WASTEWATER TREATMENT AND BIOSOLIDS FACILITIES MASTER PLAN

ENERGY MANAGEMENT

BIOSOLIDS TREATMENT & REUSE

POTABLE REUSE TREATMENT

WATER QUALITY & NUTRIENTS

DUBLIN SAN RAMON SERVICES DISTRICT

WEST YOST ASSOCIATES

in association with HDR

Wastewater Treatment and Biosolids Facilities Master Plan

Executive Summary

Dublin San Ramon Services District
Water, wastewater, recycled water

This Wastewater Treatment and Biosolids Facilities Master Plan (Master Plan) provides a comprehensive long-term vision for the Dublin San Ramon Services District (DSRSD or District) Wastewater Treatment and Biosolids Facility (WWTP). At its core, this Master Plan provide a comprehensive and efficient strategy for meeting the wastewater treatment capacity needs for the communities served by the District through the 2035 planning horizon. In addition to this core objective, this Master Plan provides a framework for evaluating and implementing improvements that may be needed at the WWTP to achieve the following key objectives:

- Reliably meet potential future water quality requirements for nutrient discharges to the San Francisco Bay,
- Take advantage of emerging opportunities for potable reuse,
- Diversify the District's biosolids management operations,
- Take advantage of emerging opportunities for organics digestion to increase biogas generation and reduce the WWTP's use of natural gas for energy production, and
- Maintain, and improve upon, plant-wide odor management.

Life cycle costs and subjective criteria have been considered when identifying approaches for addressing the identified objectives. The life cycle costs allow for a consideration of both capital and operating costs. The subjective criteria allow for consideration of indirect costs and benefits, including reliability, flexibility, odor generation potential, energy management, chemical use, and resource recovery. Recommended facilities are identified based on consideration of lowest life cycle costs and highest subjective ranking.

Overview of WWTP

The District provides wastewater treatment service for approximately 143,000 people from the cities of Dublin and Pleasanton and a portion of the City of San Ramon.

The WWTP is located on two different sites:

- The main treatment site was originally constructed in 1961 and underwent significant expansions in 1971, 1978, 1981, 1985, and 2000. It houses all liquid and recycled water treatment facilities and some solids treatment facilities. The main site also contains a cogeneration system that provides electricity and heat for operation of the WWTP and its supporting infrastructure.
- The Dedicated Land Disposal (DLD) site, which was brought online in 1982, houses the Facultative Sludge Lagoons and the biosolids disposal facilities. This site is adjacent to the Livermore-Amador Valley Water Management Agency (LAVWMA) effluent storage and pumping facilities.

Figure ES-1 provides an aerial view of these two sites and the vicinity.

FIGURE ES-1. DSRSD WWTP SITE MAP

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Existing Facilities

The WWTP facilities include liquid treatment processes, solids treatment processes, and a cogeneration system.

The liquid treatment processes include influent screening, primary sedimentation, secondary (biological) treatment, and secondary clarification. Secondary effluent from the WWTP can either be disinfected via chlorination and discharged to the San Francisco Bay, or can be directed to the WWTP's recycled water treatment facilities from where it is delivered to the District's recycled water customers.

Treated effluent not used for recycled water irrigation is discharged to the LAVWMA facilities, where it is combined with treated effluent from the City of Livermore and reverse osmosis (RO) reject water from a Zone 7 groundwater demineralization facility. The combined flows are discharged via the LAVWMA export pipeline to facilities owned and operated by the East Bay Discharge Authority (EBDA). The LAVWMA flows, along with treated effluent from the EBDA member agencies, are conveyed via the EBDA facilities to a deepwater outfall in Lower San Francisco Bay. During extreme wet weather events, or if capacity in the LAVWMA or EBDA conveyance facilities is restricted, disinfected secondary effluent can be discharged to San Lorenzo Creek or Alamo Canal.

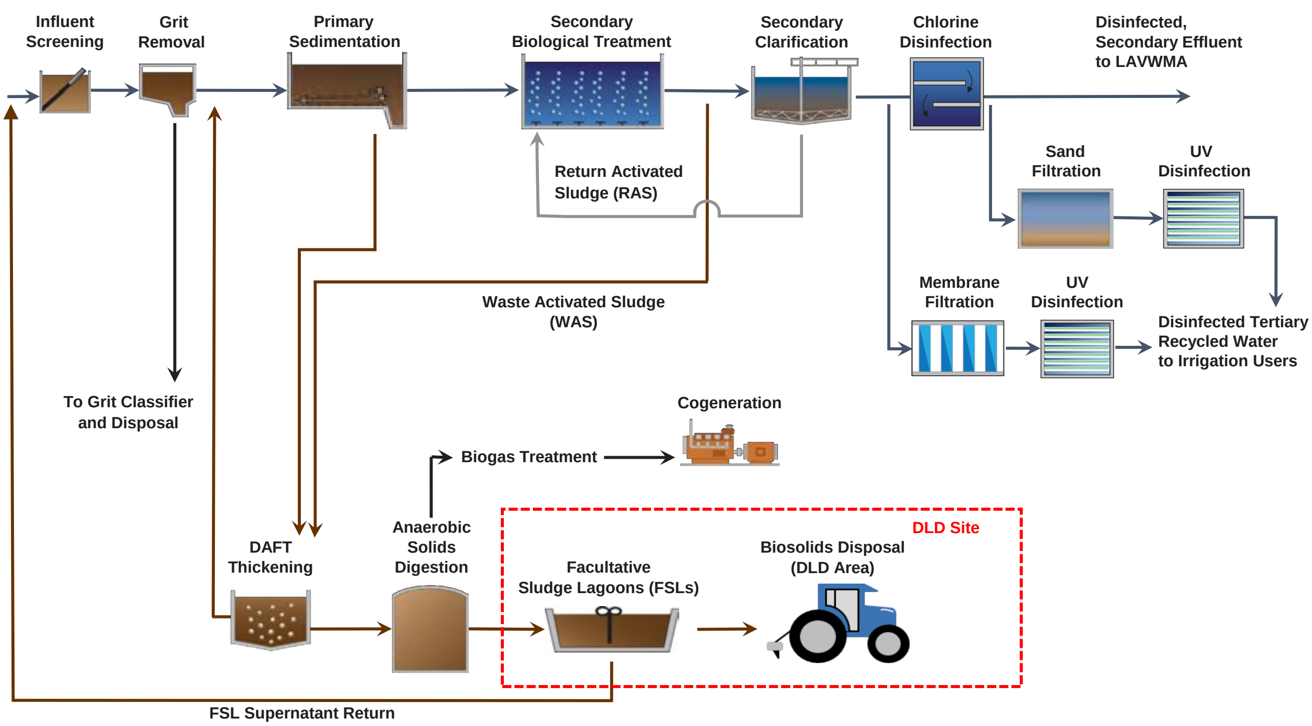
There are two separate recycled water treatment trains at the main WWTP site. The recycled water treatment system that is predominantly used consists of a granular media filtration process followed by an ultraviolet (UV) disinfection process. The second recycled water treatment system, which is typically only used in the winter months when recycled water production rates are low, consists of a microfiltration (MF) system followed by a second UV disinfection system. This secondary recycled water treatment system was originally constructed as part of the District's Clean Water Revival project, which also included a RO treatment system. However, the RO system has since been decommissioned.

Wastewater solids are treated in a Dissolved Air Flotation Thickener (DAFT), followed by anaerobic digestion. These facilities are located at the main WWTP site. Digested solids are pumped to the DLD site, where they are thickened and further stabilized in Facultative Sludge Lagoons (FSLs) prior to long-term disposal on the DLD facility.

Biogas produced from the digesters is treated and used, along with externally supplied natural gas, to power a cogeneration (heat and power) system.

Figure ES-2 presents a schematic of the WWTP facilities.

FIGURE ES-2. EXISTING WASTEWATER, RECYCLED WATER, AND BIOSOLIDS TREATMENT FACILITIES



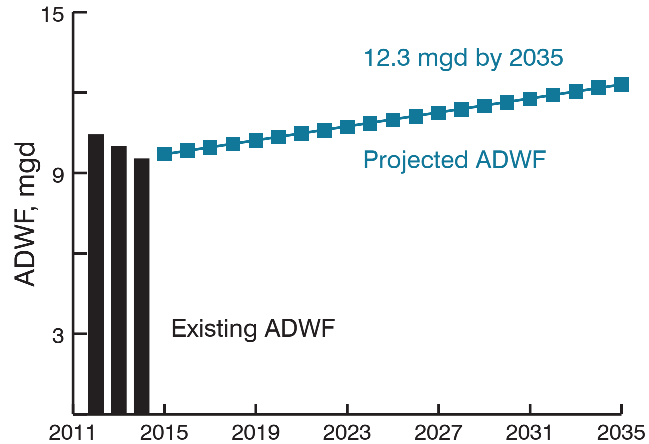
Projection of Flows and Loads into the WWTP

Projections of future influent flows and loads into the WWTP are necessary to plan the facilities needed to provide reliable wastewater treatment to the communities served by the District through the planning horizon of 2035. For the purposes of WWTP planning, increasing capacity needs are typically expressed in terms of increasing Average Dry Weather Flow (ADWF).

Figure ES-3 presents recent ADWF values for the WWTP, as well as the projected ADWF through 2035. This analysis assumes that the wastewater flow and load growth rates into the WWTP will be proportional to the anticipated service area population growth rates, which range from 1.16 to 1.30 percent over the planning period. As shown in Figure ES-3, the projected ADWF entering the WWTP in 2035 is 12.3 million gallons per day (mgd).

FIGURE ES-3. PROJECTED INFLUENT FLOW

Projected population growth will increase average flow from under 10 MGD currently to 12.3 MGD by 2035.




PRIMARY SEDIMENTATION


INFLUENT SCREENING


COGENERATION ENGINES


SECONDARY BIOLOGICAL TREATMENT

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SECONDARY CLARIFICATION

Liquid Treatment Evaluation

This Master Plan had the following primary objectives in evaluating the liquid treatment facilities:

- Identify improvements needed to address liquid treatment capacity deficiencies anticipated over 20-year the planning period.
- Identify treatment facilities potentially needed to meet future nutrient removal requirements.

KEY FINDINGS

- The primary clarifier facilities are under capacity, and expansion is recommended as soon as possible.
- The most cost effective strategy for address secondary clarification deficiencies is alum addition to the FSL return stream, which will allow for a WWTP operation that maximizes secondary solids settleability.
- Nutrient removal improvements are not likely needed for ten to fifteen years. Emerging nutrient removal technologies should be monitored, and the recommended approach for nutrient removal identified when new regulations are adopted in 2024.

Additional primary treatment capacity is needed, and the District has already initiated design to improve and expand the existing basins. In addition, relatively minor hydraulic and primary effluent diversion improvements are recommended in the near term.

Poor settleability is a concern for the existing secondary clarifiers. Without improvements, the treatment capacity of the secondary clarifier system would be exceeded by 2035. Of four alternatives evaluated to address this concern, the recommended approach is alum addition to the FSL return stream. This approach, which is significantly lower cost than other alternatives, allows for operation of the aeration basins in a mode that promotes growth of microbiological organisms that settle well in the secondary clarifiers.

Future nutrient removal requirements that would apply to the WWTP are uncertain. To account for this uncertainty, a moderately conservative estimate of the treatment improvements needed for nutrient removal have been used in the Master Plan. The following factors would have a significant impact on the costs and layouts presented in this Master Plan:

- **Water Quality Parameters of Concern.** This Master Plan assumes nutrient limitations will be adopted in 2024 that will include requirements for ammonia, nitrate, and phosphorus. However, if one or more of these parameters is not identified as a constituent of concern, then the treatment costs and footprint would be lower than the estimates provided.
- **Load-Based Versus Concentration-Based Limits.** The facilities layout and costs will also be impacted by whether the nutrient requirements are applied as load-based limitations or concentration-based limitations. The analysis presented in this Master Plan assumes that concentration-based limits will be required, thus requiring a high level of conservatism in the design compared to load-based limits.
- **Seasonal Versus Year-Round Limits.** If the nutrient limitations are applied only in the summer months (i.e., May to September), the District may be able to achieve compliance simply by implementing currently planned reuse facility expansion projects.
- **Emerging Treatment Technologies.** There are several technologies currently emerging for nutrient removal that, if proven effective and reliable, could significantly reduce the capital and operating costs, as well as reduce the overall WWTP footprint.

Potable Reuse Evaluation

The District is interested in developing a potable reuse project in the next ten-year period. In support of defining the preferred strategy toward implementing this goal, this Master Plan evaluates the following options for implementing a potable reuse treatment project at the WWTP:

- Rehabilitation of the CWR facilities to provide for approximately 3.0 mgd of potable reuse treatment.
- Construction of facilities needed to provide enough potable reuse treatment capacity to minimize WWTP effluent discharge to the San Francisco Bay.

KEY FINDINGS

- The District's available water supply for a potable reuse treatment system at the WWTP is limited by the District's commitments to its disinfected tertiary recycled water customers.
- Rehabilitation of the Clean Water Revival facilities to provide up to 3 mgd of potable reuse water supply could be a reasonably cost-effective strategy.
- Expansion beyond the 3 mgd system would not likely be cost effective unless an alternative supply of water for the potable reuse system is identified.
- Emerging potable reuse regulations and results of a separate regional potable reuse planning effort will need to be further considered before a decision can be made to move forward with potable reuse treatment at the WWTP.

The treatment facilities required for a potable reuse depend on which of the following type of reuse is implemented:

- **Groundwater Augmentation.** Potable reuse water supply is added to groundwater either via surface spreading or subsurface injection
- **Reservoir Augmentation.** Potable reuse water supply is added to a drinking water supply reservoir
- **Raw Water Augmentation.** Potable reuse water supply is blended with other raw water supplies and sent directly to a water treatment plant
- **Treated Water Augmentation.** Potable reuse water supply is sent directly to a potable water distribution system

To date, regulations have been defined for groundwater and reservoir augmentation. An overview of the current status of regulatory requirements applicable to each type of potable reuse project is provided as **Figure ES-4.**

Under a separate effort, the District is participating in a regional potable reuse study, and investment in a regional project may be found to better serve the District's needs than constructing treatment facilities at the WWTP site. The costs and benefits of both approaches will ultimately need to be considered when making a final decision. If a regional study is not pursued, a logical step toward implementation of a potable reuse project at the WWTP would be to rehabilitate the CWR facilities.

For purposes of this Master Plan, it has been assumed that an initial CWR rehabilitation project would provide for reservoir augmentation in the Chain of Lakes. It is also assumed that the initial project would be expanded in the future to provide for treated water augmentation within the District's service area. The identified project costs for the CWR facilities rehabilitation provide a reasonable assessment of the District's potential investment in potable reuse in the next 20-year time frame, are also considered indicative of the District's share of costs associated with a region-wide potable reuse project.

FIGURE ES-4. CURRENT STATUS OF POTABLE REUSE REGULATIONS

	Groundwater Augmentation	Reservoir Water Augmentation	Raw Water Augmentation	Treated Water Augmentation
ENVIRONMENTAL BUFFER	LARGE →	→ SMALL	→	→ NONE
STATUS OF REGULATIONS	ESTABLISHED	MOSTLY ESTABLISHED POTENTIAL ADOPTION LATE 2017/EARLY 2018 (ESTIMATED)	NO REGULATION YET	
REQUIRED/ POTENTIAL TREATMENT	FULL ADVANCED TREATMENT (MF + RO + UV/AOP)	FULL ADVANCED TREATMENT + PRETREATMENT TO INCREASE LOG REMOVAL	FULL ADVANCED TREATMENT + PRETREATMENT + ?	FULL ADVANCED TREATMENT + PRETREATMENT ++ ?

Solids Treatment Evaluation

The primary objectives of the solids evaluation effort under this Mater Plan are as follows:

- Identify and evaluate alternatives for addressing the solids treatment and disposal capacity deficiencies anticipated over 20-year the planning period.
- Identify strategies for diversifying the District's biosolids disposal facilities to extend beyond the current DLD operations.
- Evaluate the benefits of implementing a potential supercritical oxidation process (SCFI's AquaCritox system at the DLD site.

KEY FINDINGS

- The anaerobic digestion facilities do not have adequate capacity for current solids generation rates, and expansion is recommended as soon as possible.
- The DLD site's disposal capacity is hydraulically limited, and available information suggests this facility is currently operating at capacity.
- The District's biosolids diversification goals will be met through the implementation of a project that addresses the DLD capacity limitations.
- A region-wide supercritical oxidation biosolids facility at the DLD site provides limited financial benefit with respect to biosolids management costs.

Two alternatives for addressing the anaerobic digestion limitations were evaluated as part of the Master Plan. This analysis confirmed the District's previous decision to construct a fourth anaerobic digester (which was previously designed). The digester expansion project is currently under construction.

This master planning process revealed that the DLD site does not have adequate hydraulic capacity to accommodate the biosolids being generated at the WWTP. Four alternatives were evaluated to address this capacity limitation, and it was determined the preferred approach would involve dewatering a portion of the biosolids generated each year. It is recommended that the District contract with a third party for partial biosolids dewatering for a one or two-year period to gain a better understanding of the impact of adding this operation at the DLD site. The assessment, along with a market evaluation to assess options for biosolids disposal/reuse, should provide adequate information for a final decision.


ANAEROBIC DIGESTERS


FACULTATIVE SLUDGE LAGOONS

Storage of liquid biosolids in the FSLs and/or application of biosolids to the DLD site may be prohibited or not desired in the long-term, thus requiring full dewatering of the WWTP biosolids for offsite disposal/reuse. Given this potential, it is recommended that the partial dewatering facilities that are installed to address the DLD capacity limitations be designed and constructed to allow for ready expansion to full dewatering. This approach, along with the biosolids disposal/reuse diversification that will come from implementing the partial dewatering option, will allow the District to quickly move to a full dewatering strategy should the need arise. For purposes of this Master Plan, this conversion to full dewatering is assumed to occur in the fifteen- to twenty-year time frame.

BAY AREA Biosolids Coalition

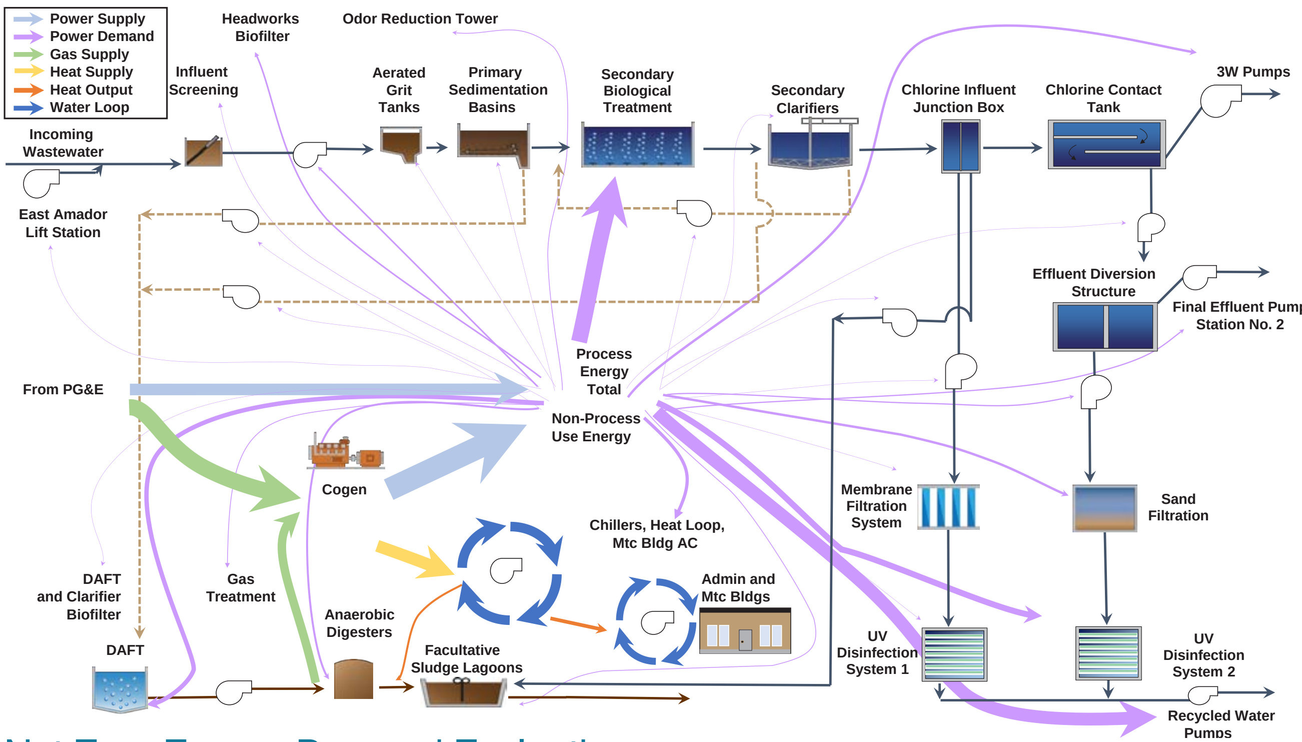
Finally, as part of the Bay Area Biosolids Coalition, the District has been considering partnering with Synagro and SCFI to implement a biosolids to energy project at the DLD site. This facility would mix liquid biosolids from the WWTP with biosolids received from multiple agencies throughout the Bay Area and use them to create electricity and an ash product using a supercritical oxidation process. This Master Plan evaluates the potential benefits of this project to the District's biosolids operations. Based on this assessment, it has been concluded that continued consideration of a regional AquaCritox facility may be warranted only if the cost for biosolids disposal at the facility is found to be competitive with other options in the Region.

WWTP Energy Balance

An energy balance for the WWTP was developed to characterize current and future WWTP energy demands and sources. In the summer months, the power demands are greatest for the secondary biological treatment process and recycled water pump station. During the winter months, the aeration basins have the greatest demand. On average, the WWTP's cogeneration system provides about two-thirds of the annual average power used at the WWTP. However, approximately two-thirds of the gas supplied to the cogeneration system is natural gas purchased from PG&E, and only a third of the gas used in the cogeneration system is biogas generated in the WWTP anaerobic digesters. The remaining power supply to the WWTP is provided directly from PG&E.

A graphical representation of the energy balance developed for the summer months is provided as **Figure ES-6**.

FIGURE ES-6. CURRENT WWTP SUMMER ENERGY BALANCE



Net Zero Energy Demand Evaluation

Potential strategies to increase onsite generation and potentially achieve a net zero energy demand (matching energy demands with onsite renewable energy production) were evaluated.

KEY FINDINGS

- Energy demands at the WWTP are typical for a facility of this size. However, some energy saving strategies were identified.
- The District is currently constructing a receiving station for hauled Fats, Oils, and Greases (FOG), which will be co-digested with the WWTP biosolids to increase biogas production.
- It is unlikely that the FOG received will be adequate to meet the biogas demands of the cogeneration system.
- The existing biogas treatment system is undersized and inefficient, and a new biogas treatment system should be constructed in the near-term.
- Recent regulations require diversion of organics from landfills, which will provide an opportunity to bring additional materials to the WWTP that can be used to generate biogas in the digesters.
- While there is some capacity for co-digestion of organics within the existing/planned system, expansion of both the digestion capacity and cogeneration system capacity would be needed. Achieving net zero energy with biogas energy alone may not be cost effective without grant funding support.
- A small (~2.3 acre) solar installation at the WWTP site would have an estimated 20-year payback. More favorable economics might be realized if this project were pursued through a public-private partnership.
- Strategies for solar expansion could be considered if land (such as the DLD site) were available. However, other demands for this property could preclude this option.

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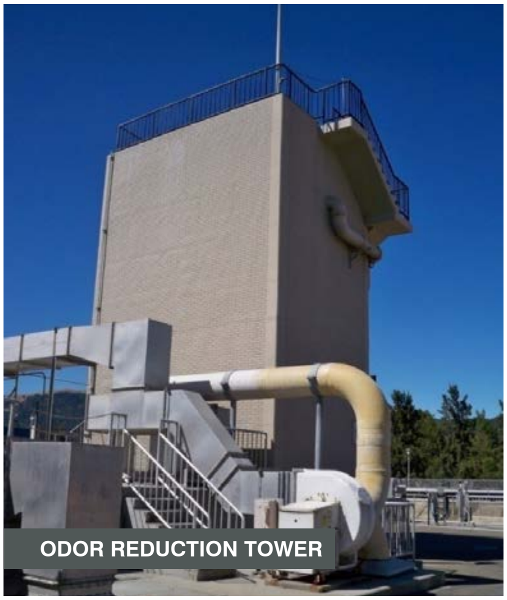
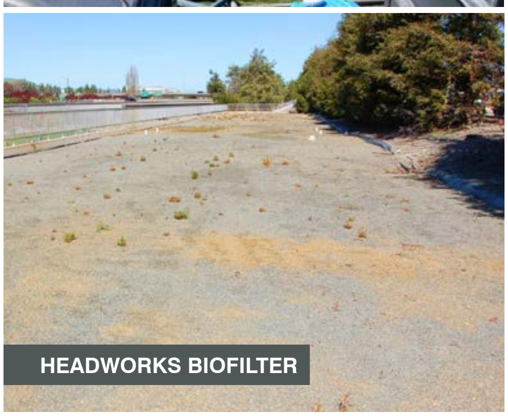

ODOR REDUCTION TOWER


TOP OF ODOR REDUCTION TOWER


HEADWORKS BIOFILTER


DAFT BIOFILTER

Odor Control Plan

Odor control is a concern for the WWTP due to its location and proximity to urban development. To support the District's continued efforts to minimize odor impacts to the surrounding community, this Master Plan included the following key features:

- The existing odor control systems were evaluated to identify major deficiencies. Improvements to address identified deficiencies were also identified.
- Potential future strategies to further reduce odors leaving the WWTP were identified.
- The Master Plan included a "no net increase in off-site odor" criterion for all major improvements. This criterion resulted in the inclusion of odor control for any new facility that has the potential to generate odors.
- The Master Plan also included odor generating potential as a subjective criterion for selecting preferred alternatives. Thus, alternatives with lower potential for generating odors offsite were ranked more favorably.

A review of the odor control systems found that the existing Odor Reduction Tower (ORT) is effective at removing odors, but that the removal potential could be higher. Odor control associated with this facility could be improved either by replacing the ORT media or by replacing the entire facility with an alternative technology. Replacement with either a hypochlorite packed tower or activated carbon filter is identified as the preferred approach in the Master Plan. This strategy was primarily recommended because it reduces the footprint required for odor control, providing space for an expansion of the odor control systems in the future.

The District recently completed a rehabilitation of the headworks biofilter. It is assumed for purposes of this Master Plan that this project will successfully address concerns with this facility. If performance decreases, replacement of this facility will be required. Under this scenario, it is possible that a whole-plant system located at the headworks biofilter location could be a cost-effective approach to addressing both the headworks biofilter and ORT deficiencies.

The DAFT biofilter is less than ten years old and is not expected to require improvements or replacement within the Master Plan period.

The next logical phase of expansion for the odor control system would involve controlling odors from the primary clarifiers and a portion of the aeration basins. This project would involve covering the primary clarifiers and a portion of the aeration basins and installing a second hypochlorite packed tower or activated carbon filter near the existing ORT.

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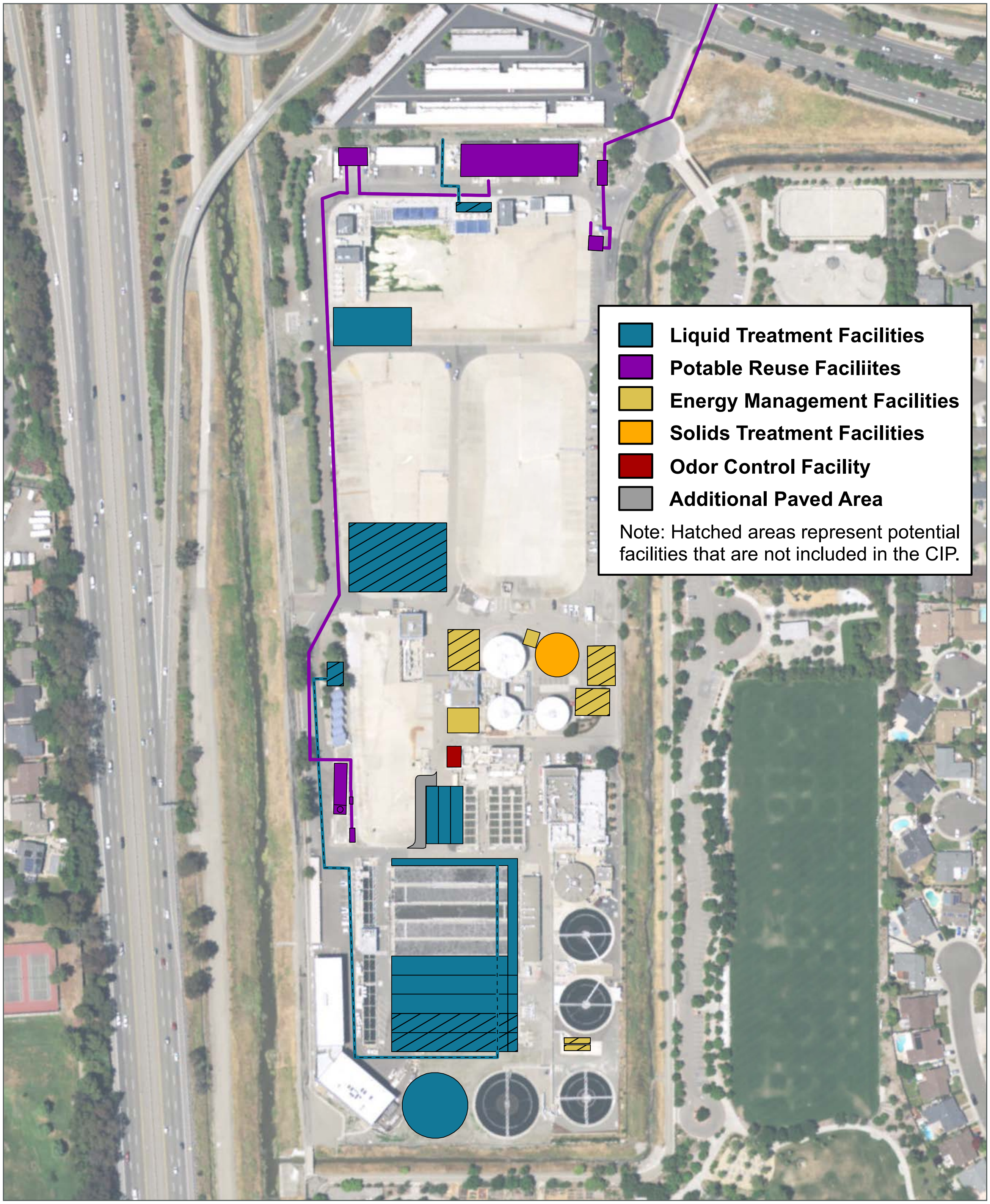
Recommended Facilities Layout

The layout of the recommended facilities identified in this Master Plan at the main WWTP site are shown in **Figure ES-7.**

FIGURE ES-7. RECOMMENDED FACILITIES AT MAIN WWTP SITE



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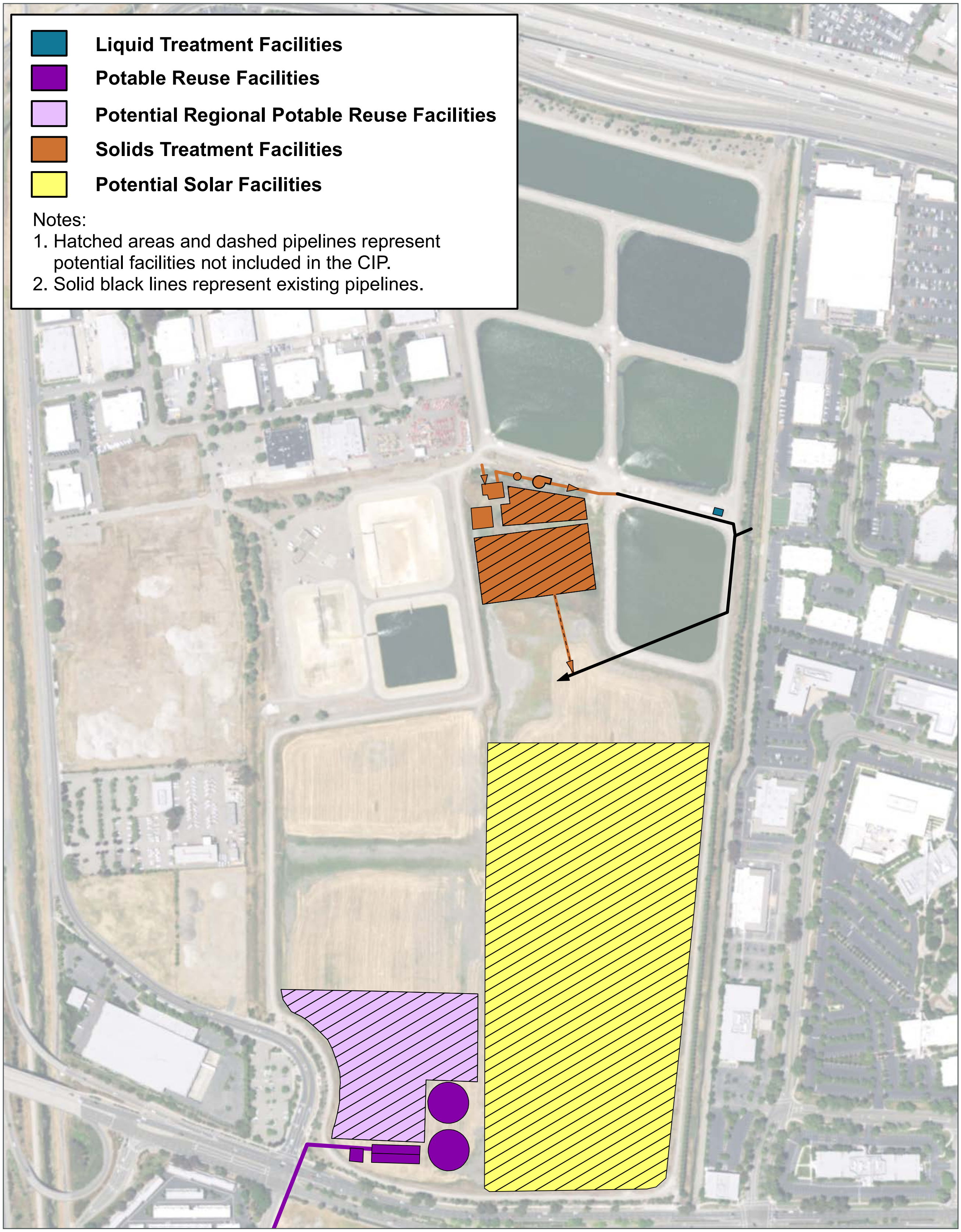
The layout of the recommended facilities identified in this Master Plan at the DLD site are shown in **Figure ES-8.**

FIGURE ES-8. RECOMMENDED FACILITIES AT DLD SITE



Recommended Evaluations

Recommendations presented in this Master Plan are based on available information. However, there are a number areas where the regulatory framework is not well defined, or where emerging technologies and markets could present opportunities that should be considered as more information becomes available. Recommendations for additional evaluations are therefore also identified. These additional evaluations are summarized in **Table ES-1.**

TABLE ES-1. RECOMMENDED ADDITIONAL EVALUATIONS

Subject	Purpose
LIQUID TREATMENT	
ALUM ADDITION JAR TESTING	Confirm/verify dosing rates for sizing alum addition facilities.
NUTRIENT REMOVAL STRATEGY	Develop a strategy for nutrient removal once regulations are defined. Look for opportunities to take advantage of new, emerging technologies.
POTABLE REUSE	
CWR FACILITIES POTABLE REUSE PLAN	Compare the results from the regional potable reuse evaluation to opportunities for treatment at the WWTP. Confirm the desired end use of the treated potable reuse water. Select preferred treatment strategy considering emerging regulations for both potable reuse and nutrient removal at the WWTP.
RAW/TREATED WATER AUGMENTATION	Determine if more advanced potable reuse is desired as regulations are further defined and the District gains experience with potable reuse treatment operations.
SOLIDS TREATMENT	
BIOSOLIDS DEWATERING FACILITIES PLAN	Confirm treatment performance of FSLs once additional data is available. Use market research to identify a preferred strategy for reuse/disposal of biosolids that cannot be accommodated on the DLD site. Use pilot study experience to identify a preferred dewatering alternative and equipment.
SUPERCRITICAL OXIDATION (SCFI) FINANCIAL ANALYSIS	Assess financial viability of SCFI process once costs are better defined.
OPPORTUNITIES FOR BIOSOLIDS REUSE/NUTRIENT RECOVERY	Determine if new opportunities for biosolids reuse or nutrient recovery provide for cost-effective approaches to achieving a higher and better use of the WWTP's resources.
ENERGY MANAGEMENT	
INCREASED CO-DIGESTION FACILITIES PLAN AND RATE STUDY	Determine if a hauled organics waste program will be economical for the WWTP considering the following factors that are specific to the hauled waste types: facilities needed to accommodate the hauled waste(s), facilities needed to accommodate the additional biosolids that will be generated, and facilities needed to control odors associated with hauled organics waste program.
ENHANCED PRIMARY TREATMENT	Determine if enhanced organics removal in the primaries will result in net savings given the anticipated nutrient removal strategy.
ENERGY GENERATION EXPANSION PLAN	Reevaluate the Master Plan findings regarding expansion of the onsite biogas energy generation facilities given opportunities from emerging technologies and increases in energy costs.
ODOR CONTROL	
ODOR CONTROL IMPROVEMENT PLAN	Further assess the options for replacement of the ORT considering space requirements, technology options, and needs for the headworks biofilter replacement.

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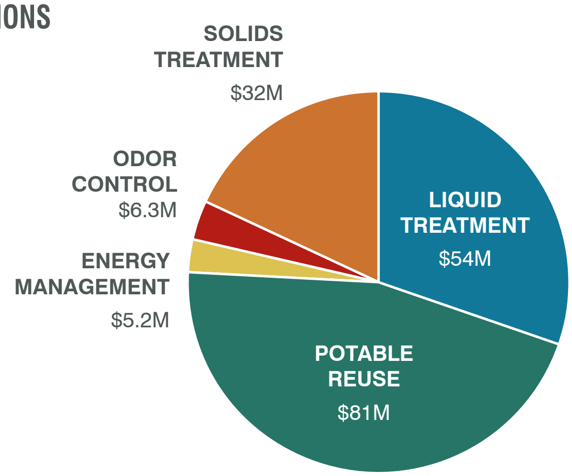
Estimated Cost of improvements

The total cost of the WWTP improvements identified in this Master Plan is approximately $179 million. These costs can be divided into the following three primary categories:

- **Capacity Driven.** Approximately $44 million of the total project costs are associated with increases to the capacity of specific WWTP processes to meet the needs of the communities served by the District. Of this total capacity related budget, approximately $17 million is associated with projects that are already underway.
- **Regulatory Driven.** Approximately $49 million of the total project costs are associated with improvements that may be needed to address regulatory requirements. Approximately $45 million of these regulatory driven costs are associated with potential future nutrient limits for discharges to the San Francisco Bay. The actual cost of these improvements could vary significantly depending on what regulations are ultimately adopted.
- **Resources Recovery Driven.** The remaining project costs, an estimated $86 million, are associated with potential resource recovery projects. Approximately $81 million of these resources recovery dollars are associated with the development of a potential potable reuse project.

Figure ES-9 provides a breakdown of the total cost of the WWTP improvements identified in this Master Plan by facility area.

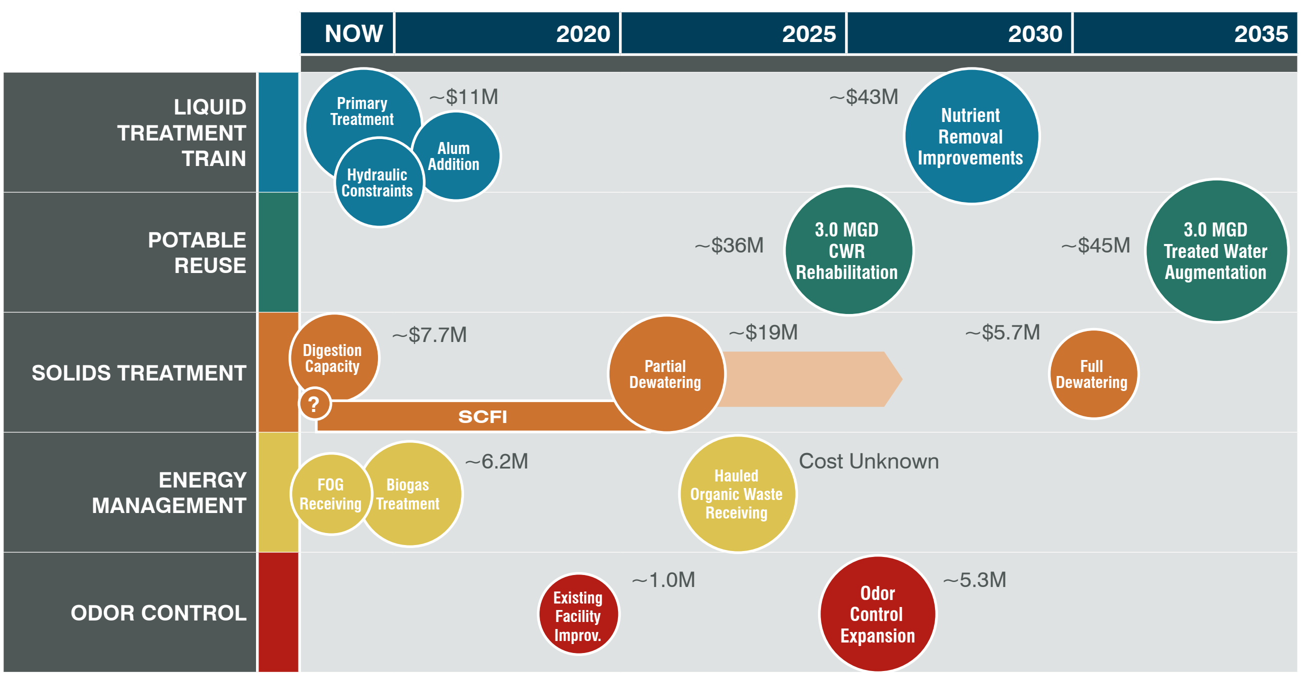
FIGURE ES-9. MASTER PLAN PROJECT COSTS IN MILLIONS



Capital Improvement Program (CIP)

The final step in the Master Planning process involved developing a CIP for District use in long-term planning and budgeting. The CIP incorporates a strategy for spreading the District resources over the planning period as much as possible given the external drivers and related time constraints identified in the master planning process. **Figure ES-10** provides a simplified representation of the CIP developed through this process.

FIGURE ES-10. PROJECT IMPLEMENTATION SCHEDULE



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