-	-	-	$4,968,000	$1,242,000	-
Subtotal	$92,740,000	-	-	-	-	$1,967,000	$50,590,000	$40,183,000	-
Studies and Predesign Activities(2)									
Biosolids Master Plan	$500,000.00	-	-	-	-	$500,000.00	-	-	-
Biogas Master Plan	$300,000.00	-	-	-	-	$300,000.00	-	-	-
Facility/Master Plan Update	$1,000,000.00	-	-	-	-	-	$500,000.00	$500,000.00	-
Grit Tanks	$500,000.00	-	-	-	-	-	-	-	$500,000.00
Primary Sedimentation Tanks	$500,000.00	-	-	-	-	-	-	$500,000.00	-
MBR System	$1,000,000.00	-	-	-	-	-	-	$1,000,000.00	-
UV Disinfection	$500,000.00	-	-	-	-	-	-	$500,000.00	-
Gravity Belt Thickeners	$500,000.00	-	-	-	-	-	-	$-500,000.00	-
Anerobic Digestion	$1,000,000.00	-	-	-	-	-	-	$1,000,000.00	-
Sludge Drying Bed	$500,000.00	-	-	-	-	-	-	$500,000.00	-
Subtotal	$6,300,000.00	-	-	-	-	$800,000.00	$500,000.00	$4,500,000.00	$500,000.00
Design/Construction(2)									
Primary Sedimentation Tanks	$32,000,000.00	-	-	-	-	-	-	-	$32,000,000.00
MBR System	$155,000,000.00	-	-	-	-	-	-	$2,500,000.00	$152,500,000.00
UV Disinfection	$7,830,000.00	-	-	-	-	-	-	-	$7,830,000.00
Gravity Belt Thickeners	$22,000,000.00	-	-	-	-	-	-	-	$22,000,000.00
Anerobic Digestion	$56,950,000.00	-	-	-	-	-	-	$8,136,000.00	$48,814,000.00
Sludge Drying Bed	$10,350,000.00	-	-	-	-	-	-	-	$10,350,000.00
Subtotal	$284,130,000.00	-	-	-	-	-	-	$10,636,000.00	$273,494,000.00
R&R Costs(3)									
R&R	$53,000,000	$2,270,000	$2,270,000	$2,270,000	$2,270,000	$2,270,000	$11,350,000	$15,150,000	$15,150,000
CIP Total	$494,910,000.00	$10,620,000.00	$22,169,000.00	$22,265,000.00	$12,766,000.00	$5,037,000.00	$62,440,000.00	$70,469,000.00	$289,144,000.00

Notes:

TWAS - thickened waste activated sludge.

(1) The costs are presented in 2024 dollars. Note that capital costs presented are for planning purposes. These costs do not include mid-point escalation or bid market allowance. Current market conditions suggest large rates of cost escalation and high rates of variance in construction bidding. It is suggested that an escalation rate and bid market allowance be added to capital costing efforts as project development becomes more refined. Total project costs include factors for estimating contingency, sales tax, general conditions, and contractor overhead and profit as well as 25 percent allowance for engineering, legal, administration, and permitting.

(2) As stated in Section 5.5, the City requested that future master plans be included in the CIP as well process areas be evaluated for when 80 percent of the capacity was exceeded to trigger when the process area should be evaluated for expansion. A planning study for process areas whose 80 percent capacity was exceeded was included in the CIP the year after it hit 80 percent capacity. If the rated capacity of the process area was expected to be exceeded within two years past the 20-year planning period, then ballpark estimates for design and construction costs were added to the CIP. If the rated capacity of the process area was not exceeded for several years after the 20-year planning period, then no additional design or construction costs were included in the CIP.

(3) Total R&R costs reflect 35 percent of the total project costs.

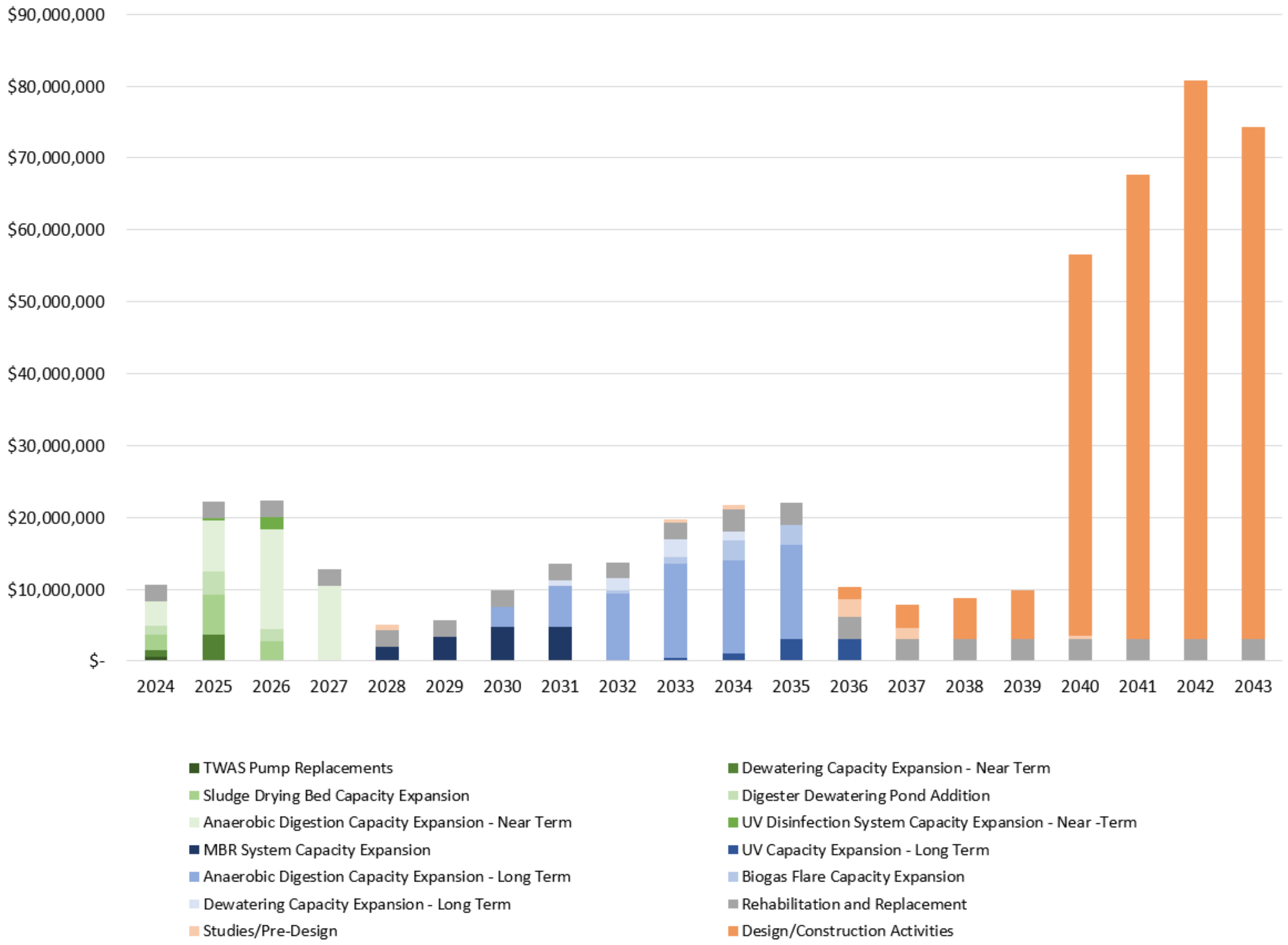

Figure 5.3 Master Plan CIP Cash Flow