SAN FRANCISCO PUBLIC UTILITIES COMMISSION

San Francisco International Airport Water Reuse Evaluation

April 2025 / FINAL

San Francisco
Water Power Sewer
Services of the San Francisco Public Utilities Commission

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Abbreviations

$/AF	basis of cost per additional acre-foot
AACE International	Association for the Advancement of Cost Engineering International
ADD	average daily demand
AFY	acre-feet per year
AGS	aerobic granular sludge
AL	action level
AOP	advanced oxidation process
ASR	aquifer storage and recovery
AWTO	advanced water treatment operator
AWTP	Advanced Water Treatment Plant
BAC	biologically active carbon
BAF	biologically active filtration
BOD	biochemical
BOI	*Basis of Implementation*
$CaCO_3$	calcium carbonate
Cal Water	California Water Service Company
Carollo	Carollo Engineers
CCR	California Code of Regulations
CEC	contaminants of emerging concern
CGC	California Golf Club
CT	contact time
DAF	dissolved air flotation
DBP	disinfection byproduct
DDW	Division of Drinking Water
DPR	direct potable reuse
FTCA	fluorotelomer carboxylic acid
GAC	granular activated carbon
GGNC	Golden Gate National Cemetery
GRRP	groundwater replenishment reuse project
gpm	gallons per minute
GWR	groundwater replenishment
HFPO-DA	hexafluoropropylene oxide dimer acid
HI	hazard index
hp	horsepower

IPR	indirect potable reuse
IWTP	Industrial Wastewater Treatment Plant
IX	ion exchange
Kennedy/Jenks	Kennedy/Jenks Consultants
kg/day	kilograms per day
kWh	kilowatt hour
MCL	maximum contaminant level
MDD	maximum daily demand
MF	microfiltration
MG	million gallons
mg/L	milligrams per liter
µg/L	micrograms per liter
mgd	million gallons per day
mg-min/L	milligrams-minutes per liter
mL	milliliter
MLTP	Mel Leong Water Treatment Plant
MPN	most probable number
MTBE	methyl tertiary-butyl ether
MTL	monitoring trigger level
N	nitrogen
NBSU	North Bayside System Unit
NDMA	N-nitrosodimethylamine
ng/L	nanogram per liter
NL	notification level
NPDES	National Pollutant Discharge Elimination System
NPR	non-potable recycled
NTU	nephelometric turbidity unit
O&M	operations and maintenance
OOP	operation optimization plan
pCi/L	picocuries per liter
PFAS	per- and polyfluoroalkyl (or polyfluorinated) substances
PFBS	perfluorobutane sulfonate
PFHxA	perfluorohexanoic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid

PFOS	perfluorooctane sulfonate
psi	pounds per square inch
RO	reverse osmosis
RWFP	*Recycled Water Facility Plan*
RWP	recycled water policy
RWQCB	Regional Water Quality Control Board
RWSP	Recycled Water System Project
SBR	sequencing batch reactor
SFIA	San Francisco International Airport
SFIA RWMP	*San Francisco International Airport Recycled Water Master Plan*
SFPUC	San Francisco Public Utilities Commission
sMCL	secondary maximum contaminant level
SRT	solids retention time
SSF	South San Francisco
SSF-SB WQCP	South San Francisco-San Bruno Water Quality Control Plant
SU	standard unit
SWA	surface water augmentation
SWRCB	State Water Resources Control Board
SWTP	Sanitary Wastewater Treatment Plant
TDS	total dissolved solids
TIN	total inorganic nitrogen
TOC	total organic carbon
TON	threshold odor number
TSS	total suspended solids
UF	ultrafiltration
UV	ultraviolet
WPCP	water pollution control plant
WWTP	wastewater treatment plant

EXECUTIVE SUMMARY

ES.1 Project Background

This report evaluates opportunities for supplying recycled water produced at San Francisco International Airport (SFIA) to other nearby customers with a goal of reducing reliance on potable water supplied by the San Francisco Regional Water System. This report assesses the quantity of available recycled water from SFIA, identifies potential offsite recycled water customers near the airport, estimates recycled water customer demands, and provides preliminary locations and costs of necessary infrastructure to supply recycled water to these offsite customers.

Currently, the SFIA Mel Leong Water Treatment Plant (MLTP) treats both sanitary and industrial wastewater from SFIA via separate parallel treatment facilities: the Sanitary Wastewater Treatment Plant (SWTP) and the Industrial Wastewater Treatment Plant (IWTP). SFIA has a long-term goal of recycling 100 percent of all sanitary and industrial wastewater produced onsite. In pursuit of this goal, SFIA embarked on the Recycled Water System Project (RWSP) in January 2024 to upgrade its IWTP treatment system; add a new Advanced Water Treatment Plant (AWTP) that includes ultrafiltration (UF), reverse osmosis (RO), and ultraviolet (UV) disinfection; build a new per- and polyfluoroalkyl (or polyfluorinated) substances (PFAS) demonstration treatment system; and add recycled water delivery infrastructure throughout the SFIA campus. Unless otherwise specifically stated, use of the term MLTP in this report will refer to all treatment systems that are part of the 2024 SFIA RWSP (IWTP, SWTP, AWTP, and PFAS treatment). Specific portions of the MLTP (IWTP, SWTP, AWTP, and PFAS treatment) will be referred to as needed for clarification.

While the RWSP will produce water that is treated to near-potable quality, the goal of the project is to serve non-potable uses. Upon completion of the RWSP, non-potable recycled (NPR) water will be delivered to several existing and planned buildings on the SFIA campus including terminals, SFIA administration, and the SFO Grand Hyatt to offset demands. This is the initial phase, or Phase I, of the project. The second phase is the Ultimate Buildout scenario, which will include additional demands and locations at SFIA.

This report coordinates with the RWSP to identify and optimize the quantity and potential use of excess recycled water produced at SFIA for offsite customers in the area.

ES.2 Review of Past Studies

Several previous studies have evaluated the opportunities and feasibility of using recycled water within the SFIA boundaries and the surrounding vicinity. Recycled water feasibility studies and master planning documents from the following entities were reviewed to identify potential recycled water customers and customer demands, pipeline routings, volumes of effluent available for reuse, and effluent water quality and treatment considerations: SFIA; San Francisco Public Utilities Commission (SFPUC); California Water Service Company (Cal Water); and the Cities of South San Francisco (SSF), San Bruno, Burlingame, Millbrae, and Daly City.

ES.3 Recycled Water Demands and Available Supply Scenarios

Based on the RWSP report's recycled water production and demand estimates, the remaining available recycled water for offsite use is 0.1 to 0.2 million gallons per day (mgd) (using SFIA average daily demand [ADD]). Additional recycled water would be available if (1) the AWTP were operated at maximum capacity while SFIA recycled water demands are average daily and (2) if the Ultimate Buildout scenario production is realized while SFIA demands are still at Phase I levels. Recycled water production at SFIA could be maximized if a supplemental feed water from offsite were transported and treated by the MLTP.

A comprehensive list of potential recycled water customers surrounding SFIA was established for this study based on previous reports and discussions with SFPUC. The feasibility of each customer in the initial list was refined through a screening that used a set of primary and secondary considerations. Customers that passed the primary and secondary screening criteria were carried forward in this study as potential end users.

The customers that were carried through were then grouped based on their location relative to the MLTP (Western Customers, Northern Customers, and Southern Customers). The refined list of customers is shown in Figure ES.1. Golden Gate National Cemetery is abbreviated GGNC. Two large customers west of Highway 101, California Golf Club (CGC) and Holy Cross, are also shown in Figure ES.1. Each of these are similar in demand to GGNC and could be substituted in to the Western Customer grouping as alternatives to GGNC.

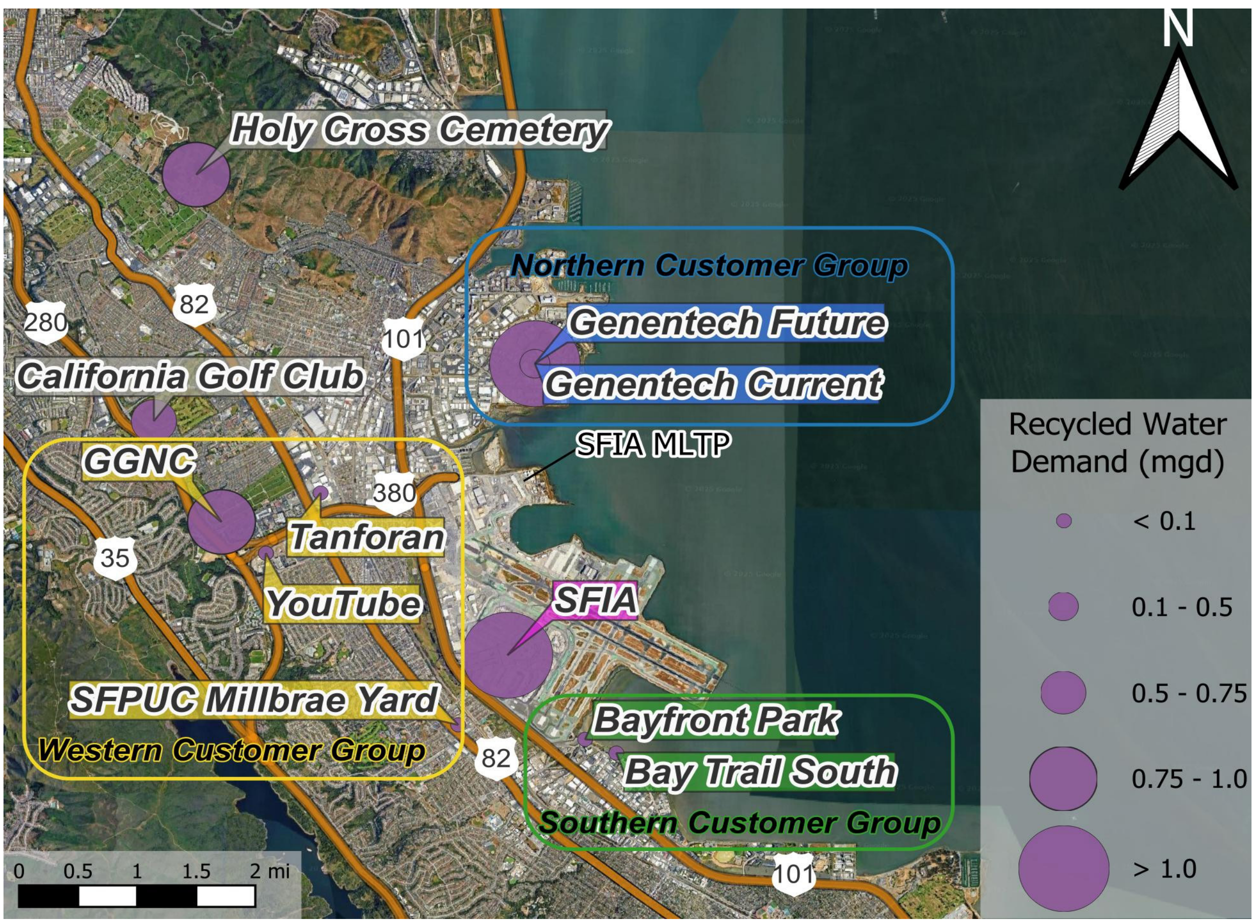


Figure ES.1 Customer Groupings by Location

More information about each customer can be found in Chapter 3.

Based on the projected flows, the expanded IWTP and new AWTP were sized to treat influent flows of up to 2.2 mgd. With this design flow, there would likely be an initial surplus of treatment capacity that could be leveraged by an additional wastewater source brought in from offsite. This will be referred to as supplement feed water. Available recycled water for offsite customers is shown in Table ES.1.

Table ES.1 Process Flows for Treating Offsite Effluent at the SFIA AWTP

Project Influent/Effluent Flow	Phase I		Ultimate Buildout	
	Average Day (mgd)	Maximum Day (mgd)	Average Day (mgd)	Maximum Day (mgd)
SFIA Wastewater	1.2	1.7	1.5	2.2
Offsite Wastewater(1)	1.0	0.5	0.7	0.0
AWTP Influent	2.2			
Recycled Water Production(2)	1.7	1.7	1.7	1.7
SFIA Recycled Water Demand	0.8	1.2	1.0	1.5
Recycled Water Available for Offsite	**0.9**	**0.5**	**0.7**	**0.2**

Notes:
(1) Referred to as supplemental feed water throughout this report.
(2) Assuming 85 percent RO recovery and 10 percent overall AWTP losses.

While the Millbrae and Burlingame wastewater facilities were considered as a supplemental feed water source for additional recycled water production at SFIA, the proximity of South San Francisco-San Bruno Water Quality Control Plant (SSF-SB WQCP) to SFIA, available supply, and comparative logistical simplicity made this supplemental feed water the most sensible option.

Adding SSF-SB WQCP supplemental feed water to the MLTP has the potential to impact current treatment and design, particularly related to high ammonia levels. With implementation of the RWSP, the SWTP effluent and IWTP influent will combine for treatment through dissolved air floatation (DAF), ozone, and biologically active carbon (BAC). BAC can only tolerate 2 to 5 milligrams per liter (mg/L) of ammonia. More ammonia would negatively impact BAC operations and effectiveness. Therefore, SSF-SB WQCP supplemental feed water would need to be treated before it can be added to the SFIA MLTP or AWTP. Three possible alternatives for treatment were assessed as a part of this report. Each of these alternatives and their solutions to the ammonia challenge are discussed in more detail in Chapter 4.

ES.4 Recycled Water Implementation

Required steps for implementation of a non-potable recycled water project include:

- Expanding the AWTP treatment system to the planned Ultimate Buildout capacity of 2.2 mgd feed flow, yielding 1.7 mgd of recycled water.
- Receiving up to 1.0 mgd of supplemental feed water from the SSF-SB WQCP (as discussed in Chapter 4), to maximize the production of recycled water at the SFIA MLTP.
- Delivering up to 0.9 mgd of recycled water to offsite customer groups (identified in Chapter 3).

To convey supplemental feed water from SSF-SB WQCP to the MLTP, a pipeline and pump station will be required. No additional storage is expected to be needed. Treatment needed for the wastewater supply is discussed in Chapter 4.

The proposed pipelines, pipeline alignments, pump stations, storage, treatment needs and cost to transport recycled water to each of the customer groupings (Northern, Western, Southern) is summarized in Chapter 5. The pipeline used to transport water to the Western Customers will require a Highway 101 crossing. The impacts of this Highway 101 crossing are also discussed in Chapter 5.

ES.5 Groundwater Recharge Opportunities

For the purpose of this evaluation, indirect potable reuse (IPR) through groundwater recharge–direct injection was identified by the SFPUC for assessment. The product water for this option will be referred to as purified water. Direct injection places advanced purified water directly into the groundwater aquifer via injection wells. SFIA and the customers identified in Chapter 3 are located within the Westside Groundwater Basin. Injecting purified water produced at the MLTP into the Westside Groundwater Basin will benefit the area by providing an additional source of drinking water and irrigation supply, improving water supply reliability during prolonged droughts, and increasing the volume of water stored in the groundwater basin.

Groundwater injection considerations and requirements are discussed in Chapter 6. Costs were not included for this option.

ES.6 Implementation Options

Project implementation options and their associated costs per acre-foot of water demand are summarized in Chapter 5. Implementation of a project considers the treatment and infrastructure required to provide recycled water to each customer/customer grouping.

The Northern Customer grouping includes Genentech's current and future demand. The Western grouping includes GGNC, Tanforan, YouTube, and Millbrae Yard. California Golf Club was removed from the final Western Customer group because its demands would exceed the available supply if both GGNC and CGC were served, and GGNC had previously been assessed as a viable customer with a greater recycled water demand than CGC. Serving the Western Customer grouping would require a Highway 101 crossing, which impacts costs and project timelines. Southern Customers Bayfront Park and Bay Trail South are small and are not recommended for further consideration, given the high unit cost of implementation.

Groundwater replenishment (GWR) via direct injection, described in Chapter 6 is an appealing and potentially cost-effective alternative to the customer delivery options. It is recommended that groundwater injection be further studied for feasibility and costs identified for comparison with the recycled water delivery options.

CHAPTER 1 PROJECT BACKGROUND

This study evaluates opportunities to use recycled water produced at the SFIA for offsite customers. Currently, the SFIA MLTP includes the IWTP and the SWTP. SFIA has a long-term goal of recycling 100 percent of all sanitary and industrial wastewater produced onsite. In pursuit of this goal, SFIA embarked on the RWSP in January 2024 to upgrade its IWTP treatment system; add a new AWTP that includes UF, RO, and UV disinfection; build a new PFAS demonstration treatment system; and add recycled water delivery infrastructure throughout the SFIA campus. Unless otherwise specifically stated, use of the term MLTP in this report will refer to all treatment systems that are part of the 2024 SFIA RWSP (IWTP, SWTP, AWTP, and PFAS treatment). Specific portions of the MLTP (IWTP, SWTP, AWTP, and PFAS treatment) will be referred to as needed for clarification.

This study seeks to examine, at a conceptual level:

1. Opportunities to supply customers offsite of the airport campus with recycled water from the MLTP following implementation of the RWSP.
2. Feasibility of supplementing SFIA wastewater with supplemental feed water from nearby wastewater treatment facilities to expand future production of recycled water by MLTP.
3. Necessary infrastructure locations and costs to enable supplementing MLTP influent with supplemental feed water and delivering recycled water to offsite customers.
4. As an alternative to delivering recycled water to offsite customers, the feasibility of using purified water for groundwater recharge near SFIA was assessed.

1.1 Report Organization

Chapter 1 "Project Background"

- Description of the SFIA RWSP and assessment of available recycled water from SFIA's MLTP.
- Introduction of nearby wastewater agencies that could supply supplemental feed water for additional recycled water production at MLTP.
- Identification of large potential offsite recycled water customers.
- Regulatory context.

Chapter 2 "Review of Past Studies"

Compilation and summary of past water reuse studies in the area.

Chapter 3 "Define Recycled Water Demands"

Description of potential offsite customers for SFIA recycled water and estimation of demands.

Chapter 4 "Available Supply and Quality"

- Identification of viable offsite sources of supplemental feed water.
- Analysis of water quality impacts of supplemental feed water on SFIA's MLTP treatment processes.

Chapter 5 "Implementation Needs"

Assessment of infrastructure needs and costs of bringing supplemental feed water to MLTP and delivering treated recycled water from SFIA to customers offsite of SFIA.

Chapter 6 "Groundwater Recharge Opportunities"

Evaluation of opportunities for groundwater recharge in the vicinity of SFIA using purified water.

Chapter 7 "Implementation Options"

Description of potential implementation scenarios and next steps.

Chapter 8 "References"

1.2 San Francisco International Airport Recycled Water System Project

Currently, the SFIA MLTP treats both sanitary and industrial wastewater from SFIA via separate parallel treatment facilities: the SWTP and the IWTP. The MLTP first started producing recycled water from the combined effluent of both plants in 1993 with a 500-gallon per minute (gpm) filtration system. Current recycled water uses include vehicle washing, minor irrigation, and street sweeping/dust control on the SFIA campus. Flows that exceed recycled water demands are discharged to the San Francisco Bay under a National Pollutant Discharge Elimination System (NPDES) permit held by the City and County of San Francisco, by and through the Airport Commission.

SFIA has a long-term goal of recycling 100 percent of all sanitary and industrial wastewater produced onsite. The IWTP has recently been upgraded to include DAF, ozonation, and BAC filtration. These treatment processes efficiently treat industrial flows that can contain high total organic carbon (TOC), oil and grease, and other constituents. In pursuit of its ambitious water recycling goal, SFIA embarked on the RWSP in January 2024 to upgrade the MLTP so that recycled water is suitable for toilet flushing and other high-quality non-potable uses. Design-build delivery is being used for the following components:

- New AWTP located at the MLTP which includes UF, RO, and UV disinfection.
- PFAS demonstration treatment system.
- Associated storage, pumping, and conveyance infrastructure for recycled water delivery throughout the SFIA campus.

While the RWSP will produce water that is treated to near-potable quality, the goal of the project is to serve non-potable uses, and the project will not be required to meet drinking water standards. If potable (or purified) water is desired, the project would need to be permitted by State Water Resources Control Board (SWRCB) Division of Drinking Water (DDW) for IPR or direct potable reuse (DPR). Additional monitoring and reporting would be required in addition to possible minor treatment upgrades or adjustments.

To meet the non-potable recycled water quality goals as part of the RWSP, IWTP capacity will be increased to handle both IWTP influent and SWTP effluent. Upon completion of the RWSP, recycled water will be delivered to several existing and planned buildings on the SFIA campus including terminals, SFIA administration, and the SFO Grand Hyatt to offset demands (namely toilet flushing and irrigation). This is the initial phase, or Phase I, of the project. The second phase is the Ultimate Buildout scenario. In the

Ultimate Buildout scenario, additional demands and locations at SFIA will be identified. Carollo Engineers (Carollo) is currently serving on the design-build team led by Walsh Construction to complete Phase I of the RWSP. This report includes information related to the programming, design, and construction of the RWSP. The programming phase is complete, and the Carollo-Walsh team is in the design phase with construction expected to start in the second quarter of 2025. Recycled water from the Phase I RWSP is expected to be delivered to the SFIA campus by mid-2027.

1.2.1 Potential Excess Treatment Capacity

From Table 1.1, Phase I of the AWTP is based on a maximum day feed flow of up to 1.7 mgd. The Ultimate Buildout scenario assumes an expanded AWTP capacity to handle a maximum day feed flow of 2.2 mgd (Table 1.1). Through UF and RO treatment, approximately 20 to 25 percent of feed water is lost to backwash and RO concentrate. Accordingly, the maximum day recycled water production for the Phase I and Ultimate Buildout scenarios is 1.3 mgd and 1.7 mgd, respectively (Table 1.1). Additionally, Table 1.1 lists the projected demands at SFIA for Phase I at 0.8 mgd average daily, and 1.2 mgd maximum daily. The Ultimate Buildout estimates a projected demand of 1.0 mgd average daily, and 1.5 mgd maximum daily.

Table 1.1 SFIA RWSP Design Flows From Basis of Implementation Report

Project Element	Phase I		Ultimate Buildout	
	Average Day (mgd)	Maximum Day (mgd)	Average Day (mgd)	Maximum Day (mgd)
AWTP Influent	1.2	1.7	1.5	2.2
Recycled Water Production(1)	0.9	1.3	1.1	1.7
SFIA Recycled Water Demand	0.8	1.2	1.0	1.5
Remaining Recycled Water for Offsite Uses – Current Scenario(2)	0.1	0.1	0.1	0.2

Source: Carollo and Walsh Group 2025.
Notes:
(1) Assuming 85 percent RO recovery and 10 percent overall AWTP losses.
(2) Assuming that the project will be built sequentially with Phase I followed by Ultimate Buildout. Demands will occur sequentially in coordination with the scenario being built.

Recycled water demand is often less than 0.5 mgd, according to discussions with SFIA, but the RWSP design criteria assumes an ADD of 0.8 mgd and maximum day demand of 1.2 mgd.

Based on the expected SFIA recycled water demands for the Phase I and Ultimate Buildout scenarios, the remaining recycled water available for offsite uses is 0.1 to 0.2 mgd, as is reflected in the 'Remaining Recycled Water for Offsite Uses – Current Scenario' row of Table 1.1.

However, if the AWTP is expanded to the Ultimate Buildout capacity to handle a maximum feed flow of 2.2 mgd and additional supplemental feed water were piped from offsite to the MLTP, the amount of excess recycled water available for offsite uses would range from 0.2 to 0.9 mgd, depending on SFIA's demands. Figure 1.1 shows a potential flow scenario where supplemental feed water from offsite is introduced at the headworks of the IWTP, yielding additional recycled water for offsite uses.

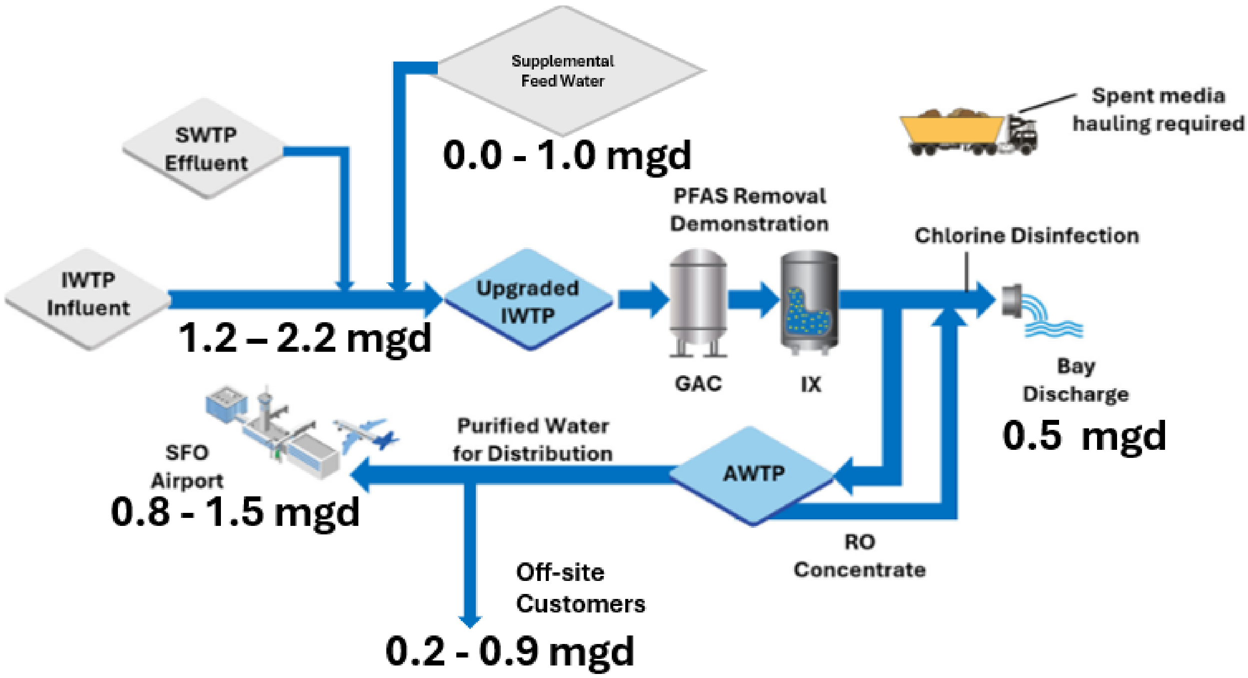


Figure 1.1 IWTP and AWTP Process Flow and Flow Rates for Treating Supplemental Feed Water From Offsite (Phase I Average Day – Ultimate Buildout Maximum Day)

Table 1.2 summarizes the process flows for the scenario depicted in Figure 1.1, based on different SFIA recycled water demands and source water supply.

Table 1.2 Process Flows for Treating Offsite Effluent at the SFIA AWTP

Project Influent/Effluent Flow	Phase I		Ultimate Buildout	
	Average Day (mgd)	Maximum Day (mgd)	Average Day (mgd)	Maximum Day (mgd)
SFIA Wastewater	1.2	1.7	1.5	2.2
Offsite Wastewater(1)	1.0	0.5	0.7	0.0
AWTP Influent	2.2			
Recycled Water Production(2)	1.7	1.7	1.7	1.7
SFIA Recycled Water Demand	0.8	1.2	1.0	1.5
Recycled Water Available for Offsite	**0.9**	**0.5**	**0.7**	**0.2**

Notes:
(1) Referred to as supplemental feed water throughout this report.
(2) Assuming 85 percent RO recovery and 10 percent overall AWTP losses.

There may be space at the MLTP for future expansions to increase recycled water production up to 3 mgd; however, this would need to be evaluated as part of a future study if additional recycled water supply is desired.

1.3 Neighboring Wastewater Treatment Facilities

The SFIA MLTP is one of four facilities whose wastewater is discharged to the San Francisco Bay via the North Bayside System Unit (NBSU) shared deepwater outfall. The NBSU is owned by a Joint Powers Authority that includes all four participating wastewater agencies. The Burlingame Wastewater Treatment Plant (WWTP), Millbrae Water Pollution Control Plant (WPCP), and the SSF-SB WQCP also use the NBSU outfall, and SSF-SB WQCP is responsible for NBSU operation. Chlorinated effluent from the Burlingame, Millbrae, and SFIA MLTP facilities is conveyed to the SSF-SB WQCP for dechlorination, after which the combined effluent from all four facilities is discharged to the San Francisco Bay through the NBSU, as pictured in Figure 1.2. The NBSU dischargers are the most convenient potential sources of additional supplemental feed water for treatment at the MLTP. Chapter 4 includes more detailed information about each discharger.

Figure 1.2 Overview of the NBSU Discharging Facilities in Relation to SFIA

1.4 Potential Offsite Recycled Water Customers

Several reuse studies in the vicinity of SFIA have been completed and are summarized in Chapter 2. From these studies, four potential recycled water customers near SFIA are identified:

- GGNC – ADD of 0.63 mgd.
- CGC – ADD of 0.44 mgd.
- Genentech Campus – ADD of 0.31 mgd.
- Bayfront Park and Bay Trail South – ADD of 0.025 mgd.

The viability of serving these customers and others is addressed in Chapter 3.

1.5 Regulatory Context

This project analyzed opportunities for recycled water (non-potable) and purified water (indirect potable reuse via groundwater injection). Permitted recycled water applications are briefly summarized below.

Water recycling for both non-potable and potable use in California falls under the jurisdiction of the SWRCB. Within the SWRCB, two departments are responsible for protecting public health and the environment with respect to water: (1) the DDW and (2) the Regional Water Quality Control Boards (RWQCB). DDW regulates public drinking water systems and is responsible for developing regulations for recycled water quality and use and for reviewing recycled water project permits. The RWQCBs enforce water quality objectives for receiving water bodies and oversee implementation plans to protect the beneficial uses of the water bodies. The RWQCBs write permits for discharges related to recycled water projects, such as RO concentrate flows or wastewater treatment plant outfall effluent flows.

In California, the production and use of recycled water and purified water is governed by several regulatory frameworks and guidelines, primarily the California Code of Regulations (CCR), Title 22. Key requirements and considerations for recycled water and purified water projects are described below. Details related to treatment requirements for IPR via groundwater injection are presented in Chapter 6.

Water quality needs differ for recycled water (irrigation, industrial reuse, and indoor municipal non-potable) and purified water (potable reuse). Water quality must meet CCR requirements along with customer-based objectives. The new AWTP at MLTP will be able to produce two qualities of recycled water: a "tertiary disinfected" Title 22 water that meets general purpose reuse standards and an advanced treated water quality that is designed for possible future upgrades to allow for IPR and DPR.

The San Francisco Bay RWQCB has adopted the third Nutrient Permit which protects watersheds from impacts due to municipal wastewater treatment plants. With this permit, wastewater agencies are required to meet a monitor final effluent limitations for nutrient loading to the San Francisco Bay. This impacts both SFIA and the SSF-SB WQCP. Detail regarding this regulatory impact as it relates to this project are discussed in Section 4.2.1.

1.5.1 Recycled Water Regulatory Requirements

CCR Title 22, Division 4, Chapter 3, Section 60301 and Section 60304 lists four types of recycled water defined by three factors: treatment process, total coliform requirement, and disinfection requirement. In addition, disinfected tertiary recycled water must meet turbidity requirements. These factors dictate the allowable end-use of the recycled water. Table 1.3 summarizes this information.

Table 1.3 Summary Title 22 Recycled Water Types

Recycled Water Type	Requirements	Uses
Undisinfected Secondary Recycled Water	▪ N/A	▪ Surface irrigation or orchards and vineyards (recycled water not to come in contact with edible portion of crop). ▪ Non-food bearing trees. ▪ Fodder and fiber crops and pasture for animals (not producing milk for human consumption). ▪ Seed crops not eaten by humans. ▪ Food crops (must undergo pathogen-destroying process before being consumed by humans). ▪ Ornamental nursery stock and sod forms (no irrigation 14 days prior to harvesting, retail, or access by public).
Disinfected Secondary-23 Recycled Water	TOTAL COLIFORM ▪ 7 Day Median Concentration: 23 MPN/100 mL (median). ▪ 30 Day Median Concentration: 240 MPN/100 mL (total).	▪ Cemeteries and freeway landscaping. ▪ Restricted access golf courses. ▪ Nonedible vegetation (access controlled so irrigated area cannot be used as park, playground, or school yard). ▪ Pasture for animals producing milk for human consumption. ▪ Ornamental nursey stock and sod farms (public not restricted).
Disinfected Secondary-2.2 Recycled Water	TOTAL COLIFORM ▪ 7 Day Median Concentration: 2.2 MPN/100 mL. ▪ 30 Day Median Concentration: 23 MPN/100 mL.	▪ Surface irrigation of food crops where the edible portion is produced above ground and *not contacted by the recycled water*.
Disinfected Tertiary Recycled Water	DISINFECTION REQUIREMENTS (either) ▪ Chlorine disinfection following filtration that meets a CT of 450 mg-min/L. ▪ Disinfection combined with filtration that inactivates or removes 99.999 (5-log) of plaque forming units of F-specific bacteriophage MS2 or polio virus in wastewater. TOTAL COLIFORM ▪ 7 Day Median Concentration: 2.2 MPN/100 mL. ▪ 30 Day Median Concentration: 23 MPN/100 mL. TURBIDITY ▪ Filter effluent turbidity does not exceed 2 NTU (24-hour period). ▪ Filter effluent turbidity is less than 5 NTU 95% of the time (24-hour period). ▪ Filter effluent turbidity never exceeds 10 NTU.	▪ Food crops, including all edible root crops, where recycled water comes in contact with the edible portion. ▪ Parks and playgrounds. ▪ School yards. ▪ Residential landscaping. ▪ Unrestricted access golf courses. ▪ Any other irrigation use not specified and not prohibited by other sections of the CCR.

Source: SWRCB 2018b.
Notes:
CT – contact time; mg-min/L – milligrams-minutes per liter; mL – milliliter; MPN – most probable number; NTU – nephelometric turbidity unit.

As shown in Table 1.3, the different end use of the recycled water dictates the treatment required. Treatment requirement increases based on public health considerations from undisinfected secondary effluent to disinfected tertiary effluent. Based on the treatment provided at the MLTP, the quality of recycled water produced will surpass requirements for delivery to any non-potable customer.

Irrigation and industrial uses (cooling towers) require low salinity water. For aesthetic purposes, it is desirable that municipal non-potable uses be served with odorless and colorless water. The AWTP will be able to produce an enhanced quality of recycled water using the RO system which will produce a low salinity water that is odorless and colorless and is appropriate for recycled water and purified water uses.

1.5.2 Indirect Potable Reuse Regulatory Requirements

IPR leverages use of an environmental buffer between the production of water and its distribution. IPR comes in two primary forms: GWR and surface water augmentation (SWA). IPR via GWR can be accomplished via either (1) surface spreading or (2) direct injection. Surface spreading recharges purified water into the groundwater aquifer through percolation whereas direct injection uses a well to transport purified water into the groundwater aquifer. For this study only direct injection GWR was considered as a viable IPR option.

Purified water used for a direct injection groundwater replenishment reuse project (GRRP) must meet the full advanced treatment definition listed in CCR Title 22. The treatment must consist of at least three separate processes, including RO followed by an advanced oxidation process (AOP), each credited with no more than 6-log reduction and no less than 1-log reduction. The treatment must demonstrate 12-log enteric virus reduction, 10-log *Giardia* cyst reduction, and 10-log *Cryptosporidium* oocyst reduction. Direct injection GWR also requires a minimum aquifer retention time of two months.

The AWTP would be able to satisfy the treatment requirements for direct injection GWR but would require modification of the UV system to a UV/AOP. AOP is not a requirement for SFIA's currently planned water reuse applications.

1.5.3 Direct Potable Reuse Regulatory Requirements

Due to the lack of the environmental buffer required in an IPR project, DPR requires additional treatment, sampling, monitoring, blending, source control, reporting, and staffing. Together the MLTP and AWTP could meet DPR requirements with the addition of AOP to the UV system (also required for IPR), so that the entire treatment would consist of ozone, biologically active filtration (BAF), RO, and UV/AOP. Monitoring and sampling would be required to ensure pathogen and chemical control requirements are met. Including adequate log reduction, drinking water standards, and TOC requirements. The frequency of monitoring and number of constituents required for sampling increases with a DPR project as compared to an IPR project.

DDW regulations require dilution through equalization basins, storage tanks, and related pipelines between the terminus of a wastewater collection system and point of delivery to the drinking water distribution system, such that one-hour of flow with elevated contaminant levels would be attenuated and blended by a factor of 10. An analysis of the hydraulic residence time in the MLTP and AWTP treatment systems and any contributing wastewater systems would be necessary to ensure that adequate contaminant attenuation can be achieved. Also, an enhanced source control program must be implemented to limit the contaminants in the wastewater for a DPR project. This source control program would apply to the wastewater collection system at SFIA, as well as that of any other supplemental feed water system.

DPR projects require several plans and reporting that are not required for IPR projects. In addition, more staff and higher certification levels would be required for operations, as well as 24/7 staffing for at least the first year of operation. As such, the increase in requirements for a DPR project would have implications for the overall cost of implementation. DPR was not considered in this evaluation.

CHAPTER 2 REVIEW OF PAST STUDIES

Several previous studies have evaluated the opportunities and feasibility of implementing recycled water within the SFIA boundaries and in the surrounding vicinity. Each study is summarized separately below, followed by a summary table with quantitative information from each study.

2.1 San Francisco International Airport Recycled Water Studies

Two primary SFIA recycled water studies were reviewed as part of this water reuse evaluation: (1) *San Francisco International Airport Recycled Water Master Plan* (*SFIA RWMP*) (Kennedy/Jenks Consultants [Kennedy/Jenks] 2014) led by SFIA and (2) SFIA MLTP RWSP *Basis of Implementation* (*BOI*) draft report (Carollo and Walsh Group 2025) led by the SFIA design-build team. The *SFIA RWMP* provided valuable information about offsite irrigation customer demands, potential infrastructure alignments, and the relative costs associated with reaching different offsite customers. The *BOI* report provides detailed information about the planned treatment capacity at MLTP and planned AWTP, including the ability and timeline to expand treatment, along with information about water quality constraints for bringing in supplemental feed water as a new supply to the MLTP treatment systems.

2.1.1 *San Francisco International Airport Recycled Water Master Plan*

The *SFIA RWMP* analyzed ways to expand the airport's existing recycled water program and work towards reusing 100 percent of onsite wastewater.

The *SFIA RWMP* included a market assessment of existing and anticipated future NPR water demands within SFIA boundaries (onsite) and outside the SFIA boundaries (offsite). The market assessment identified five phases of recycled water implementation, with a final Buildout peak day demand of 1 mgd for onsite uses and 0.9 mgd of offsite irrigation use. The offsite irrigation customers identified were Lions Park and Belle Air Elementary School, Bayside Manor Park, Bayfront Park, Bay Trail South, and GGNC. The market assessment also provided high-level evaluations of alternative scenarios, such as IPR via groundwater recharge, DPR within SFIA, and subregional partnerships for non-potable recycled water use with the surrounding communities of SSF, San Bruno, Millbrae, and Burlingame.

The *SFIA RWMP* identified water quality objectives for specific onsite end uses, such as landscape irrigation, cooling towers, and toilet/urinal flushing, summarized in Table 2.1. A treatment train of coagulation/flocculation, microfiltration (MF)/UF, UV disinfection, and chlorine injection was recommended to achieve non-potable water quality objectives with RO and ozone or advanced oxidation as additional treatment steps to achieve IPR water quality.

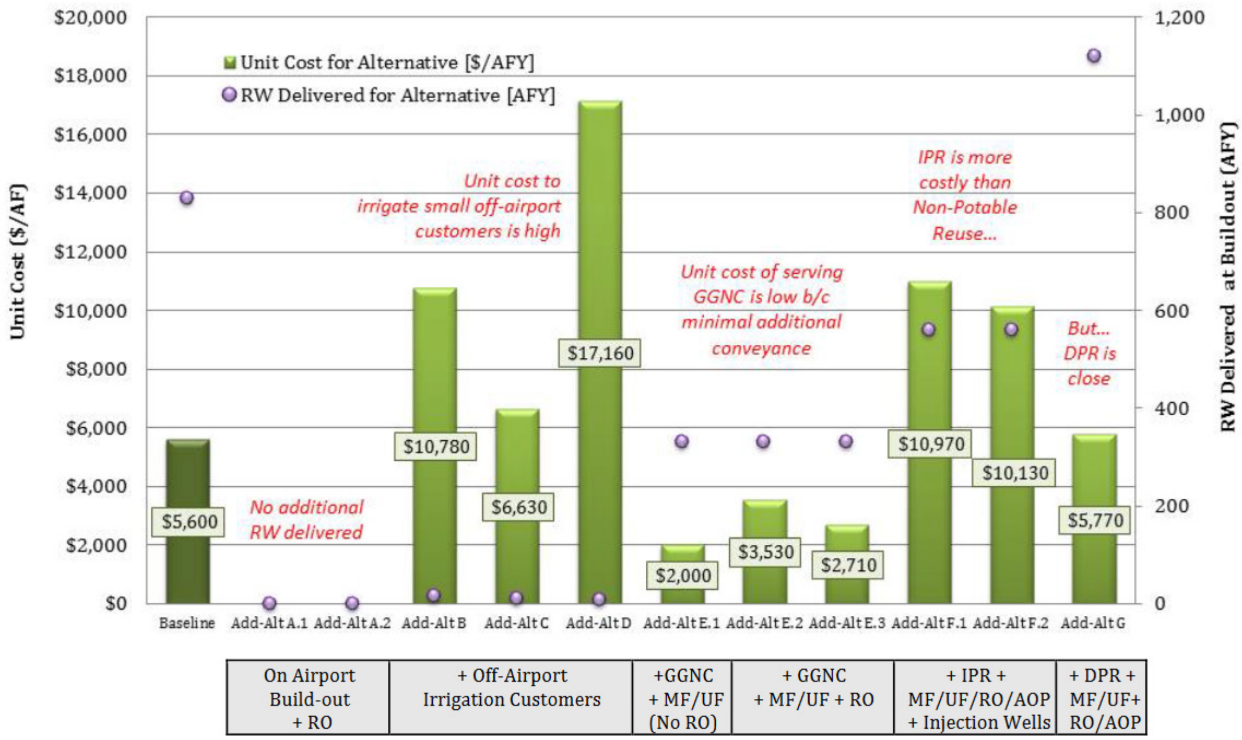
Table 2.1 Recycled Water Quality Objectives Identified in the *SFIA RWMP*

Onsite Recycled Water End Use at SFIA	Water Quality Parameter	Recycled Water Quality Objective
Landscape Irrigation (Redwood Trees)	TDS	<1,340 mg/L
	Chloride	<100 mg/L
	Sodium	<70 mg/L
Dual-Plumbed Facilities	Color	<15 units
	Odor	<3 TON
Cooling Towers	TSS	<100 ng/L
	Ammonia	<2.5 mg/L (as N)
	Hardness	<1,000 mg/L (as $CaCO_3$)

Source: Kennedy/Jenks 2014.
Notes:
$CaCO_3$ – calcium carbonate; ng/L – nanograms per liter; TDS – total dissolved solids, TSS – total suspended solids, TON – threshold odor number.

For alternatives comparison, serving all onsite non-potable customers was defined as the baseline project. Additional customer groups were added to the baseline project and compared on a basis of cost per additional acre-foot ($/AF) of finished water produced over the project lifetime, as shown in Figure 2.1 from the *SFIA RWMP*. Figure 2.1 also shows the expected annual volume of recycled water delivered by each alternative on the right-hand, y-axis. Unit costs are presented in 2014 dollars and are outdated, but can be used to compare projects on a relative basis. Alternatives were developed to allow comparison of specific additional project components, such as advanced treatment, off-airport (i.e., offsite) customers, and potable reuse to the baseline project. The alternatives are summarized below:

- Alternative A.1 Advanced treatment for non-potable reuse; centralized at the MLTP.
- Alternative A.2 Advanced treatment; decentralized at cooling towers.
- Alternative B Offsite irrigation to Bayfront Park and Bayside Trail South.
- Alternative C Offsite irrigation to Lions Park and Belle Air Elementary.
- Alternative D Offsite irrigation at two Caltrans sites and two San Bruno Parks.
- Alternative E.1 Offsite irrigation to GGNC; no advanced treatment.
- Alternative E.2 Offsite irrigation to GGNC; centralized advanced treatment for non-potable reuse.
- Alternative E.3 Offsite irrigation to GGNC; decentralized advanced treatment for non-potable reuse.
- Alternative F.1 IPR; centralized treatment.
- Alternative F.2 IPR; decentralized treatment.
- Alternative G DPR.



Source: Kennedy/Jenks 2014.

Figure 2.1 Comparison of Unit Costs for SFIA Recycled Water Project Alternatives

From Figure 2.1, implementing Alternative E.1, E.2, or E.3 (serving GGNC with non-potable quality water) would provide one of the lowest-cost alternatives added to the baseline project. Alternative E.1 had unit costs lower than the baseline project. Serving offsite irrigation customers with relatively small demands, such as Bayfront Park and Bayside Trail South (Alternative B), had unit costs three to five times greater than serving GGNC. The costs for implementing IPR via groundwater recharge (Alternative F.1 and F.2) were also considerably higher than the GGNC non-potable alternative. With the additional water produced under a DPR scenario (Alternative G), the unit costs of this alternative were less than those of IPR and comparable to the costs of the baseline project implementation. As stated earlier, costs are from 2014 and are only useful for general comparison of project alternatives.

The *SFIA RWMP* concluded with a recommendation that SFIA pursue the baseline project with the additional delivery of finished water to GGNC. The study also concluded that SFIA keep DPR in mind as a potential means of achieving the airport's long-term goal of using 100 percent of onsite wastewater.

2.1.2 San Francisco International Airport Mel Leong Water Treatment Plant Recycled Water System Project Basis of Design Documentation

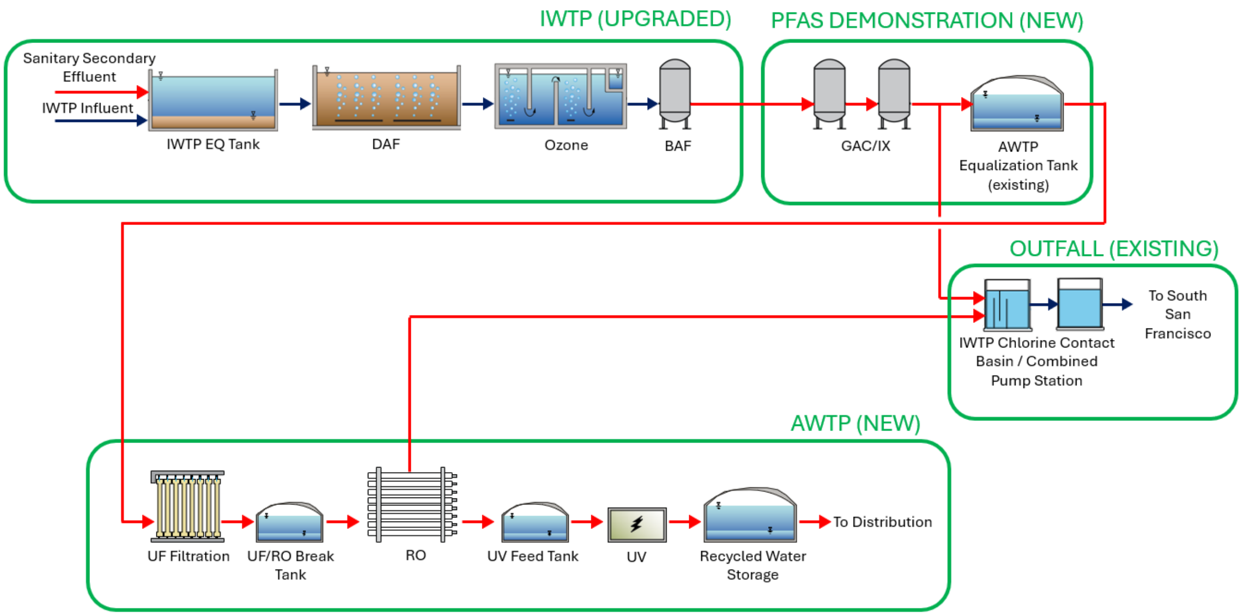
SFIA began work in early 2024 on a design-build project to implement improvements to the MLTP including:

- Expansion of the existing IWTP.
- Construction of a new PFAS treatment demonstration unit.
- Construction of a new AWTP.

Construction of these improvements is expected to be completed in 2027.

Multiple design documents have been produced for the SFIA MLTP RWSP, including the *Basis of Design Report, Title 22 Engineering Report*, and *BOI* report. The *BOI* report was completed in February of 2025 and serves as the authoritative source of information for the design assumptions made and the work to be completed under the SFIA MLTP RWSP.

The *BOI* provides documentation of the new treatment systems to be constructed at the MLTP, the expected influent water quality, and the anticipated volume of influent flows. The SFIA treatment design-build project incorporates treatment systems used to address two main project components (1) treatment of PFAS and (2) treatment of water that can be used for non-potable purposes. The SFIA industrial wastewater treatment design incorporates DAF, ozone, and BAF. The BAF process at the IWTP consists of a fixed bed filtration system in which biological growth occurs on carbon, typically referred to as BAC. After DAF/ozone/BAF, water is sent through granular activated carbon (GAC) or ion exchange (IX) for PFAS treatment, and then on to the AWTP. The AWTP will utilize UF, followed by RO and UV. Figure 2.2 illustrates the relevant MLTP treatment processes, as documented in the *BOI* report. Moving forward in this report, biologically active filtration will be referred to as BAC.



Source: Carollo and Walsh Group 2025.

Figure 2.2 Treatment Process Diagram for the Upgraded IWTP, PFAS Treatment Demonstration, and AWTP at SFIA

The current IWTP is designed to treat an industrial peak flow of 1.4 mgd. Modifications will be made to the IWTP to increase the influent peak flow capacity from 1.4 mgd to 2.2 mgd.

The finished water quality goals for satisfying Title 22 disinfected tertiary recycled water and the customer-specific water quality requirements are defined the *BOI* report along with the AWTP finished water quality characteristics based on RO treatment projections and planned chemical additions to finished water. Customer-specific water quality requirements are consistent with those defined in the *SFIA RWMP*.

2.2 Prior Non-Potable Recycled Studies

In addition to the SFIA studies discussed above, several reports focused on NPR water in the vicinity of SFIA were reviewed:

- City of SSF *Recycled Water Facility Plan (RWFP)* (Carollo 2009).
- *Evaluation of Potential Recycled Water Effluent Sources for Irrigating Four South San Francisco/San Bruno Landscapes* (HortScience, Inc. 2011).
- *Golden Gate National Cemetery Recycled Water Delivery Interoffice Memorandum* (Carollo 2017).
- Cal Water – South San Francisco Recycled Water Feasibility Study (Draft).

The City of SSF *RWFP* provided key information related to raw and treated wastewater quality from SSF-SB WQCP, recycled water customer demands in the area, and potential infrastructure alignments to reach customers. The *Evaluation of Potential Recycled Water Effluent Sources for Irrigating Four South San Francisco/San Bruno Landscapes* report provided information about salinity hazards when using recycled water for irrigation of four customers. The 2017 *Golden Gate National Cemetery Recycled Water Delivery Interoffice Memorandum* provided pipe alignments and cost estimates for delivering recycled water from SFIA to GGNC. Details regarding each of these studies are discussed below.

2.2.1 City of South San Francisco *Recycled Water Facility Plan*

The City of SSF *RWFP* evaluated recycled water use for the Cities of SSF and San Bruno. The motivation for pursuing a recycled water project was to reduce demands for potable water from SFPUC and reduce withdrawals from the Westside Groundwater Basin which serves as a water source for both Cal Water and SFPUC, as well as the City of Daly City. The plan was never implemented due to the high salinity concentration in SSF-SB WQCP effluent. Sodium and salts can reduce soil permeability, which can be countered by adding calcium in the form of high-grade gypsum. However, high salinity can also be reduced at the source, which was an identified industrial area in SSF. Brine from the source can be collected in tanker trucks and discharged to an evaporation or holding pond. Therefore, while recycled water was not implemented within the SSF-SB WQCP due to the high salinity concentrations, options for salinity reduction can allow recycled water to be used for irrigation.

The City of SSF *RWFP* analyzed options for upgrading the SSF-SB WQCP to produce recycled water for non-potable use, and identified potential recycled water customers. The facility plan defined a preferred tertiary treatment system consisting of MF and UV disinfection.

The report identified two customer groupings corresponding to two phases of project development: Phase 1 customers were in the SSF and San Bruno area, and Phase 2 customers were in the Town of Colma. Customers in both phases consisted of parks, schools, golf courses, and cemeteries, with most cemeteries in the Town of Colma. The maximum day demands were estimated at 2 mgd for Phase 1 customers and an additional 3 mgd for Phase 2 customers. Many of the customers identified in the report are also potentially viable customers of the SFIA MLTP.

Conceptual designs for recycled water infrastructure systems—consisting of transmission mains, storage tanks, pump stations, and distribution pipelines—were developed for the two project phases and customer groupings. Given the proximity of the SSF-SB WQCP to the SFIA MLTP, the preliminary alignments for transmission mains and distribution pipelines are relevant to the pipeline routing for delivery of recycled water offsite from SFIA.

2.2.2 Evaluation of Potential Recycled Water Effluent Sources for Irrigating Four South San Francisco/San Bruno Landscapes

As a follow-up to the City of SSF *RWFP*, an *Evaluation of Potential Recycled Water Effluent Sources for Irrigating Four South San Francisco/San Bruno Landscapes* was completed. The four potential customer locations included GGNC, Orange Park, Linear Park, and SSF High School. While recycled water may contain nutrients that reduce the need for fertilization, recycled water often contains salts that, over time, can damage sensitive plants and degrade soil quality. To gain an understanding of the potential soil and plant response to recycled water at each customer location, the source water quality, soil characteristics, and salt sensitivity of plant species at each site were taken into consideration.

The evaluation considered water from six sources within the greater SSF-SB WQCP collection system:

- Shaw Road Pump Station.
- San Mateo Pump Station.
- Millbrae effluent.
- Burlingame effluent.
- SSF-SB WQCP combined effluent (E002).
- SSF-SB WQCP secondary clarifier effluent.

Samples were collected from each of these sources over a three-week period in June 2010 for water quality analysis. The results of the water quality tests were used to evaluate the suitability of each water source for recycled water irrigation. The results indicated that recycled water produced from the Burlingame effluent, Millbrae effluent, San Mateo Pump Station, and Shaw Road Pump Station pose a minimal to slight salinity hazard and can be used for irrigation with minimal negative effects. The SSF-SB WQCP combined effluent and secondary clarifier effluent water had a slight to moderate salinity hazard and would result in gradual increase in soil salinity and ultimately damage salt-sensitive plants.

This study did not account for any modelling of expected finished recycled water quality but, instead only used the wastewater water quality parameters "as-is." The treatment system planned for the SFIA MLTP includes RO, which will result in almost complete removal of salts and nutrients in the finished water.

Excluding Linear Park, the soils at the proposed irrigation sites were all similarly low in salts, pervious, and pH neutral to slightly acidic. At Linear Park, the presence of pavement base materials and construction spoils within the site soil likely caused moderately alkaline soil and higher salinity as compared to other irrigation sites. The study suggests that the dense and compacted soils at Linear Park would likely restrict infiltration of irrigation water and result in poorer plant performance.

At each of the four potential customer sites, most plant taxa (groups of plants classified based on their similarities) identified were either categorized as having high or moderate salt tolerance. At GGNC, 85 percent of plant taxa had high to moderate salt tolerance, while SSF High School had only 72 percent of plant taxa with high to moderate salt tolerance. The percentage of plant taxa categorized as having low salt tolerance at each site ranged from 15 percent at GGNC to 19 percent at Linear Park.

2.2.3 *Golden Gate National Cemetery Recycled Water Delivery Interoffice Memorandum*

The *Golden Gate National Cemetery Recycled Water Delivery Interoffice Memorandum* estimated the costs to deliver purified water to GGNC from SFIA. The memo identified concept-level pipeline, pump station, and storage facilities to send sufficient recycled water to GGNC. The proposed alignment made use of a utility trench and easement already existing under Highway 101. Additional storage was not accounted for beyond the existing 700,000-gallon tank located at GGNC. The pipeline and pump station were sized for a peak flow of 1 mgd. The memorandum included a Class 5 cost estimate.

Chapter 5 includes additional information regarding pipelines and pump stations needed to serve GGNC with recycled water.

2.2.4 Cal Water – South San Francisco Recycled Water Feasibility Study (Draft)

Cal Water is actively preparing a South San Francisco Recycled Water Feasibility Study as of summer 2024. To aid SFPUC's water reuse evaluation for SFIA, Cal Water provided preliminary information that may be subject to change upon finalization of the study.

The Cal Water study investigated producing recycled water and/or advanced treated purified water at a new facility in Brisbane for conveyance to locations in Brisbane and SSF including Sierra Point, Oyster Point, and Genentech. Cal Water considered existing customers only, not users outside its service area. As of August 2024, the study does not consider customers south of Colma Creek due to the need for a costly pipeline crossing. Wastewater sources for the Cal Water study include the Bayshore Sanitary District and the Baylands Development project. The Bayshore Sanitary District currently sends 0.33 mgd of raw wastewater to SFPUC for treatment and disposal. The projected average daily raw wastewater generated by the Baylands Development is 1.4 mgd.

Year-round recycled water demand for potential customers in Brisbane, Sierra Point, Oyster Point, and Genentech is estimated at 1 mgd, consisting of an estimated 0.7 mgd for Brisbane and Sierra Point and 0.3 mgd for Oyster Point and Genentech. Note that demand estimates included both non-potable and potable customers (who would require advanced treated purified water) for supplying water for irrigation, hotels, offices, commercial buildings, cooling towers, etc. Pipeline sizing was based on the largest hourly demand but may need to be increased if more customers are added (e.g., potential to extend the system to include the Colma Cemetery). Demand and existing infrastructure at the proposed customer facilities should be confirmed through outreach as and if the project progresses.

As part of the Cal Water South San Francisco Recycled Water Feasibility Study, the study identified and developed a cost for a Highway 101 crossing and pipeline alignment from the potential recycled water facility in Brisbane to Sierra Point, Oyster Point, and Genentech.

2.3 Other Related Recycled Water Studies

2.3.1 Daly City Recycled Water Expansion Project Studies

Daly City operates an existing recycled water treatment system, sited at the North San Mateo County Sanitation District WWTP. The recycled water treatment system currently produces a maximum of 2.77 mgd that is delivered to nearby golf courses, parks, and medians. A remaining 3 to 6 mgd (dry and wet weather flows, respectively) of secondary effluent is currently discharged to the Pacific Ocean under Daly City's NPDES permit.

SFPUC partnered with Daly City in 2017 to prepare the *Final Initial Study/Mitigated Negative Declaration* report for the Daly City Recycled Water Expansion Project (SMB Environmental 2017). The report evaluated the feasibility of developing an expanded tertiary treatment recycled water facility with the goal of using the excess 3 mgd of Daly City's dry weather effluent to offset nearby irrigation demands and reduce withdrawals from the South Westside Groundwater Basin. The primary recipient of additional recycled water would be cemeteries as well as some schools and parks in the Town of Colma.

More recent studies include the *Conceptual Alternatives Evaluation Technical Memorandum* (Carollo 2021) and *Feasible Alternatives Evaluation Technical Memorandum* (Carollo 2022). In the *Conceptual Alternatives Evaluation Technical Memorandum*, six project alternatives were developed, each scenario providing a combination of irrigation in the Town of Colma and/or groundwater recharge within the South Westside Groundwater Basin, with varying treatment systems. In the *Feasible Alternatives Evaluation Technical Memorandum*, three viable alternatives were refined and preliminary cost estimates and site layouts developed. Key information from these studies regarding groundwater travel time and siting considerations for potential groundwater recharge wells is described in Chapter 6.

2.3.2 Genentech – Past Studies and Ongoing Interest in Recycled Water

Since 2012, Genentech's SSF campus has been interested in reducing potable water usage and increasing recycled water opportunities. In 2016, a study evaluated the feasibility of two recycled water options:

1. Recycling secondary effluent from the NBSU or SSF-SB WQCP.
2. Recycling neutralized process water from a campus building (Building B3).

Following the study, Genentech decided to pursue treatment and use of recycled water using Building B3 effluent. The firm carried out a pilot study to explore treatment options and produced a report in 2018 summarizing results of MF and RO treatment. A 2019 *Concept Design Report* compiles various technical studies, including the 2016 and 2018 reports, and presents design concepts for implementing onsite recycled water use. The design was never implemented due to high cost and other factors.

Since 2018, Genentech's water consumption has changed due to the evolving campus, but there continues to be an interest in recycled water opportunities. Potential non-potable expansion opportunities include interior uses (primarily toilet flushing), irrigation, and cooling water. Monthly average water demand estimates by non-potable demand type as of December 2024 are shown in Figure 2.3. Non-potable demands by month showing monthly total gallons used and monthly average gallons per day are shown in Appendix B.

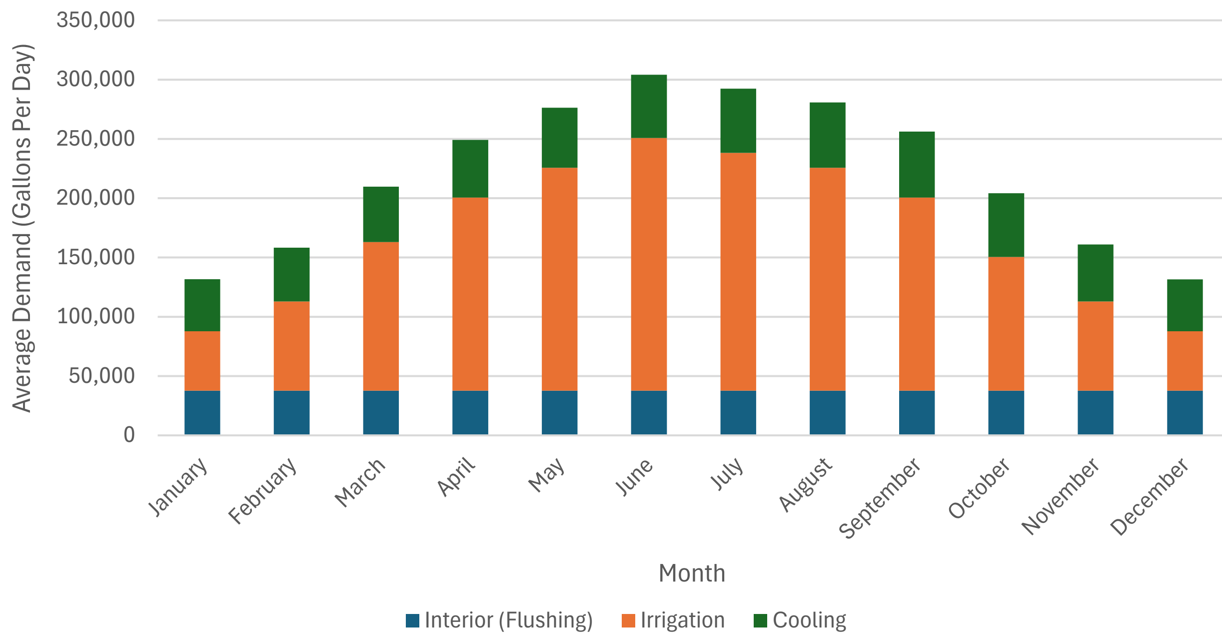


Figure 2.3 Estimated Monthly Average Water Demand by Non-Potable Use Type

The expected irrigation demand is the highest in the summer and accounts for the largest non-potable consumption. Interior (flushing) and cooling non-potable demand is fairly consistent month to month.

2.3.3 Burlingame Recycled Water Feasibility Study

The City of Burlingame received funding in 2023 from the California Department of Water Resources to pursue a Recycled Water and Wastewater Discharge Reduction project. The purpose of the project is to reduce wastewater discharges to the San Francisco Bay while also developing recycled water to diversify and add resilience to Burlingame's water portfolio. At the time of writing, Burlingame is just beginning a recycled water and wastewater discharge reduction feasibility study to evaluate potential approaches to achieve the project goals.

2.3.4 *Millbrae Recycled Water Feasibility Study and Alternatives Analysis Report*

In October 2024, the City of Millbrae completed its *Millbrae Recycled Water Feasibility Study and Alternatives Analysis Report*, which describes options for recycled water treatment at Millbrae's WPCP and identifies potential current and future customers and recycled water demands, lays out infrastructure options for serving customers, and discusses potential regional partnership opportunities. The report also considers how recycled water production will affect upcoming nutrient reduction requirements for San Francisco Bay (West Yost 2024).

The study evaluated the feasibility of producing and distributing disinfected tertiary recycled water that meets Title 22 requirements for unrestricted use. The expected increase in water demands due to growing population was the main project driver identified. The City of Millbrae's potable water supply comes entirely from the SFPUC. The goal of the project is to diversify the city's water supply portfolio by identifying an additional water source. The city uses secondary treatment and disinfection at its WPCP prior to pumping the effluent into the Noth Bayside System Unit force main which is discharged to the San Francisco Bay. A limited amount of secondary effluent is used as recycled water onsite at the WPCP. Potential recycled water customers were identified, and it was determined the WPCP has sufficient supply to meet the demand. Regional partnership discussions were held with three viable regional opportunities: Caltrans, the City of Burlingame, and the City of San Bruno. However, Caltrans is the only partner that expressed interest in purchasing the City of Millbrae's recycled water.

Because the City of Millbrae is currently looking to maximize its use of produced wastewater for its potential local recycled water project, this water reuse evaluation report does not consider Millbrae's wastewater as a possible supplemental feed water source for an SFIA-based project.

2.4 Summary of Past Reports

Key information from each of the studies reviewed is summarized in Table 2.2.

Table 2.2 Summary of Past Reports and Potential Customers

Reference	Reuse Location	Type of Reuse	Reuse Demand	Project Infrastructure Components	Study Outcomes	Information Used by this Study
SFIA RWMP (Kennedy/Jenks 2014)	Onsite at SFIA	Non-potable (near term) Potable (future)	Peak Daily: 1 mgd	Includes pumping, distribution, and treatment, and storage needed to deliver water to SFIA. Treatment considers magnesium/UF/UV/chlorination.	Important input for the SFIA RWSP *BOI* (2024).	▪ Customer locations and demands. ▪ Pipeline alignments from SSF to SFIA.
SFIA RWMP (Kennedy/Jenks 2014)	Offsite at GGNC	Non-potable	Peak Daily: 0.9 mgd	Includes pumping, distribution, and treatment needed to deliver water to GGNC. Storage not included.	Important for considering delivery to GGNC and potential Highway 101 crossing alignments.	▪ Customer locations and demands. ▪ Pipeline alignments from SFIA to GGNC.
SFIA MLTP RWSP *BOI* (Carollo and Walsh Group 2025)	Onsite at SFIA	Non-potable and potable	Peak Daily: 1.2-1.5 mgd	▪ IWTP: DAF, ozone, BAF. ▪ PFAS demo: GAC/IX. ▪ AWTP: UF, RO, UV.	Important for understanding treatment systems and flows for Phase I and the Ultimate Buildout scenarios.	▪ Water quality information at SFIA. ▪ SFIA effluent quantity and timing of flows.
Golden Gate National Cemetery Recycled Water Delivery Interoffice Memorandum (Carollo 2017)	Offsite at GGNC	Non-potable	Peak Annual: 1 mgd	Includes pipeline, pump station, and costs associated with transporting and delivering water to GGNC.	To date, this project has not been implemented.	▪ Customer locations and demands. ▪ Pipeline alignments from SFIA to GGNC.
SFIA RWMP (Kennedy/Jenks 2014)	Offsite at Bayfront Park and Bay Trail South	Non-potable	Peak Daily: 0.04 mgd	Includes pumping and distribution of water to Bayfront Park and Bay Trail South.	Important for determining flow demands for Bayfront Park and Bay Trail South.	▪ Customer locations and demands. ▪ Pipeline alignments from SFIA to Bayfront/Bay Trail.
City of SSF *RWFP* (Carollo 2009)	Phase I – Users in SSF and San Bruno Phase 2 – Users in Colma	Non-potable	Peak Daily, Phase I: 2 mgd Peak Daily, Phase 2: 3 mgd	Includes pumping, distribution, treatment, and storage. Treatment considers pressure membranes and UV disinfection.	Not implemented due to high salinity challenges.	Customer locations and demands.
Cal Water SSF Recycled Water Feasibility Study (Pending)	Around SSF (Brisbane, Sierra Point, Oyster Point, Genentech)	Non-potable and potable	Year-round Average: 1 mgd	Information pending.	Information pending.	Customer demands.

Source: Carollo 2009; Carollo 2017; Carollo and Walsh Group 2025; Kennedy/Jenks 2014.

CHAPTER 3 DEFINING RECYCLED WATER NEEDS

This chapter analyzes potential customers and demands for recycled water from the AWTP.

3.1 San Francisco International Airport Onsite Demands and Water Available

As part of the SFIA design-build project currently underway, recycled water from the AWTP will be conveyed to areas in the SFIA terminals that are already dual-plumbed. Other opportunities for NPR water use within SFIA include vehicle/equipment washdown stations, landscape irrigation, cooling tower supply, and additional indoor uses (e.g., toilet flushing) requiring the installation of dual-plumbing. The timing of implementation of recycled water conveyance and new dual plumbing will affect recycled water demands in both Phase I and the Ultimate Buildout scenario. Current demand based on existing fixtures is approximately 0.5 mgd. As discussed in Chapter 1, for Phase I of the project, average daily recycled water demand is expected to be 0.8 mgd, and maximum daily demand (MDD) is expected to be 1.2 mgd. At Ultimate Buildout, average and MDD are expected to be 1.0 mgd and 1.5 mgd, respectively.

Based on the *BOI* report's recycled water production and demand estimates, and summarized in Table 1.1, the remaining available recycled water for offsite use is 0.1 to 0.2 mgd using dry-weather flow. However, if the AWTP were operated at its maximum daily production capacity while SFIA recycled water demands were at average day levels, recycled water for offsite use could be as much as 0.5 mgd in Phase I and 0.7 mgd in the Ultimate Buildout scenario. Similarly, if Ultimate Buildout scenario production is realized in the near term while SFIA demands are still at Phase I levels, 0.3 to 0.5 mgd of recycled water could be available for offsite uses. Modeling and analysis of diurnal trends in recycled water production and demands at SFIA would improve understanding of the expected volumes and timing of surplus recycled water.

Recycled water production at SFIA could be maximized if supplemental feed water from offsite were treated at the MLTP, making 0.2-0.9 mgd of recycled water available for offsite non-potable and potentially potable demands; this option is further explored in Chapter 4. Recycled water for offsite use could increase substantially if the MLTP capacity were expanded to 3 mgd (not evaluated in this study) and supplemental feed water were obtained from offsite facilities.

Although the volume varies, there is potential to send excess recycled water to offsite recycled water customers. These customers are described below.

3.2 Identification of Potential Offsite Customers

A comprehensive list of potential recycled water customers near SFIA is compiled in Table 3.1, which includes customer name, water supplier, type of demand/use, current or future customer, and demand. Customers are organized from the largest to smallest ADD. Only non-potable uses are considered except where noted.

Table 3.1 Recycled Water Customer Demand Summary

Customer	Water Supplier	Type of Demand/Use	Current vs Potential Future Demand	ADD (mgd)	MDD (mgd)
City of Brisbane development[1]	N/A (future)	Municipal potable	Potential future	1.1	--
GGNC[3]	SFPUC	Irrigation	Current	0.631	0.820
CGC[4]	Private Well	Irrigation	Current	0.443	0.576
Genentech and redevelopment[1]	Cal Water	Indoor (17%), Cooling (23%), Irrigation (60%)	Current	0.22	0.31
			Potential future	1.0	--
South San Francisco High[4]	Cal Water	Irrigation	Current	0.152	0.198
El Camino High[4]	Cal Water	Irrigation	Current	0.078	0.101
Linear Park (along top of BART corridor)[4]	Cal Water	Irrigation	Current	0.064	0.083
YouTube[1]	City of San Bruno	Indoor (dual plumbing)	Current	0.026	0.034
Baden High and Adult Education[4]	Cal Water	Irrigation	Current	0.021	0.027
Ponderosa Elementary[4]	Cal Water	Irrigation	Current	0.017	0.022
Lions Park and Belle Air Elementary School[2]	City of San Bruno	Irrigation	Current	0.017	0.022
Buri Buri Park[4]	Cal Water	Irrigation	Current	0.015	0.020
Bayfront Park[2]	City of Millbrae	Irrigation	Current	0.015	0.019
Commodore Park[4]	San Bruno	Irrigation	Current	0.011	0.014
Bay Trail South[2]	City of Burlingame	Irrigation	Current	0.010	0.013
Tanforan Shopping Center redevelopment[5]	N/A (future demand)	Irrigation, indoor non-potable uses	Potential Future	0.009	0.012
Brentwood Park[4]	Cal Water	Irrigation	Current	0.009	0.012
Millbrae Yard[3]	SFPUC	Irrigation, indoor non-potable uses	Current	0.009	0.01
Avalon Memorial Park[4]	Cal Water	Irrigation	Current	0.008	0.010
San Bruno Creek Area park development (potential Future)[2]	City of San Bruno	Irrigation	Potential future	0.008	0.010
Sneath Lane Medians[4]	City of San Bruno	Irrigation	Current	0.006	0.008
Los Cerritos Elementary[4]	Cal Water	Irrigation	Current	0.003	0.004
Bayside Manor Park[2]	City of Millbrae	Irrigation	Current	0.002	0.003

Sources:
(1) Customer-defined demand estimate.
(2) Kennedy/Jenks 2014.
(3) SFPUC customer meter data, 2016 to 2022. Millbrae Yard is undergoing renovations, but post-renovation demand estimates are not available.
(4) HortScience, Inc. 2011.
(5) City of San Bruno estimate, 2025.

Seventeen additional potential irrigation customers in the Colma area, primarily cemeteries, have a combined ADD of approximately 2.2 mgd. These irrigation customers have been included as part of the Daly City Recycled Water Expansion project (described in Section 2.3.1).

A study specifically evaluating the feasibility of serving the Holy Cross Cemetery (in the Colma area) with recycled water from SFIA was prepared by Carollo/WRE for SFPUC in parallel with this report and was completed in March of 2025. The main conclusion of the study was that an expanded Daly City recycled water project would better match the Holy Cross Cemetery demands and be more affordable than using recycled water from SFIA.

3.2.1 Refining and Grouping Potential Customers

The feasibility of each customer in Table 3.1 was determined through an initial screening using a set of primary and secondary considerations. Primary screening criteria for the customer(s) carried forward in this study include:

- Customer has an ADD that can be met entirely by the Ultimate Buildout scenario (rather than mixing multiple water sources to meet demand).
- Customer is near the SFIA MLTP facility.
- Customer is near other potential recycled water customers.

Secondary screening criteria for the customer(s) carried forward in this study include:

- Customer will require year-round flow rather than just seasonal (summer) flow.
- Customer has current demand and is ready to receive recycled water immediately, rather than an uncertain future date.

These primary and secondary criteria were applied to the customers listed in Table 3.1, narrowing the list to the most feasible potential recycled water customers. These customers were then grouped based on their location relative to the MLTP (Western Customers, Northern Customers, and Southern Customers). The customer groupings is reflected in Figure 3.1. Information regarding primary and secondary considerations for each customer grouping is summarized in Table 3.2 along with the customer groupings and corresponding ADDs. The “Distance from Nearest Recycled Water Customer” column is left blank for customers that are considered the primary or top priority customer within the customer group.

Table 3.2 Refined Recycled Water Customer Demand Summary

Customer	Water Supplier	Expected ADD (mgd)	Expected MDD (mgd)	Entire Demand can be met by Recycled Water from SFIA	Distance from SFIA (miles)	Distance from Nearest Recycled Water Customer (miles)	Flow Seasonality	Site Status
Western Customers								
GGNC(1)	SFPUC	0.63	0.82	Yes	4.6		Summer	Current
Tanforan Shopping Center redevelopment(2)	Cal Water	0.009	0.0120	Yes	3.7	GGNC Junction to Tanforan: ~0.11	Summer	Future
YouTube(3)	City of San Bruno	0.026	0.034	Yes	4.3	GGNC Junction to YouTube: ~0.9	Spring, Summer, Fall	Current
Millbrae Yard(1)	SFPUC	0.009	0.0120	Yes	4.2	GGNC Junction to Millbrae Yard: ~1.8	Year-Round	Current
Northern Customers								
Genentech and redevelopment(3)	Cal Water	0.22-1.0(5)	0.31-1.0(5)	Current – Yes Future – No	2.4		Year-Round	Current/Future
Southern Customers								
Bayfront Park(4)	City of Millbrae	0.015	0.019	Yes	2.4		Summer	Current
Bay Trail South(4)	City of Millbrae	0.010	0.013	Yes	4.3	Bay Trail South to Bayfront Park:~0.36	Summer	Current

Sources:
(1) SFPUC customer meter data, 2016 to 2022. Millbrae Yard is undergoing renovations, but post-renovation demand estimates are not available.
(2) City of San Bruno estimate, 2025.
(3) Customer-defined demand estimate.
(4) Kennedy/Jenks 2014.
(5) First value is current demand, and the second value is future demand.

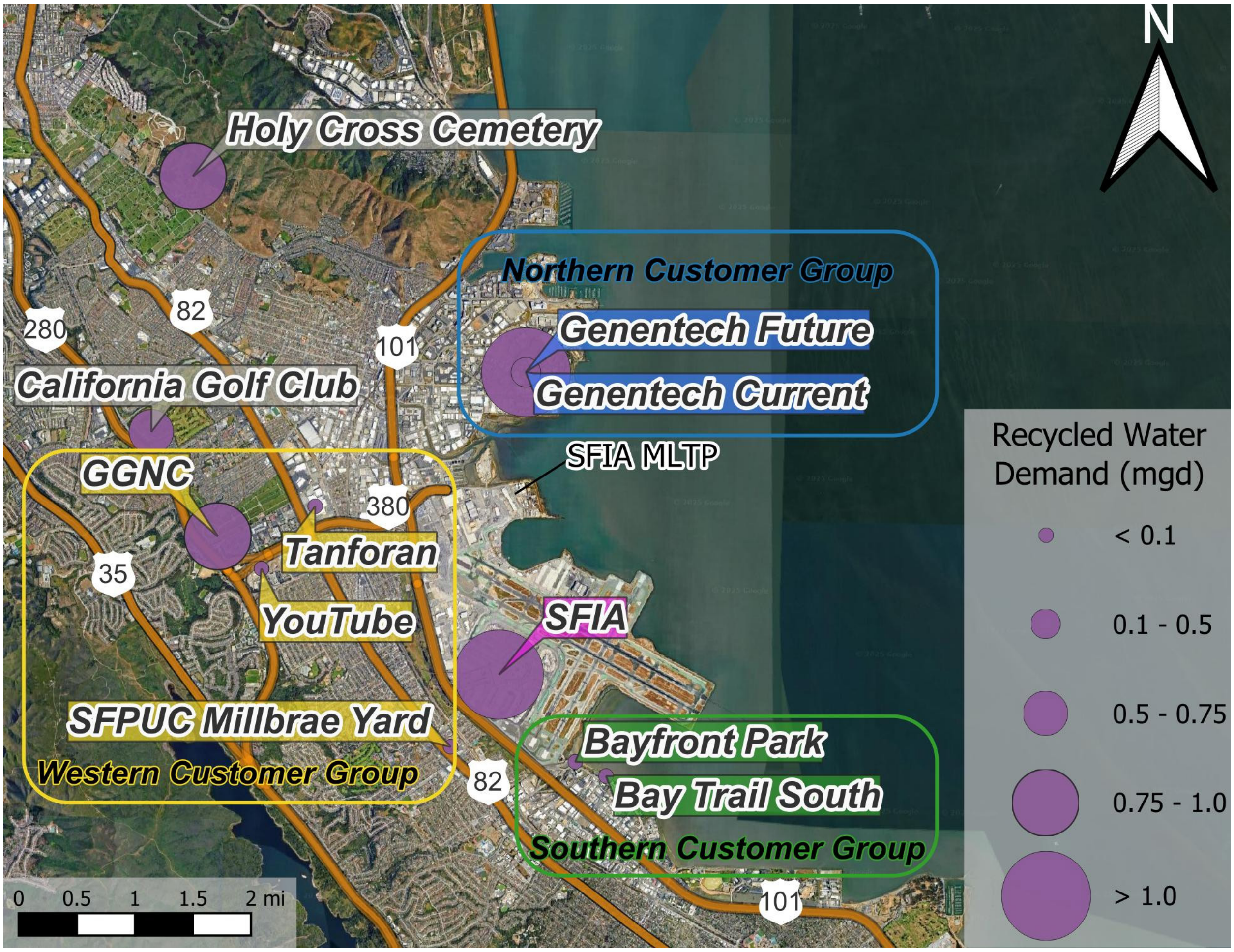


Figure 3.1 Customer Groupings by Location

3.2.2 Priority Customer Profiles

The motivations for retaining each potential customer and initial feasibility considerations are summarized below. Infrastructure needs and estimated costs for serving each customer are summarized in Chapter 6.

3.2.2.1 San Francisco International Airport – Expanded Non-Potable Recycled

SFIA is the primary recipient of recycled water in the SFIA RWSP. As mentioned in Section 3.1, recycled water from the AWTP will be conveyed to areas in the SFIA terminals that are already dual-plumbed for non-potable use. Phase I of the recycled water project is set for completion in 2027. Phase I demands are anticipated by this date; however, it may take time to have the demands fully realized.

The Ultimate Buildout scenario requires identification of additional opportunities for recycled water use at SFIA. Due to the unknown uses, locations, and timeline, the expansion of recycled water use at SFIA is not retained as a potential customer for this study.

3.2.2.2 Northern Customers

Cal Water is investigating the possibility of developing a new satellite wastewater treatment and recycling plant that could supply Brisbane, Genentech, and others with recycled water. As the Cal Water project is expected to be costly due to the need for a new treatment plant, serving Brisbane and Genentech as part of the SFIA RWSP could be an economical alternative.

Genentech

Genentech is located 2.4 miles north of SFIA. With a current total demand of 0.22 mgd and expected future demand of up to 1.0 mgd, AWTP could reliably meet Genentech requirements for recycled water. Genentech is a unique customer in that most of its demands are for non-potable industrial uses; thereby requiring a more consistent, year-round water supply. The industrial demand will likely occur during normal working hours, in contrast to irrigation demands, which typically occur overnight. Coupling Genentech's industrial demands with an irrigation customer could allow for a more complete utilization of surplus recycled water from SFIA. There may be an opportunity to serve Genentech's industrial demands with existing non-potable pipelines onsite.

Genentech has installed some dual-plumbing across the campus that could be leveraged with recycled water. If Genentech wants to implement recycled water use, they will have to either receive this from an outside water supply source or treat water onsite. A benefit for Genentech in using SFIA's recycled water would be the cost savings from not having to build its own treatment plant.

3.2.2.3 Western Customers

Serving any of the customers west of SFIA would require a Highway 101 crossing. If the investment is made to cross Highway 101, multiple customers within relatively close proximity to one another become accessible. These potential customers are discussed below.

Note that California Golf Club was removed from the final Western customer group because its demands exceed available supply if both GGNC and CGC were served. Without CGC, the total MDD for the Western customer grouping is 0.87 mgd which aligns well with the 0.9 mgd of available flow.

Golden Gate National Cemetery

GGNC, located in San Bruno, has previously been investigated as a potential offsite customer of SFIA. Recycled water at GGNC would be used for non-potable irrigation. GGNC currently receives raw water from SFPUC (Carollo 2009). Before it obtained this SFPUC supply, GGNC used onsite wells for irrigation.

The estimated ADD at GGNC is 0.63 mgd, which aligns well with the estimated amount of excess recycled water from AWTP (0.2-0.9 mgd). Since GGNC would use recycled water for irrigation, its demand would vary seasonally. If an existing storage tank were used to hold recycled water, the timing of recycled water delivery could be flexible. GGNC is considered a currently-available potential customer rather than a site that will be developed in the future.

GGNC currently has a 700,000-gallon storage tank onsite. Storage for recycled water use was determined based on the assumption of the MDD. At GGNC the MDD is 0.82 mgd, or 820,000 gallons. For the purposes of this evaluation, it is assumed this tank will be converted for recycled water use. The existing tank nearly meets the assumed peak daily demand.

Tanforan Shopping Center

Tanforan Shopping Center located approximately 0.11 miles southeast of GGNC, is a proposed redevelopment project planned for future mixed uses including retail, an innovative life science campus, housing units, and public/private open space. Based on the preliminary planning documents available at the time of writing of this report, only irrigation was considered in the estimation of Tanforan's non-potable demands. If the redevelopment project ends up pursuing dual-plumbing for indoor recycled water use, the timing of dual-plumbed demands would likely be more evenly distributed over the course of each day as compared to the daily and seasonal variation expected from irrigation demands. The Tanforan redevelopment is considered a future potential customer.

The estimated average daily non-potable demand (irrigation and indoor) for the Tanforan redevelopment is 0.009 mgd, which assumed 75 percent of the project site's 11 acres of open space will require drip irrigation. Due to the small demand requirements, delivery of recycled water to this customer only makes sense in a scenario where neighboring GGNC is also receiving recycled water. Approximately 580 feet of additional pipeline from the GGNC junction would be needed to serve Tanforan. A 15,000-gallon storage tank would be required to meet the MDD of 0.01 mgd.

YouTube

YouTube campus has expressed interest in receiving NPR water from the AWTP. Some buildings onsite are dual plumbed and piped for potential purple pipe delivery. One of the buildings has a cistern that stores recycled water for the building. The YouTube campus is located adjacent to GGNC, thereby making it easier to serve both customers together. A 25,000-gallon storage tank would be required to meet the MDD of 0.03 mgd at the YouTube Campus. It is recommended that further discussions take place with YouTube to refine expected demands.

San Francisco Public Utilities Commission Millbrae Yard

SFPUC's Millbrae Yard is located approximately 1.8 miles southeast of GGNC. Millbrae Yard is currently slated for renovations, although dual-plumbing is not included in the renovation plans. Current potential demand is for irrigation and potential vehicle/equipment washdown. If final plans include interior uses, demand will expand to the year-round use of recycled water. Serving Millbrae Yard with recycled water would have the added benefit of providing educational opportunities for SFPUC staff and visitors to learn about recycled water. The renovated Millbrae Yard is considered a future potential customer.

Based on SFPUC metering data for 2016 to 2022, Millbrae Yard has an ADD of 0.009 mgd. Given this relatively low demand, serving Millbrae Yard would only make sense if other larger customers west of Highway 101 were also being served. A 15,000-gallon storage tank would be required to meet the MDD of 0.01 mgd at Millbrae Yard.

3.2.2.4 Southern Customers

Bayfront Park

Bayfront Park is located southeast of SFIA and east of Highway 101. Of all the potential customers considered, Bayfront Park is the closest offsite recycled water customer to SFIA. The estimated ADD is 0.015 mgd, which is on the lower end of the customer demand that SFIA could supply. recycled water would be used for irrigation of the existing trails and landscaped areas. Therefore, water supply requirements would fluctuate seasonally and daily. Bayfront Park is considered a currently-available potential customer.

While Bayfront Park is near the southern edge of SFIA, the pipeline required to transport water from SFIA is approximately 1.4 miles. A 20,000-gallon tank would be needed to meet the MDD of 0.019 mgd.

Bay Trail South

Bay Trail South is located southeast of Bayfront Park and would require an additional 0.34 miles of pipeline. The estimated ADD is 0.01 mgd. Due to its lower demand, Bay Trail South should be combined with Bayfront Park. The combination of these two customers at 0.25 mgd (ADD) can be met fully by the excess recycled water produced at the AWTP. Like Bayfront Park, Bay Trail South would use recycled water for irrigation. Therefore, water supply requirements would fluctuate seasonally and daily. A 15,000-gallon tank will sufficiently meet the MDD of 0.013 mgd. Bay Trail South is considered a current potential customer.

3.2.2.5 Other Customers of Significance

Some customers were not included in the customer groupings listed above but may be worthy of study in the future.

City of Brisbane

The City of Brisbane anticipates needing 1.1 mgd of additional potable water supply to serve planned development projects within the city. Unlike irrigation-only customers, the City of Brisbane will require a consistent, year-round source of potable water supply. The water treatment process for the upgraded IWTP, PFAS treatment demonstration, and AWTP at SFIA (shown in Figure 2.2) includes most of the treatment processes required to satisfy the California SWRCB DDW's DPR Regulations as adopted in October 2024.

The 0.5 to 0.9 mgd of surplus recycled water (Phase I + supplemental feed water) that would typically be available from MLTP could be used for the City of Brisbane. However, the surplus would not be able to meet the entire ADD.

While planned development in the City of Brisbane may present a good opportunity for use of SFIA's excess recycled water, it is not considered further in this report due to its distance from SFIA compared to other potential customers being evaluated.

CHAPTER 4 AVAILABLE SUPPLY AND QUALITY

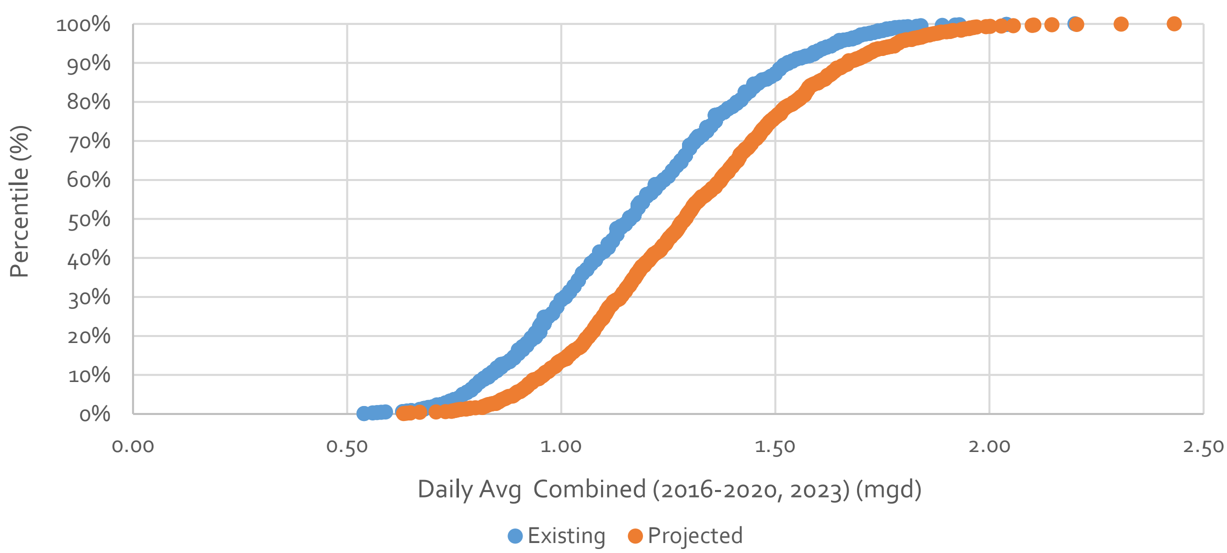
This chapter analyzes supplemental feed water sources for additional treatment at SFIA that would increase the amount of recycled water available to meet off-site demands. Issues evaluated include possible sources and volumes, infrastructure needed to bring supplemental supply to the SFIA MLTP/AWTP, and potential water quality concerns.

4.1 Potential Sources and Volumes of Reuse Supply

Three neighboring agencies were identified as potential supplemental feed water sources to the MLTP: Burlingame WWTP, Millbrae WPCP, and SSF-SB WQCP. The section starts with a discussion of flows available from SFIA, followed by potential from the three neighboring agencies to provide supplemental feed water.

4.1.1 Existing San Francisco International Airport Industrial and Municipal Flows Available

As part of the SFIA RWSP, design flows were determined from Self-Monitoring Report data and future flow projections at both the IWTP and SWTP. The IWTP is not expected to have increased flow in the future due to equalization capabilities within SFIA and the SWTP. For the SWTP, a conservative assumption of 20 percent flow increase was made to reflect future growth at SFIA, estimated to reach a maximum annual passenger count of 65.4 to 71.1 million passengers per year by 2030. Figure 4.1 shows the current and projected combined IWTP and SWTP flows that would be available for recycled water production. Note that the upgraded IWTP will treat a combination of raw IWTP influent and sanitary effluent as pretreatment to the AWTP.



Source: Carollo and Walsh Group 2025.

Figure 4.1 Existing and Projected Combined IWTP and SWTP Flows Available to SFIA AWTP by 2030

Based on projected flows, the upgraded IWTP and AWTP were sized to treat influent flows of up to 2.2 mgd. With a projected 99th percentile flow of 2.0 mgd, the maximum daily design flow of 2.2 mgd is conservative and unlikely to be exceeded. With this conservative design flow, there would likely be 0.6 mgd of surplus treatment capacity available 85 percent of the time and up to 0.9 mgd of surplus treatment capacity sitting idle 50 percent of the time. This potential excess treatment capacity provides an opportunity for additional recycled water production, if sufficient supplemental feed water is brought in from offsite.

4.1.2 Millbrae and Burlingame Wastewater Facilities

As shown in Figure 1.2, the Millbrae WPCP is located roughly 2.5 miles southeast of SFIA. During the recent drought conditions in 2015 and 2016, the Millbrae WPCP had an average dry-weather flow of 1.2 mgd. The Burlingame WWTP is roughly 3.5 miles south of SFIA. In 2015 and 2016, the Burlingame WWTP had an average dry-weather flow of 2.5 mgd. The combined average dry-weather flow from both facilities is 3.7 mgd.

Currently, chlorinated secondary effluent from both wastewater facilities is conveyed through the NBSU force main to the SSF-SB WQCP for sodium bisulfite dechlorination and discharge to the San Francisco Bay through a shared outfall. The NBSU pipeline conveys combined Millbrae WPCP and Burlingame WWTP effluent northwards, parallel to Highway 101, along the western side of the SFIA campus, and passes within roughly 1 mile of the MLTP.

While it may appear convenient from an infrastructure perspective to tap into surplus flow from these two facilities, treating the combined Millbrae WPCP and Burlingame WWTP effluent flows at MLTP would come with challenges. Source control is a critical component of recycled water projects and involves monitoring the wastewater collection system and coordinating with wastewater dischargers to ensure that contaminants are maintained at stable, treatable levels to avoid upsetting treatment equipment and causing water quality exceedances in the resulting recycled water. If SFIA or SFPUC were to pursue a future potable reuse project, using the combined flows would require a complex source control program within SFIA, Millbrae, and Burlingame’s respective collection systems, posing a potential obstacle to implementation and permitting. In addition, with a blended source water, determining the volume of wastewater from each source would considerably complicate the current flow metering system for NBSU discharges. Installation of new pipelines would be necessary to convey effluent flow from the facilities separately.

If a future potential partnership is of interest, both the Millbrae WPCP and Burlingame WWTP have infrastructure that could be leveraged for potential capture, conveyance, and treatment of flows to MLTP. The cities of Millbrae and Burlingame are both currently investigating local recycled water projects for their service areas and may not have supplemental feed water available for a joint recycled water project with SFIA in the future.

4.1.3 South San Francisco-San Bruno Water Quality Control Plant

The SSF-SB WQCP is located roughly 0.75 miles northeast of SFIA. During the recent drought conditions in 2015 and 2016 the SSF-SB WQCP had an average dry-weather flow of 7.4 mgd. Typical average dry-weather flow at SSF-SB WQCP is 13 mgd. While there is interest in generating recycled water at SSF-SB WQCP, a project has never been realized partially due to the high salinity of its effluent. A summary of the City of SSF *RWFP* is included in Section 2.2.1. Because the SFIA AWTP will include RO treatment, salinity will not pose a problem in the treated water, and SSF-SB WQCP effluent (or supplemental feed water) could potentially be used to supplement the recycled water produced at SFIA's MLTP. When referring to SSF-SB WQCP effluent, it should be noted that this terminology is interchangeable with offsite wastewater (mentioned earlier in this report) and supplemental feed water.

Given the proximity of SSF-SB WQCP to SFIA, quantity of available effluent supply, and comparative simplicity of source control within a single additional collection system, using effluent from SSF-SB WQCP is the most viable option for supplemental feed water. Considerations regarding effluent water quality from SSF-SB WQCP are reviewed below.

4.2 Acceptability of South San Francisco-San Bruno Water Quality Control Plant Effluent Water Quality

The current treatment train operation at SSF-SB WQCP is shown in Figure 4.2.

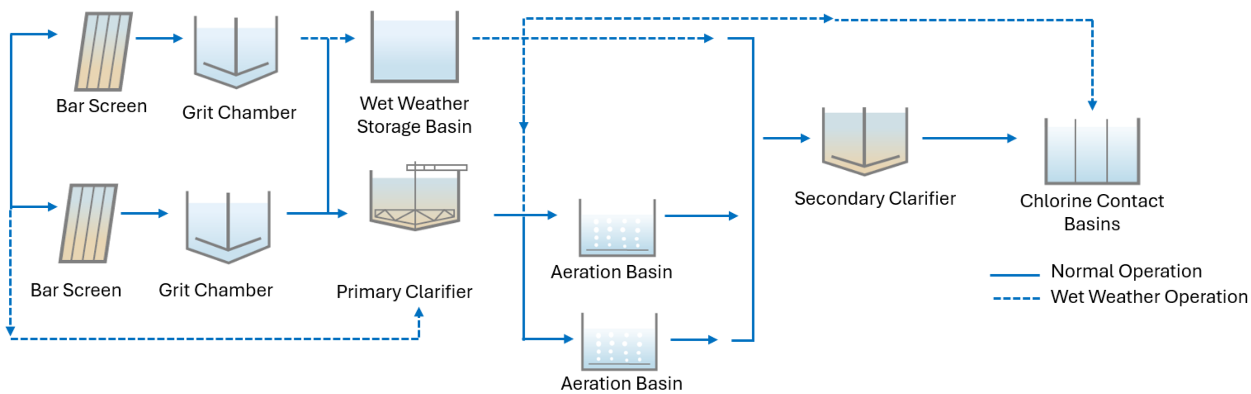


Figure 4.2 Existing Treatment Process Flow at SSF-SB WQCP

In 2018, wet-weather and digester improvements were made at SSF-SB WQCP. Under normal operation, raw wastewater is processed through screening and grit removal before going on to primary clarification. The primary effluent is then sent to the aeration basins, followed by secondary clarification and sodium hypochlorite disinfection in chlorine contact basins. At higher flow rates, influent raw sewage may be sent directly to primary clarification, bypassing screening and grit removal, though this option is reserved for emergency use only. Screened water may be sent from the grit chambers to wet-weather storage basins, bypassing primary clarification. Primary effluent may also be routed directly to the chlorine contact basins, bypassing aeration and secondary clarification. Any flow scenario where aeration is bypassed would make the final SSF-SB WQCP effluent unfit for recycled water use due to incomplete treatment.

4.2.1 San Francisco Bay Regional Water Quality Board Nutrient Watershed Permit Requirements

The San Francisco Bay RWQCB adopted the third Nutrient Watershed Permit (Order R2-2024-0013) in July 2024. The purpose of the permit is to protect the watershed from impacts from municipal wastewater treatment plants by introducing total inorganic nitrogen (TIN) limits. Under this permit, wastewater agencies are required to monitor their discharges, support studies to evaluate the bay's response to current and future nutrient loads, and evaluate opportunities to remove nitrogen through treatment plant improvements. Nitrogen is of interest because it increases the risk of harmful algal blooms. During the dry season, dischargers to San Francisco Bay account for 86 percent of the total nitrogen loading in the bay (SWRCB 2024).

The third Nutrient Watershed Permit impacts NPDES permit dischargers by requiring interim and final effluent limitations to be met. The final effluent limitation requires, by 2034, a 40 percent reduction in the current loading by each discharger during the dry season (May 1 through September 30).

Specific to SSF-SB WQCP, the interim and final effluent limitations are listed below:

- SSF-SB WQCP Interim Effluent Limitation for TIN = 1,500 kilograms per day (kg/day).
- SSF-SB WQCP Final Effluent Limitation for TIN = 560 kg/day.

The interim and final effluent limitations for SFIA are listed below:

- SFIA Interim Effluent Limitation for TIN = 560 kg/day.
- SFIA Final Effluent Limitation for TIN = 71 kg/day.

The following subsections describe options for how SSF-SB WQCP effluent could be accepted and used as a supplemental feed water source at SFIA. An additional option not discussed below is to wait for SSF-SB WQCP to upgrade its plant to meet the new nutrient requirements. Any level of nutrient removal on the full process stream (instead of a side stream) requires near complete nitrification, thus addressing the ammonia concerns that can negatively impact treatment operations.

4.2.2 Existing Water Quality at South San Francisco-San Bruno Water Quality Control Plant

Currently, the AWTP at SFIA is designed to further treat SFIA's industrial and sanitary effluent to meet Title 22 standards for recycled water. The treatment systems used at the SWTP, IWTP, and AWTP are sensitive to specific water quality parameters that affect performance. Below are some examples of parameters that affect treatment systems:

- TOC and nitrite exert significant ozone demand within the ozone system at the MLTP. Higher TOC and nitrite result in reduced ozone system capacity.
- BAC (included as part of IWTP) can only tolerate 2 to 5 mg/L of ammonia. More ammonia would cause the BAC to become anaerobic due to the consumption of oxygen during partial nitrification of ammonia. Thus, high levels of ammonia may render BAC ineffective.
- High salt loads increase the necessary driving pressure head into a RO system (used in AWTP).
- High loads of minerals, such as silica, result in greater scaling of RO systems, which reduces run time and lowers treatment efficiency due to more frequent chemical descaling.

With implementation of the RWSP, the SWTP effluent and IWTP influent will combine for treatment through DAF, ozone, and BAC. Water will then be sent though the PFAS treatment facility, after which it could either be: (1) chlorinated and sent through the NBSU force main to the SSF-SB WQCP for sodium bisulfite dechlorination and discharged to the lower San Francisco Bay, or (2) sent to the AWTP for additional treatment and recycled water production. See Figure 2.2 for the upgraded IWTP and AWTP process flow diagram.

Adding SSF-SB WQCP effluent as a supplemental feed water to the MLTP could affect current treatment and design, particularly for high ammonia levels (see discussion above). The design water quality parameters for the MLTP are listed and compared against SSF-SB WQCP effluent water quality values in Table 4.1. Note that the MLTP is the blended concentration from the IWTP and SWTP effluent with values collected in 2023 as part of the sampling program.

Table 4.1 Effluent Water Quality at the MLTP (IWTP and SWTP) and SSF-SB WQCP

Constituent	MLTP Average Effluent Blended Concentration(1)	SSF-SB WQCP Average Effluent Concentration(2)
pH	6.8 SU	7.8 SU(3)
TDS	742	--
TSS	30.8 mg/L	5.9 mg/L(4)
BOD	4.9 mg/L(5)	7.5 mg/L
Ammonia as N	3.2 mg/L	35.5 mg/L(3)
Nitrite as N	2.07 mg/L	1.3 mg/L(3)
Nitrate	0.208 mg/L	2.7 mg/L(3)
Phosphorous as PO_4	14.1 mg/L	0.93 mg/L(4)
Arsenic, As	1.2 µg/L	0.88 µg/L(4)

Notes:
BOD – biochemical oxygen demand; µg/L – micrograms per liter; N – nitrogen; SU – standard unit.
(1) Source: Carollo and Walsh Group 2025. Values listed are the Design Water Quality analytes for the blended IWTP and SWTP effluent.
(2) SSF-SB WQCP effluent is also referred to as supplemental feed water throughout this report.
(3) Source: 2023 SSF-SB WQCP Effluent Process data. Provided by staff via email on July 19, 2024.
(4) Source: SSF-SB WQCP California Integrated Water Quality System Project data. Accessed October 15, 2024.

Effluent water (supplemental feed water) from SSF-SB WQCP could be added at three possible locations:

1. Upstream of the IWTP (including multiple nitrogen treatment options).
2. Upstream of the SWTP (whose effluent is processed at the IWTP).
3. Upstream of the AWTP.

Each of these alternatives is described below.

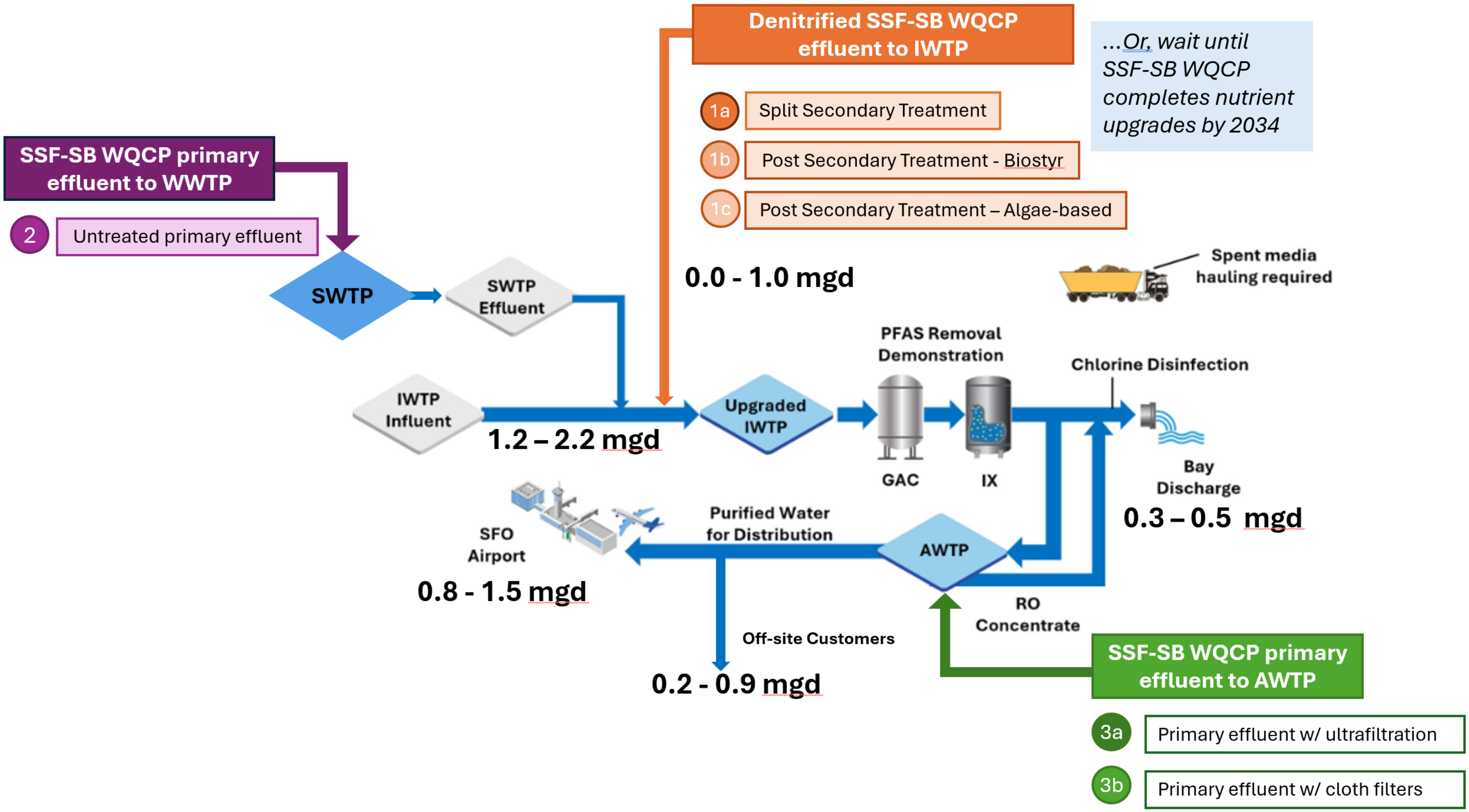


Figure 4.3 Treatment Options for Bringing SSF-SB WQCP Effluent to MLTP

4.2.2.1 Adding South San Francisco-San Bruno Water Quality Control Plant Effluent Upstream of the Industrial Wastewater Treatment Plant

Adding SSF-SB WQCP effluent upstream of the IWTP (Figure 4.3 Option 1 and 2) would have significant impacts on the existing BAC system (downstream of ozonation). High ammonia concentrations exert an oxygen demand on the BAC process that can cause conditions in the system to become anaerobic, which would change the treatment system's functionality and ability to biodegrade chemical pollutants. Ideal ammonia concentrations for BAF are below 2 mg/L, while the average SSF-SB WQCP effluent is 35.5 mg/L. Therefore, the ammonia concentration in the effluent from SSF-SB WQCP would need to be significantly reduced. At wastewater treatment plants, ammonia and nitrogen removal is typically achieved efficiently through a biological process that involves nitrification (converting ammonia to nitrate and nitrite) and denitrification (converting nitrate and nitrite to nitrogen gas).

Four potential solutions for ammonia reduction at SSF-SB WQCP were considered:

- Split secondary treatment at SSF-SB WQCP.
- Post-secondary nitrogen removal at the SFIA SWTP or SSF-SB WQCP.
- Treatment of SSF-SB WQCP primary effluent at the SFIA SWTP with existing technologies.
- Treatment at the SSF-SB WQCP to satisfy the San Francisco Bay RWQCB's recent Nutrient Watershed Permit (further discussed in Section 4.2.1), requiring approximately 40 percent reduction in TIN by 2034. This option would delay the use of SSF-SB WQCP effluent for feed at SFIA, since compliance with the permit is not required until 2034.

Each of these potential solutions is discussed further below. Infrastructure needs associated with each solution are presented in Chapter 6.

Split Secondary Treatment at South San Francisco-San Bruno Water Quality Control Plant

Secondary treatment at SSF-SB WQCP (Figure 4.3 Option 1a) utilizes an air-activated sludge process. Currently, the discharge permit for SSF-SB WQCP does not require total nitrogen and phosphorus removal. See Section 4.2.1 for more details about future permit nutrient requirements that SSF-SB WQCP will have to meet.

Solids retention time (SRT) is the amount of time sludge is kept in a WWTP and is an important performance factor for ammonia reduction. At an average dry-weather flow of 13 mgd, the SRT at SSF-SB WQCP is designed to be one to two days. The SRT must be increased to result in nitrification of ammonia to nitrate (typically, a SRT of four to five days is needed to promote nitrification). Modifications would be needed to provide denitrification and thus nutrient removal. For the nitrification option, SSF-SB WQCP would utilize one of the two sets of aeration basins to increase ammonia removal. One train would run in nitrification mode while the remaining train would run as usual to meet existing requirements. This option would likely require a nutrient study to determine the optimum SRT to reduce ammonia concentrations to the desired level. The study would need to include a capacity analysis: as SRT increases, so does flow, which increases the size of the aeration basin needed. Splitting the operation of the aeration basins would likely also require splitting operation of secondary clarifiers, adding design complexity. Currently, flows from the two sets of aeration basins combine before separating into the four secondary clarifiers. Therefore, dedicated secondary clarifiers and separate solid return systems would be needed to ensure the reduced ammonia and nitrogen concentrations are retained. The benefit of this option is that any facility upgrades or improvements would likely be useful for future Bay Area nutrient permit requirements that SSF-SB WQCP will eventually be required to adhere to. Therefore, this option could be leveraged to minimize stranded assets. Because further analysis (nutrient study) is needed to determine potential capacity increases required after adjusting the SRT, cost estimates were not defined for this option. However, SSF-SB WQCP will likely have to incur costs in the near future to comply with discharge requirements. Figure 4.4 shows this treatment option at SSF-SB WQCP.

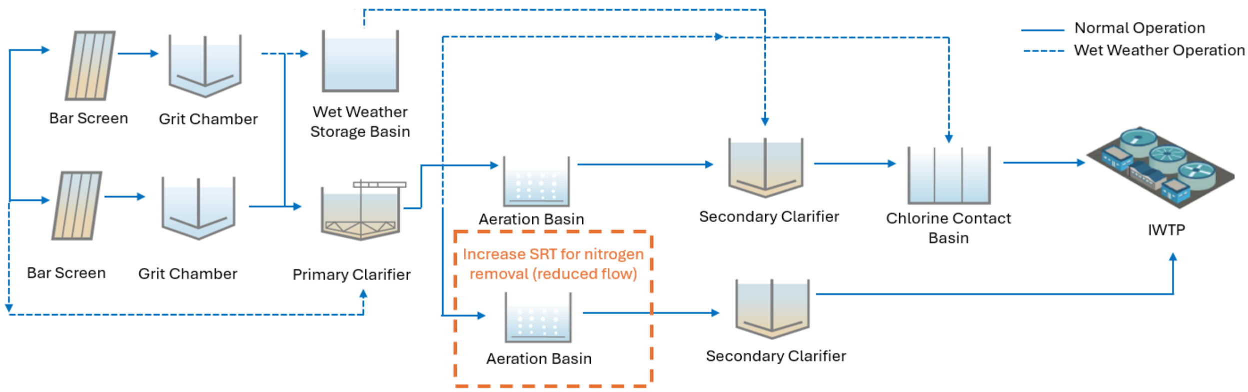


Figure 4.4 Split Secondary Treatment at SSF-SB WQCP Before Sending Effluent to IWTP

If large facility upgrades are needed to achieve the desired ammonia concentrations (<2 mg/L) for influent to the IWTP, SSF-SB WQCP effluent could be blended with SFIA SWTP effluent to meet the desired low ammonia concentration upstream of the IWTP. Currently, the SFIA SWTP has three sequencing batch reactors (SBR) (with an additional reactor in the process of being implemented). These SBRs provide reliable nitrification of the SFIA SWTP effluent. Eventually, the SBRs will be upgraded to aerobic granular sludge (AGS) which will further improve nutrient removal at the SWTP.

Post-Secondary Nitrogen Treatment at South San Francisco-San Bruno Water Quality Control Plant or San Francisco International Airport Sanitary Wastewater Treatment Plant

Post-secondary nitrogen treatment can take place either at the SSF-SB WQCP or the SFIA SWTP. Two treatment options are considered: Biostyr (Figure 4.3 Option 1b) and an algae reactor (Figure 4.3 Option 1c).

The Biostyr option would nitrify secondary effluent through a combined biologically active filter and a moving bed biofilm reactor (nitrification filter). Denitrification filters could be added in series after the nitrification filter to meet future nutrient removal goals. Biologically active filters promote growth on the filter media and are suspended in solution to allow for maximum oxygen transfer. Oxygen is provided to the system to promote biomass growth. The Biostyr system combines biological treatment and filtration into a compact modular system with a small footprint. Figure 4.5 depicts the Biostyr system, including the potential for both nitrification and denitrification filters for treating SSF-SB WQCP effluent. However, only nitrification is not required for water that is sent to the IWTP.

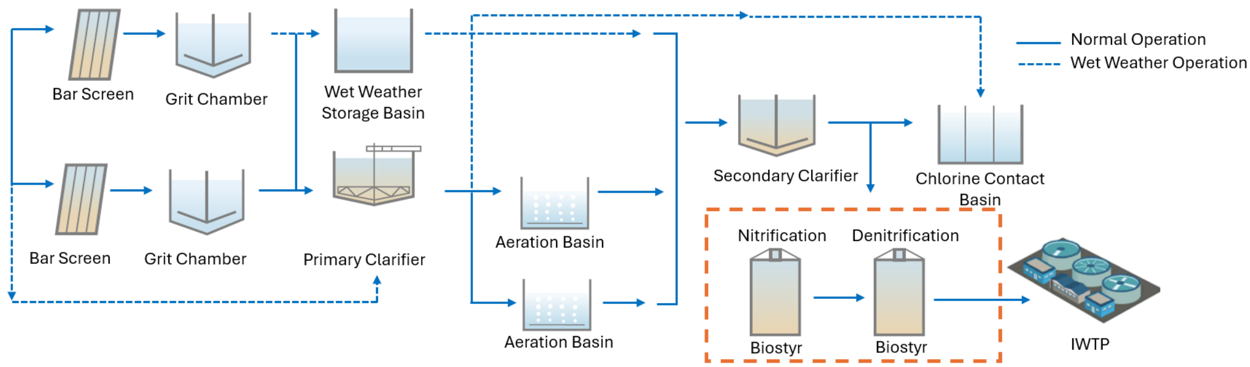


Figure 4.5 Post-Secondary Nitrogen Treatment at SSF-SB WQCP or SFIA SWTP – Biologically Aerated Filters

An innovative and potentially low-energy second option for post-secondary nitrogen removal involves an algae-based solution. ***This system would require pilot testing before implementation.*** The system includes a vertical conveyor belt for growing algae, which consumes nitrogen and phosphorus from the wastewater. Inputs are sunlight and carbon dioxide. The system eliminates nitrous oxide generation and reduces aeration costs, both of which reduce overall greenhouse gas emissions as compared to other biological nitrification/denitrification processes. Figure 4.6 shows the algae-based solution for treating SSF-SB WQCP secondary effluent.

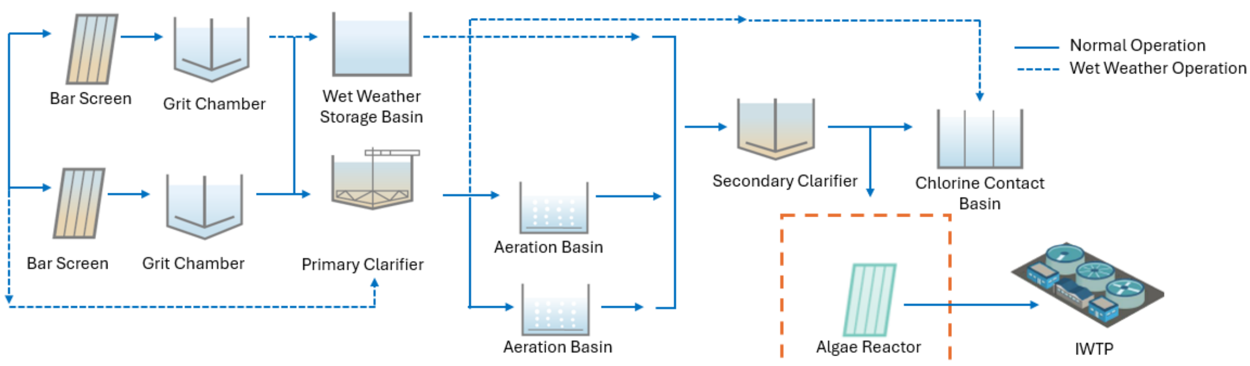


Figure 4.6 Post-Secondary Nitrogen Treatment at SSF-SB WQCP or SFIA SWTP – Algae-Based Solution

Both of these processes are anticipated to attain the target ammonia levels without blending with SWTP effluent. Other treatment options may also be effective. For instance, it is possible that nutrient reduction could be achieved using a constructed wetland or horizontal levee, if land could be secured. Nature-based solutions could have multiple benefits besides water quality improvement, such as habitat creation, recreational/aesthetic benefits, and potential sea level rise resilience. However, most of these options would not allow for recollection of the water to be sent to SFIA. Such an option would require significant further study to evaluate its feasibility.

4.2.2.2 Adding Effluent Upstream of the San Francisco International Airport Sanitary Wastewater Treatment Plant

Instead of sending secondary effluent from SSF-SB WQCP to the IWTP, a second alternative sends primary effluent from SSF-SB WQCP to the SFIA SWTP for treatment within existing and future systems (Figure 4.3 Option 2). The SFIA SWTP is currently in the process of adding an additional SBR to its existing three SBR configuration. The additional SBR is part of the SBR Upgrades project which also includes a retrofit of the existing three SBRs to AGS to provide TIN removal ahead of the AWTP and to meet TIN reductions required by the San Francisco Bay RWQCB Nutrient Watershed Permit (further discussed in Section 4.2.1). The SBR Upgrades will provide SFIA sufficient capacity to take a tank offline when maintenance is required on any system, but the system will be configured such that all four SBRs can be in operation. The current maximum monthly flow at the SWTP is 0.8 mgd. The system is being designed for an Ultimate Buildout maximum month flow of 1.1 mgd and a peak daily flow of 2.0 mgd with three SBRs in service.

SBRs provide time-based treatment. Each SBR acts as both an aeration basin and a clarifier and goes through a series of stages of treatment. In the first stage wastewater is fed into a reactor. Following the fill stage, the SBR enters the reaction stage and is operated like a conventional activated sludge system with aeration and mixing. The process is stopped, and the biomass settles, creating a layer of clean effluent at the top of the reactor. Systems that have multiple tanks may have tanks in different stages at the same time. Due to the cyclical nature of the SBR system, the flow is not sent at a constant rate. Therefore, it is difficult to precisely define the excess treatment capacity as this is a function of the fill rate, cycle times, and available flow equalization storage.

While there isn’t significant excess capacity within the planned SBR buildout, there is the potential to accept supplemental feed water from the SSF-SB WQCP to fill in the gap up to the capacity of the system. With this option the additional capacity within the SBR system can be used year-round. The capacity available depends on the upgrade. With the fourth SBR and AGS upgrade (expected in 2027/2028) it is estimated that there will be potential to send up to 0.5 to 1 mgd of supplemental feed water depending on the availability of the entire system or redundant tank to accept up to the design capacity. Having the fourth SBR available increases confidence in available capacity. If this option is chosen, further analysis will be required to confirm how much SSF-SB flow can be accepted.

Figure 4.7 shows the scenario where primary effluent is added to the SWTP at SFIA.

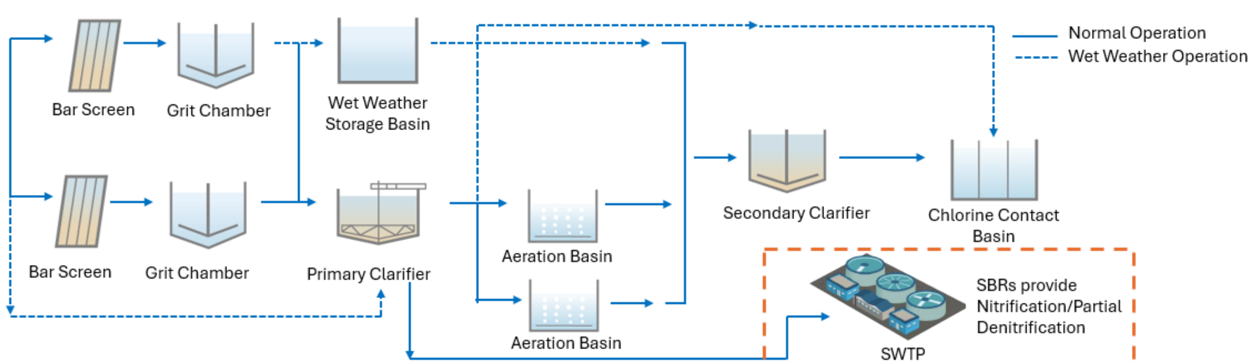


Figure 4.7 SSF-SB Effluent to the SFIA SWTP

With the additional SBR planned for implementation, the target effluent quality is expected to be 1 mg/L of ammonia.

4.2.2.3 Adding Effluent Upstream of the San Francisco International Airport Advanced Water Treatment Plant

A third option for accepting SSF-SB WQCP effluent at SFIA is adding SSF-SB WQCP secondary effluent upstream of the SFIA AWTP (Figure 4.3 Option 3). The SFIA AWTP was designed to receive flows with upstream treatment including DAF, ozone, BAF, and GAC at the IWTP as well as PFAS removal (Figure 2.2). Filtration as part of upstream treatment reduces the quantity of solids entering the SFIA AWTP. Without the upstream treatment, the low-pressure membranes in the AWTP would be damaged by the higher solids in the SSF-SB WQCP effluent. Therefore, if SSF-SB WQCP effluent were added upstream of the SFIA AWTP (rather than at the IWTP or SWTP), solids removal from the SSF-SB WQCP effluent might be needed. This report considers two treatment options for solids removal: UF (Figure 4.3 Option 3a) and cloth filters (Figure 4.3 Option 3b). Cost estimates were not prepared for these options, but they may be considered in future studies.

Ultrafiltration for Solids Removal

UF removes suspended solids and other contaminants through pore exclusion. With this option, the UF system would treat the SSF-SB WQCP effluent before sending the flow to the RO system at the AWTP. Treatment would then continue through the rest of the AWTP processes. Pretreatment with UF would allow the existing AWTP treatment systems to perform as they are intended, rather than being clogged with solids from SSF-SB WQCP effluent. This option would require pilot testing to determine whether UF can treat the SSF-SB WQCP effluent to acceptable water quality conditions that will maintain the integrity of the treatment systems at the AWTP. Figure 4.8 shows this treatment option.

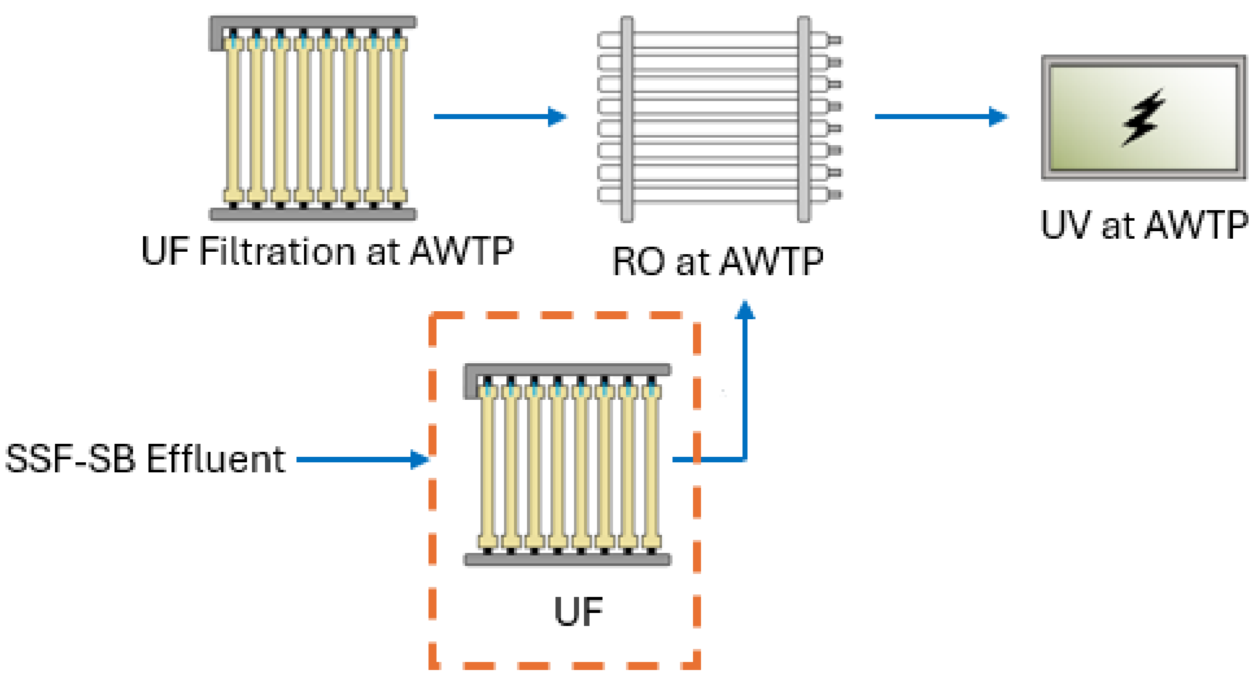


Figure 4.8 UF Treatment Prior to Additional RO and UV Treatment at the AWTP

Cloth Filters for Solids Removal

Cloth filters would likely be more cost-effective than UF for treating SSF-SB WQCP effluent before sending it to the AWTP. Figure 4.9 shows this treatment option. Pilot testing of this option is also recommended.

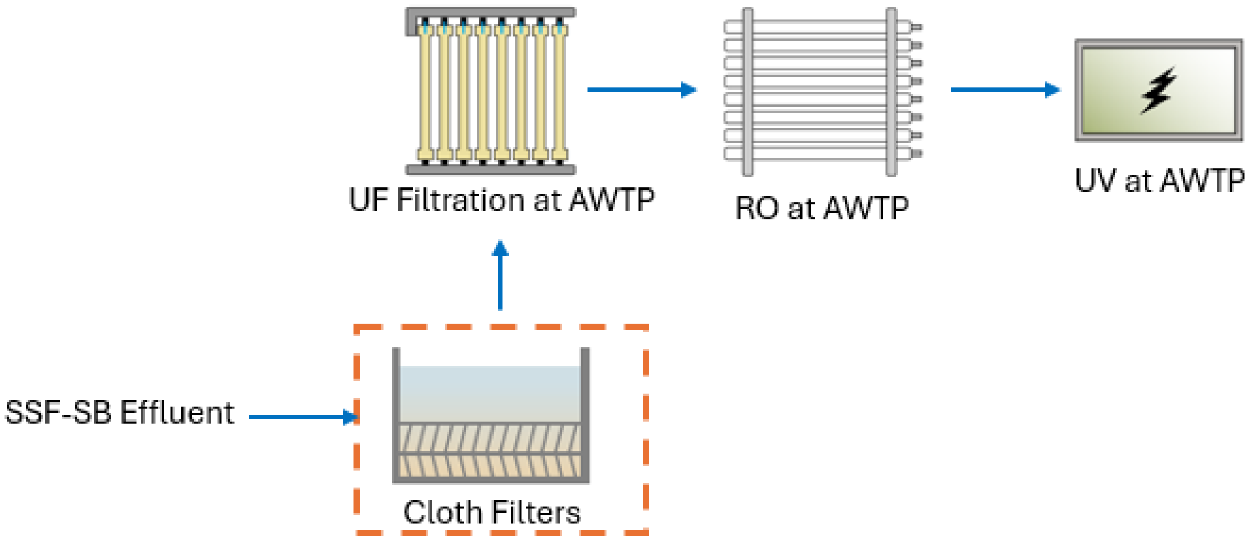


Figure 4.9 Cloth Filter Treatment Prior to Additional Treatment at the AWTP

4.2.3 Per- and Polyfluoroalkyl (or Polyfluorinated) Substances

The SSF-SB WQCP effluent has typical PFAS concentrations for a municipal WWTP. The PFAS concentrations at SFIA are higher due to the industrial sources, causing the values to be atypical. Table 4.2 shows the 2023 sampling results of PFAS concentrations at both SSF-SB WQCP and SFIA. Only analytes that were above detection limits in SSF-SB WQCP effluent are included in the comparison.

Table 4.2 PFAS Comparison between SSF-SB WQCP, SWTP, and IWTP

Constituent	MLTP Effluent Blended Concentration(1) (ng/L)	SSF-SB WQCP Average Effluent Concentration (ng/L)
PFOA (ng/L)	47	2.0
PFOS (ng/L)	388.2	2.6
PFHxA (ng/L)	125.7	11
5:3 FTCA (ng/L)	4.8	2.8

Notes:
FTCA – fluorotelomer carboxylic acid; PFHxA – perfluorohexanoic acid; PFOA – perfluorooctanoic acid; PFOS – perfluorooctane sulfonate.
(1) Source: Carollo and Walsh Group 2025. Values listed are the Design Water Quality analytes for the blended IWTP and SWTP effluent.

As seen in Table 4.2, all the PFAS constituent concentrations in the SSF-SB WQCP effluent are considerably lower than, or comparable to, SFIA effluent levels. Therefore, introducing SSF-SB WQCP effluent to the MLTP would reduce the PFAS concentrations entering the AWTP.

CHAPTER 5 RECYCLED WATER IMPLEMENTATION

This chapter describes the steps and infrastructure necessary to implement the delivery of recycled water to potential customers off site of SFIA:

1. Expanding the AWTP treatment system to the planned Ultimate Buildout capacity of 2.2 mgd feed flow, yielding 1.7 mgd of recycled water.
2. Sending up to 1.0 mgd of supplemental feed water from the SSF-SB WQCP (as discussed in Chapter 4), to maximize the production of recycled water at the MLTP.
3. Delivering up to 0.9 mgd of recycled water to offsite customer groups (identified in Chapter 3).

5.1 Advanced Water Treatment Plant Expansion to Ultimate Buildout Capacity

As mentioned, the AWTP was designed for phased expansion, with a Phase I maximum daily production capacity of 1.2 mgd and an Ultimate Buildout maximum daily production capacity of 1.7 mgd. To have sufficient recycled water supply for potential offsite customers, the AWTP would need to be operated at the expanded Ultimate Buildout capacity.

The modifications necessary to expand the AWTP to the Ultimate Buildout capacity are as follows:

- UF system:
  - Upsize UF feed pumps (three total) to 50 hp.
  - Additional UF modules (36 total).
  - Upsize UF backwash pumps (two total) to 50 hp.
- RO system:
  - Upsize RO feed pump to 50 hp.
  - Additional RO train.
- UV system:
  - Additional ballasts (four total).
  - Additional lamps (16 total).

5.1.1 Costs

The capital and operations and maintenance (O&M) costs associated with expanding and operating the AWTP are summarized in Table 5.1. The O&M costs presented are for a recycled water production rate of 0.9 mgd. In cases where NPR demand is less than 0.9 mgd, the O&M cost is allocated proportionally to the flow demand.

Table 5.1 Costs to Expand and Operate the AWTP

Project Component	Total Capital Cost ($)(1)	Total Annual O&M Cost (0.9 mgd) ($)(2)
AWTP Treatment Expansion	$3,020,000	$3,160,000

Notes:
(1) Total capital cost includes costs for the treatment system modifications described above. Appendix C provides the Basis of Cost assumptions used for this study. Appendix D provides detailed cost estimates documenting cost assumptions and allowances.
(2) Total O&M cost includes costs for treatment system consumables, sludge disposal, and power costs. Appendix D provides detailed cost estimates documenting cost assumptions and allowances.

For the purposes of this chapter, the MLTP treated recycled water will be referred to as finished water.

5.2 Infrastructure and Treatment Needs for Supplemental Feed Water Supply

Based on current and projected SFIA flows (shown in Section 4.1.1), up to 1.0 mgd of supplemental feed water from SSF-SB WQCP could be used to supplement the available reuse supply from SFIA and maximize the utilization of the treatment capacity at the MLTP. Bringing supplemental feed water from SSF-SB WQCP to SFIA will require new pipelines, pump stations, and treatment infrastructure.

5.2.1 Pipelines and Pump Stations

Figure 5.1 shows the proposed pipe alignment for conveying supplemental feed water from SSF-SB WQCP to the SFIA MLTP. The proposed alignment follows that of an existing 21-inch pipeline conveying effluent from the MLTP to SSF-SB WQCP for dechlorination and discharge to San Francisco Bay. It is expected that a trenchless crossing would be required at San Bruno Creek.

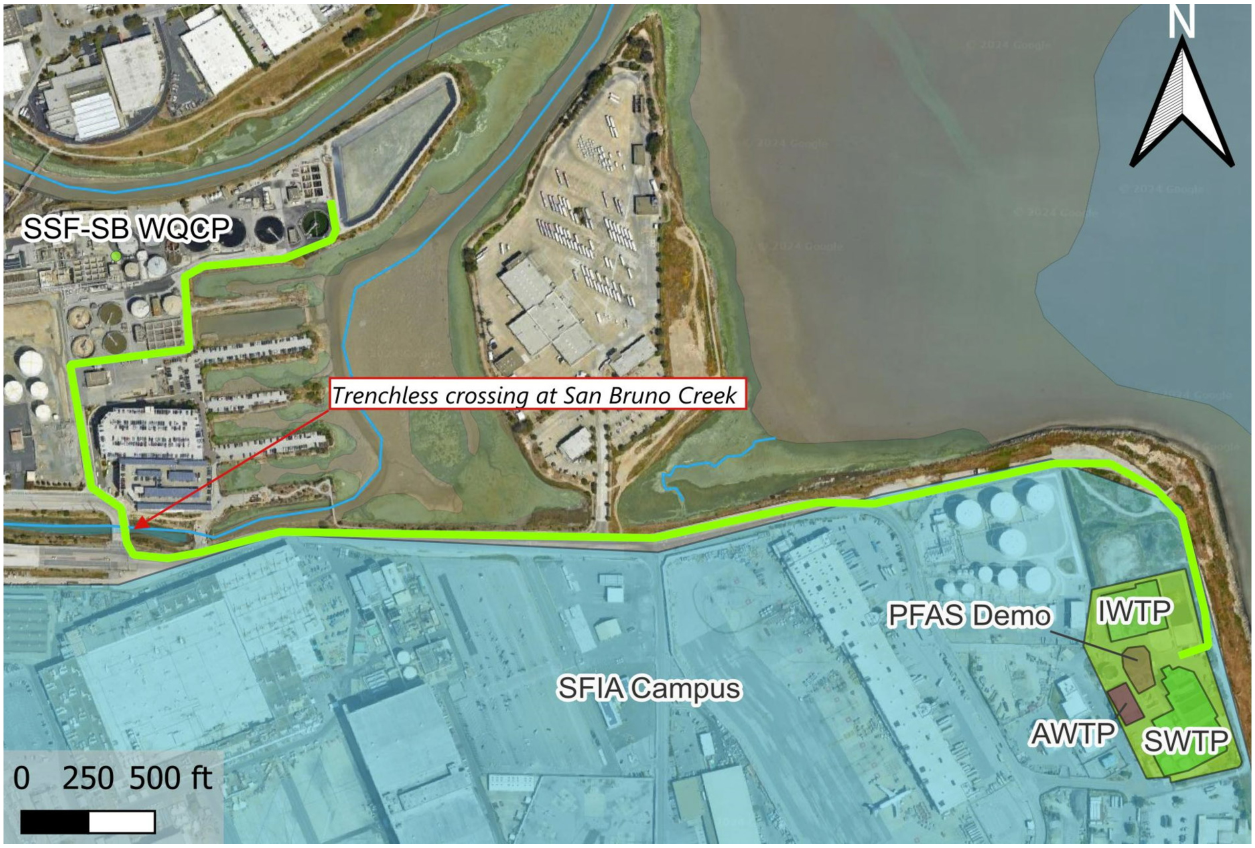


Figure 5.1 Proposed Pipe Alignment for Conveyance of Supplemental Feed Water from SSF-SB WQCP to SFIA's MLTP

SFIA is planning to construct a second, redundant, 20-inch pipeline along this alignment due to concerns about the age and condition of the current 21-inch effluent pipeline. If this pipeline is constructed, the proposed alignment would be very tight with three parallel pipelines. One option would be to slip-line the current 21-inch pipeline and use it to convey supplemental feed water from SSF-SB WQCP to MLTP, although SFIA would need to agree with this approach. Pipeline details are provided in Table 5.2. Conveyance of supplemental feed water from the SSF-SB WQCP to MLTP would require installation of new pumps at the SSF-SB WQCP. Details of the pumping requirements are provided in Table 5.3.

Table 5.2 SSF-SB WQCP to SFIA MLTP Supplemental Feed Water Pipeline Details

Pipeline Length (miles)	Design Flow (mgd)	Pipe Diameter (inches)
1.45	1.0	8

Table 5.3 Pumping Requirements for Conveyance of Supplemental Feed Water From SSF-SB WQCP to SFIA MLTP

Design Flow (mgd)	Friction Head Loss (feet)	Pressure Head (feet)(1)	Elevation Head (feet)	Minimum Pump Capacity (hp)(2)	Design Pump Capacity (hp)
1.0	62	92.4	3	39.8	40

Notes:
hp – horsepower.
(1) Assumes 40 pounds per square inch (psi) minimum at point of connection.
(2) Assumes 70 percent pump efficiency.

5.2.2 Storage

With the utilization of flow meters and variable-frequency driven pumps, supplemental feed water from SSF-SB WQCP could be provided only on an “as-needed" basis, effectively eliminating the need for flow equalization storage at the MLTP. However, depending on where the supplemental feed water is introduced at SFIA, existing storage structures would likely be available to receive flows from SSF-SB WQCP under each of the scenarios discussed above:

- IWTP equalization tank, if the additional supply is introduced upstream of the IWTP.
- SWTP flow equalization basins, if the additional supply is introduced upstream of the SWTP.
- AWTP equalization tank, if the additional supply is introduced upstream of the AWTP.

Therefore, no storage is expected to be needed for supplemental feed water from the SSF-SB WCQP.

5.2.3 Treatment Needs

As discussed in Section 4.2.2, wastewater from SSF-SB WQCP has elevated ammonia concentrations that impact the BAC process at the MLTP. Consequently, treatment is needed to reduce the ammonia concentrations to less than 2 mg/L. Four treatment options, listed below, were discussed in Chapter 4. High level cost estimates for these options are provided in Section 5.2.4.

- Introduce denitrified SSF-SB effluent upstream of IWTP. This includes either *split secondary treatment* at SSF-SB WQCP, or *post-secondary nitrogen removal* at SFIA or SSF-SB WQCP.
- Send primary effluent to SWTP for treatment for nitrification.
- Send primary effluent to AWTP for treatment for nitrification.
- Wait for SSF-SB WQCP to meet the requirements of the San Francisco Bay RWQCB’s recent Nutrient Watershed permit, which requires approximately 40 percent reduction in TIN by 2034.

5.2.4 Costs

The pipeline and pump station costs for conveying supplemental feed water to the MLTP are summarized in Table 5.4.

Table 5.4 Project Costs for Conveyance of Supplemental Feed Water to the MLTP

Project Component	Total Infrastructure Capital Cost ($)(1)	Total Annual Infrastructure O&M Cost ($)(2)
Supplemental Feed Water Conveyance from SSF-SB WQCP to MLTP	$9,480,000	$120,800

Notes:
(1) Total capital costs include pipeline and pump station costs. Appendix C provides the Basis of Cost assumptions used for this study. Appendix D provides detailed cost estimates documenting cost assumptions and allowances.
(2) O&M costs include pipeline maintenance and pumping energy costs. A power cost of $0.37 per kilowatt hour (kWh) is assumed, corresponding to supplemental feed water pump station being sited at the MLTP.
(3) Appendix D provides detailed cost estimates documenting cost assumptions and allowances.

The costs for reducing ammonia levels in the SSF-SB WQCP effluent depend on the approach taken. Of the four potential options for nitrification, only the post-secondary nitrogen removal approach would incur direct capital costs for new treatment systems. The estimated costs for two potential post-secondary nitrogen removal technologies at MLTP are presented in Table 5.5.

Table 5.5 Costs for Two Potential Post-Secondary Nitrogen Removal Treatment Options for SSF-SB WQCP Effluent

Treatment Option	Total Treatment Capital Cost ($)	Total Annual Treatment O&M Cost ($)(1)
BIOSTYR DUO System (Veolia)	$4,380,000(2)	$63,000
Algae-based Solution (Gross-Wen Technologies)	$9,880,000(3)	$99,000

Notes:
(1) O&M costs assume a power cost of $0.17 per kWh, corresponding to the post-secondary nitrogen removal treatment being sited at the MLTP.
(2) Based on proposal from Veolia dated November 13, 2024, with allowances for engineering, legal, and administrative costs, as well as owner's reserve for change orders. Cost includes process and design engineering, field services, and equipment supply. See Appendix D for detailed cost estimates.
(3) Based on the proposal from Gross-Wen Technologies, dated November 13, 2024. Cost includes process and design engineering, field services, equipment supply, and supplemental process infrastructure. See Appendix D for detailed cost estimates.

Using split secondary treatment at SSF-SB WQCP for ammonia reduction would require installation of additional process piping and valving to convey aerated, nitrified effluent to a dedicated secondary clarifier (as described in Section 4.2.2.1). Additional costs would include those associated with a nutrient study to determine the optimal SRT in aeration basins and operational costs.

Sending primary effluent to the SWTP from SSF-SB WQCP would incur additional O&M costs for operating the SWTP for the additional flows. Costs for sending primary effluent to AWTP from SSF-SB WQCP would need to include the filtration system required upstream of the AWTP (either UF or cloth filters). Costs for waiting for SSF-SB WQCP to satisfy RWQCB's latest Nutrient Watershed Permit would be minimal.

5.3 Northern Customer Delivery Infrastructure

Genentech is the only potential recycled water customer to the north of SFIA. The infrastructure needs for serving Genentech's current and potential future recycled water demands are summarized below.

5.3.1 Pipelines and Pump Stations

Figure 5.2 shows the proposed pipeline alignment for conveying finished water to Genentech. The alignment requires trenchless crossings at San Bruno Creek and Colma Creek. Pipeline details for delivery to Genentech at both the current and expected future demands are summarized in Table 5.6.

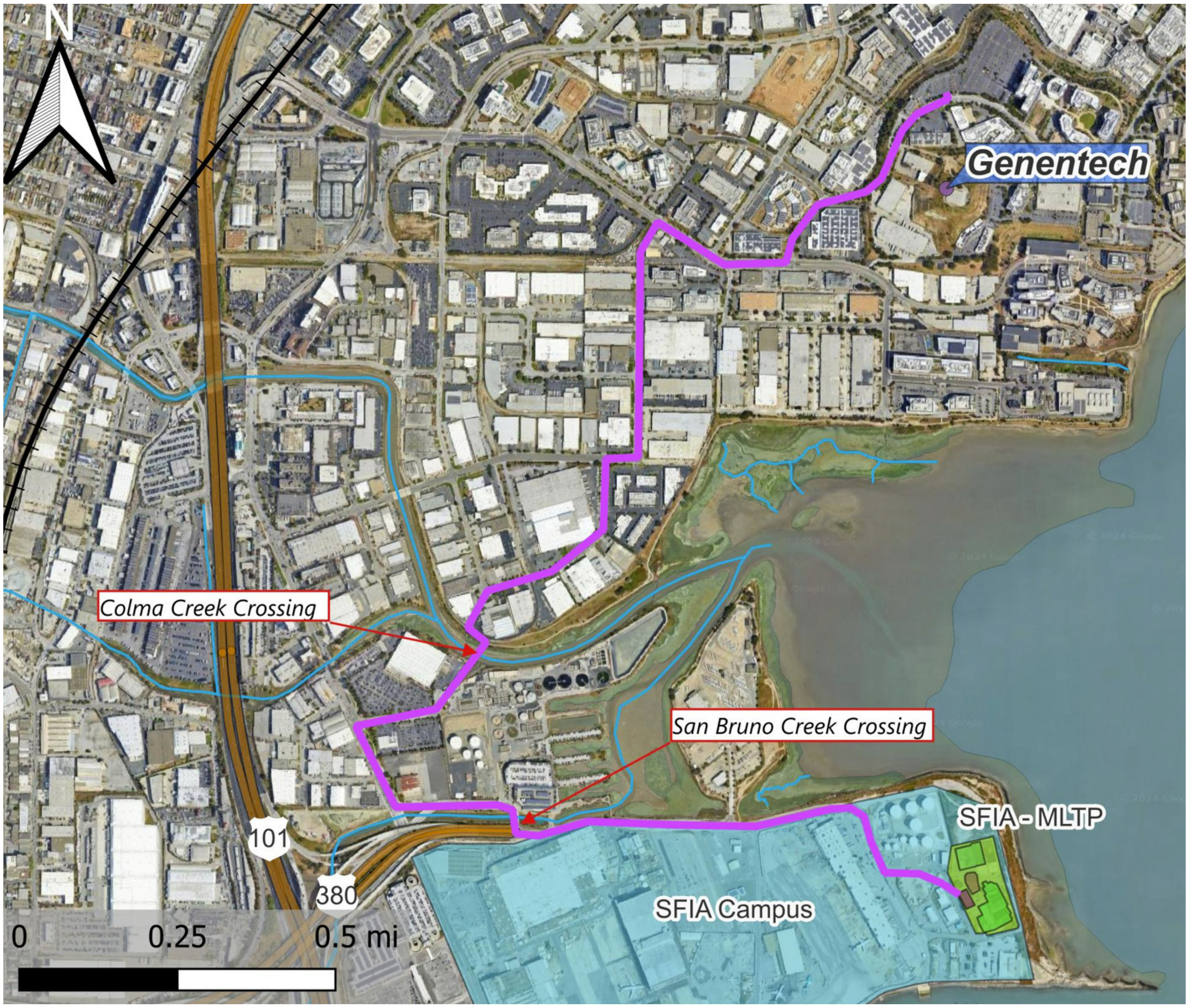


Figure 5.2 Overview of Pipe Alignment for Finished Water Delivery to Genentech

Table 5.6 Genentech Finished Water Delivery Pipeline Details

Demand Scenario	Pipeline Length (miles)	Design Flow (mgd)	Pipe Diameter (inches)(1)
Current	2.87	0.31	4
Future	2.87	0.90	8

Notes:
(1) Pipelines were sized to accommodate the MDD. When MDD exceeds the total available amount of recycled water, pipelines were sized to accommodate a maximum flowrate of 0.9 mgd. Recycled water is delivered to a tank sized to accommodate the MDD or maximum flow.

Conveyance of finished water from the MLTP to Genentech would require additional pumping capacity at the MLTP. Table 5.7 summarizes the pumping requirements.

Table 5.7 Pumping Requirements for Conveyance to Genentech

Demand Scenario	Design Flow (mgd)(1)	Friction Head Loss (feet)	Pressure Head (feet)(2)	Elevation Head (feet)	Minimum Pump Capacity (hp)(3)	Design Pump Capacity (hp)
Current	0.31	442	92.4	114	51.5	55
Future	0.90	112	92.4	122	74.2	75

Notes:
(1) Pumps were sized to accommodate the MDD. When MDD exceeds the total available amount of recycled water, pumps were sized to accommodate a maximum flowrate of 0.9 mgd.
(2) Assumes 40 psi minimum at point of connection.
(3) Assumes 70 percent pump efficiency.

5.3.2 Storage

Delivery of recycled water to Genentech would require construction of a storage tank at Genentech (a "day tank"). Storage tanks were sized to accommodate approximately one day's worth of MDD flow under the current and future demands. Tank dimensions are provided in Table 5.8. Figure 5.3 shows the proposed tank site at Genentech and approximate tank footprint for both demand scenarios. The proposed tank site was selected based on its elevation relative to the rest of the Genentech campus, as well as proximity to existing recycled water pipes that are currently unused.

Table 5.8 Genentech Tank Dimensions for Current and Future Demand Scenarios

Demand Scenario	Nominal Tank Size (MG)	Tank Height (feet)	Tank Diameter (feet)
Current	0.25	24	42
Future	1.0	32	78

Notes:
MG – million gallons.

Figure 5.3 Genentech Tank Site for Current and Future Demand Scenarios

5.3.3 Costs

The estimated costs for serving Genentech's current and future expected recycled water demands are summarized in Table 5.9.

Table 5.9 Infrastructure Costs for Genentech

Customer(s)	Total Infrastructure Capital Cost ($)(1)	Total Annual Infrastructure O&M Cost ($)(2)
Genentech - Current	$14,840,000	$127,200
Genentech - Future	$28,250,000	$249,900

Notes:
(1) Total capital costs include pipeline, pump station, and storage costs. Appendix C provides the Basis of Cost assumptions used for this study. Appendix D provides detailed cost estimates documenting cost assumptions and allowances.
(2) O&M costs include pipeline maintenance and pumping energy costs. Appendix D provides detailed cost estimates documenting cost assumptions and allowances.

5.4 Western Customer Delivery Infrastructure

Potential recycled water customers west of SFIA include GGNC, Tanforan, YouTube, and Millbrae Yard. The infrastructure needed to serve these customers is summarized below.

5.4.1 Pipelines and Pump Stations

Serving any of the Western Customers would require crossing Highway 101. Several potential crossing locations identified in prior related projects were considered as part of this study. These locations are summarized in Table 5.10 and shown on Figure 5.4.

Table 5.10 Summary of Potential Highway 101 Crossing Options for Western Customer Group

Crossing Option, Source	Comments
S. Airport Boulevard Undercrossing, SSF *Recycled Water Facility Plan* (Carollo 2009)	▪ Utilizes existing Highway 101 undercrossing along S. Airport Boulevard. ▪ Further north than the other options, thereby increasing pipeline and pumping costs.
Produce Avenue Overcrossing, US Highway 101/Produce Avenue Interchange Project *Draft Environmental Impact Report/Environmental Assessment* (State of California et al. 2022)(1)	▪ Would incorporate pipeline support in the design of proposed new Highway 101 overcrossing at Utah Avenue/South Airport Boulevard intersection to San Mateo Avenue. ▪ Timeline for project completion unknown. ▪ Elevation gain for overcrossing would require additional pump capacity and may pose other hydraulic challenges.
Highway 101/380 Maze, *Golden Gate National Cemetery Recycled Water Delivery Interoffice Memorandum* (Carollo 2017)	▪ Potential utility chase in the area owned by SFIA. ▪ Determined to be not feasible based on SFIA staff feedback.
Existing SFIA Utility Tunnels, *San Francisco International Airport Recycled Water Master Plan* (Kennedy/Jenks 2014)	▪ Four utility tunnels running east-west beneath Highway 101 from various parts of SFIA. ▪ Includes an existing utility chase (size unknown), 84-inch utility tunnel, 60-inch utility tunnel, and 4-foot by 4-foot utility tunnel.

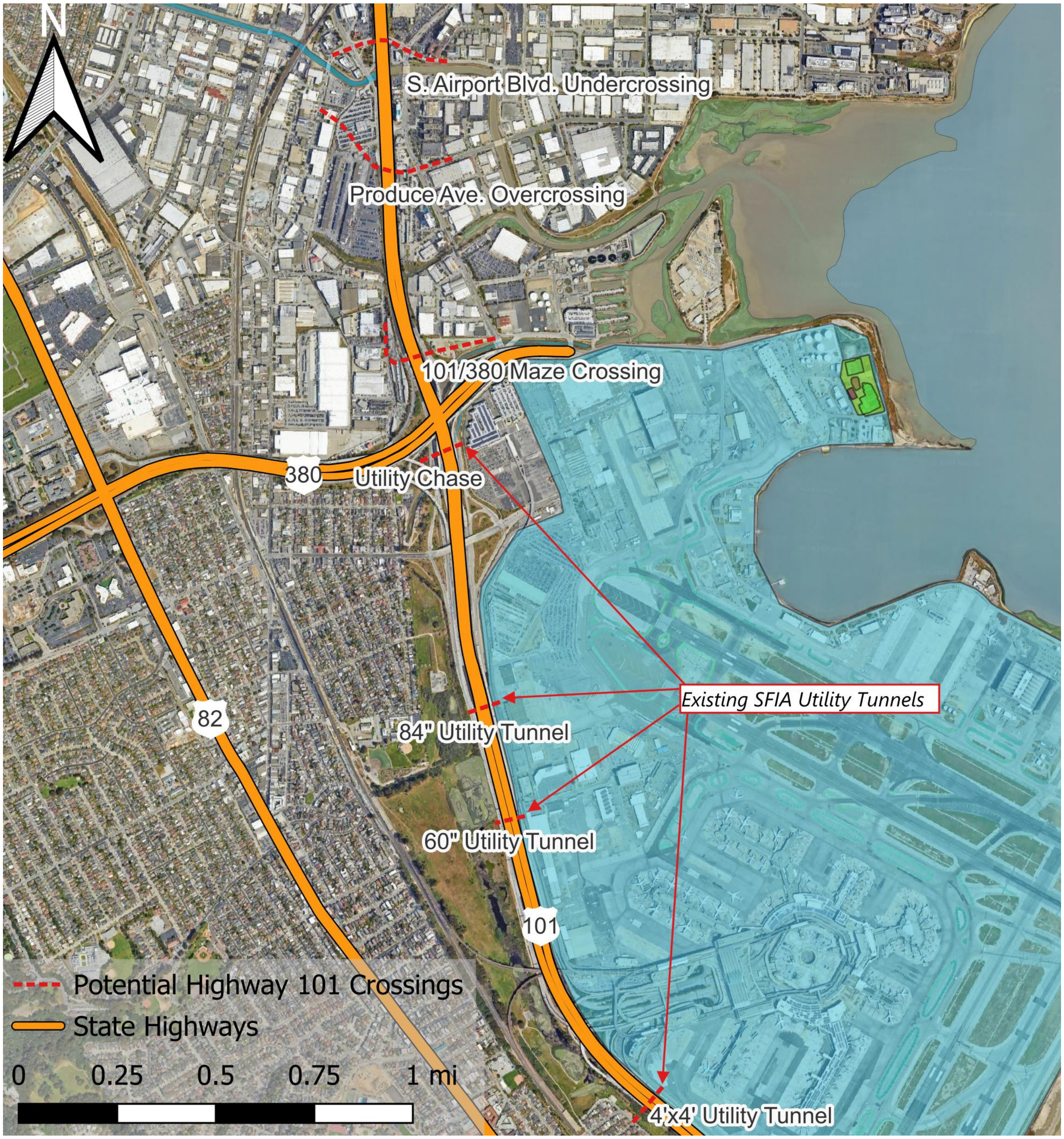


Figure 5.4 Potential Highway 101 Crossings

Based on discussions with SFIA utilities staff, both the 84-inch and 60-inch existing utility tunnels have space to accommodate a recycled water pipeline. The 84-inch tunnel was ultimately chosen as the preferred Highway 101 crossing due to its central location relative to the Western Customers.

As part of the SFIA RWSP, a 12-inch recycled water pipeline will convey finished water from the AWTP to the SFIA terminals. The supply to Western Customers would branch off from the 12-inch pipeline near the existing 84-inch utility tunnel and then cross under Highway 101. Figure 5.5 shows the proposed pipe alignment at the selected Highway 101 crossing.

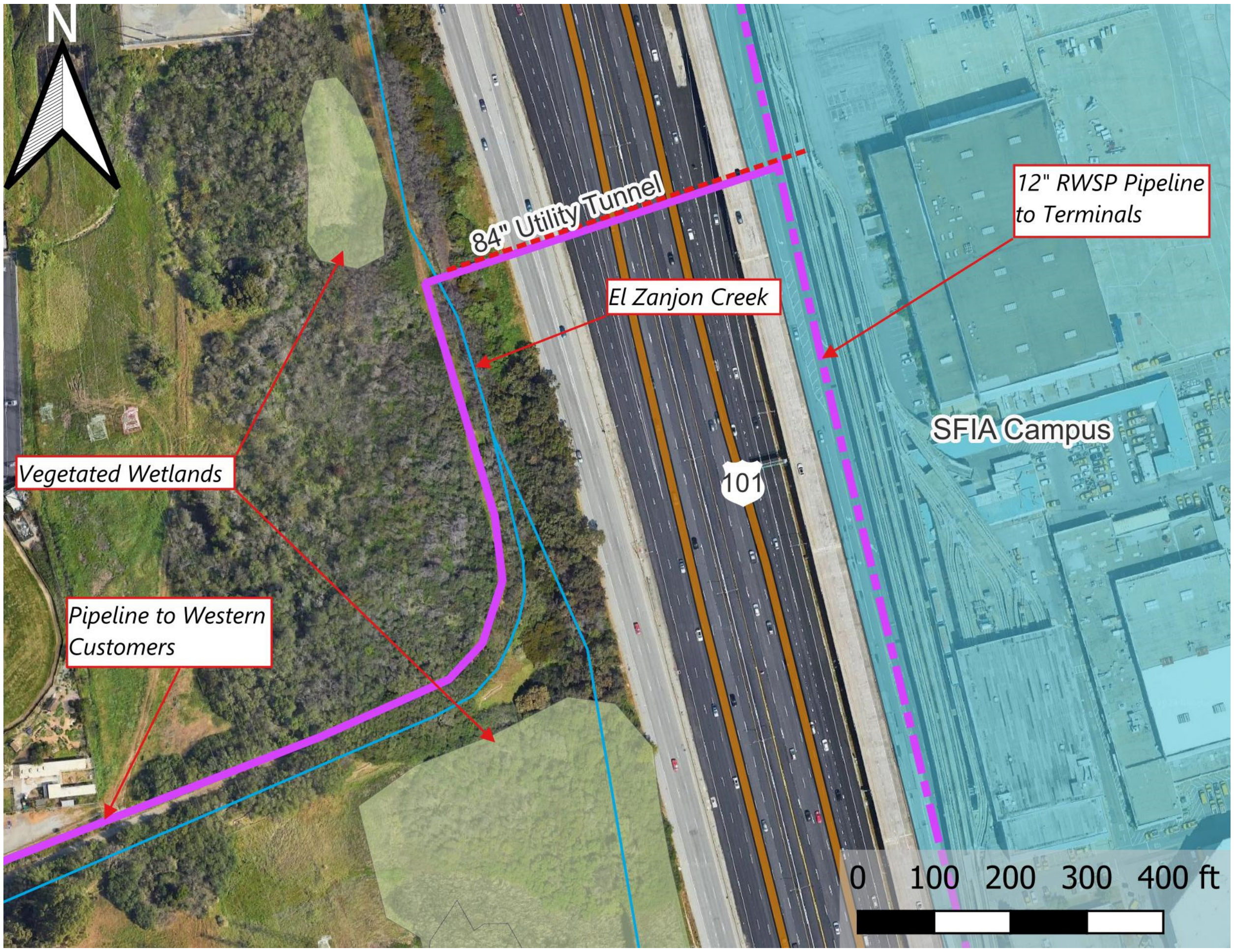


Figure 5.5 Chosen Highway 101 Crossing at Existing 84-inch Utility Tunnel

As shown in Figure 5.5, the western side of the 84-inch utility tunnel emerges in an undeveloped area, which includes two wetlands identified in San Francisco Estuary Institute's Bay Area Aquatic Resources Inventory. This pipeline alignment would require crossing El Zanjon Creek, a tributary of San Bruno Creek. Pipeline construction in this area has a high potential to impact sensitive habitats and would likely require a full California Environmental Quality Act, evaluation. The costs and schedule impacts of such an evaluation would depend largely on the Initial Study findings and are not quantified in this study. Close coordination among the relevant stakeholder agencies would be necessary throughout the design and permitting process.

Beyond the Highway 101 crossing, the pipeline would use an existing undercrossing on Angus Avenue to cross the Caltrain rail lines, after which pipelines to Western Customers would largely follow surface streets, as shown in Figure 5.6. After the Caltrain undercrossing, a two-inch line would tee off from the main pipeline to serve Millbrae Yard to the south. The main pipeline would continue northwestwards along El Camino Real (Highway 82). It is assumed that a trenchless crossing would be required to minimize traffic disruptions at the intersection of Highway 82 and Highway 380. Further north, at the intersection of Highway 82 and Sneath Lane, a junction would direct flows to GGNC, Tanforan, and YouTube. Table 5.11 summarizes the details of the different pipeline segments.

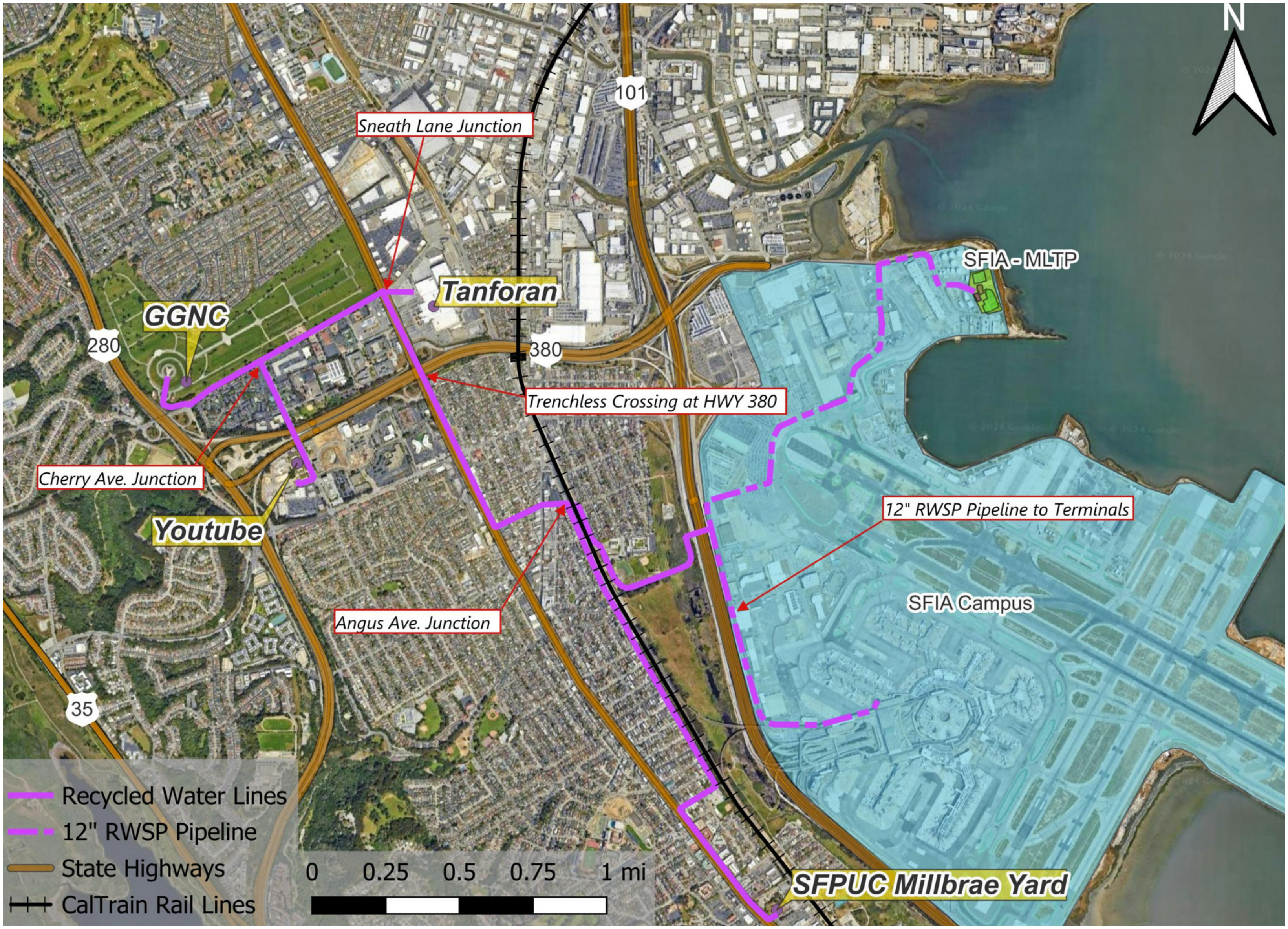


Figure 5.6 Proposed Pipe Alignments for Service to Western Customers

Table 5.11 Western Customers Finished Water Delivery Pipeline Details

Pipe Segment	Pipeline Length (miles)	Design Flow (mgd)	Pipe Diameter (inches)(1)
84-inch Utility Crossing to Sneath Lane Junction	2.0	0.9	8
Sneath Lane Junction to GGNC	0.9	0.9	8
Sneath Lane Junction to Tanforan	0.1	0.012	2
Cherry Avenue Junction to YouTube	0.5	0.034	2
Angus Avenue Junction to Millbrae Yard	1.8	0.012	2
84-inch Utility Crossing to Sneath Lane Junction	2.0	0.9	8

Notes:
(1) Pipelines were sized to accommodate the MDD. When MDD exceeds the total available amount of recycled water, pipelines are sized to accommodate a maximum flowrate of 0.9 mgd. Recycled water would be delivered to a tank sized to accommodate the MDD or maximum flow.

Conveyance of finished water from the MLTP to Western Customers would require additional pumping capacity at the MLTP. Table 5.12 summarizes the pumping requirements for conveyance of recycled water to the different Western Customers. It is assumed that the additional pumps would be sited at the MLTP.

Table 5.12 Pumping Requirements for Conveyance to Western Customers

Customer(s)	Design Flow (mgd)(1)	Friction Head Loss (feet)	Elevation Head (feet)	Minimum Pump Capacity (hp)(2)	Design Pump Capacity (hp)
GGNC	0.82	95	212	82	85
Tanforan	0.012	1	0	0.5	1
YouTube	0.034	38	2	1.4	2
Millbrae Yard	0.012	20	19	0.5	1

Notes:
(1) Where possible, pumps are sized to accommodate the MDD. In cases where the MDD exceeds the total available amount of recycled water, pumps are sized to accommodate a maximum flowrate of 0.9 mgd.
(2) Assumes 70 percent pump efficiency and 40 psi minimum at point of connection.

5.4.2 Storage

GGNC has an existing underground storage onsite with capacities of 0.7 MG. With a MDD of 0.82 mgd, the reservoir is sufficient for storing recycled water from the MLTP. The remaining Western Customers (Tanforan, YouTube, and Millbrae Yard) would require construction of storage tanks onsite. Tanforan and Millbrae Yard each require a 15,000-gallon tank (12-foot diameter by 16-foot tall) to supply a MDD of 0.012 mgd. Both sites are slated for renovation and construction work; given the relatively small size of the storage tanks needed, specific tank sites are not defined in this study. YouTube would need a 34,000-gallon (24-foot diameter by 15.5-foot tall) tank to meet the MDD of 0.034 mgd. A proposed tank site for YouTube is presented in Figure 5.7.

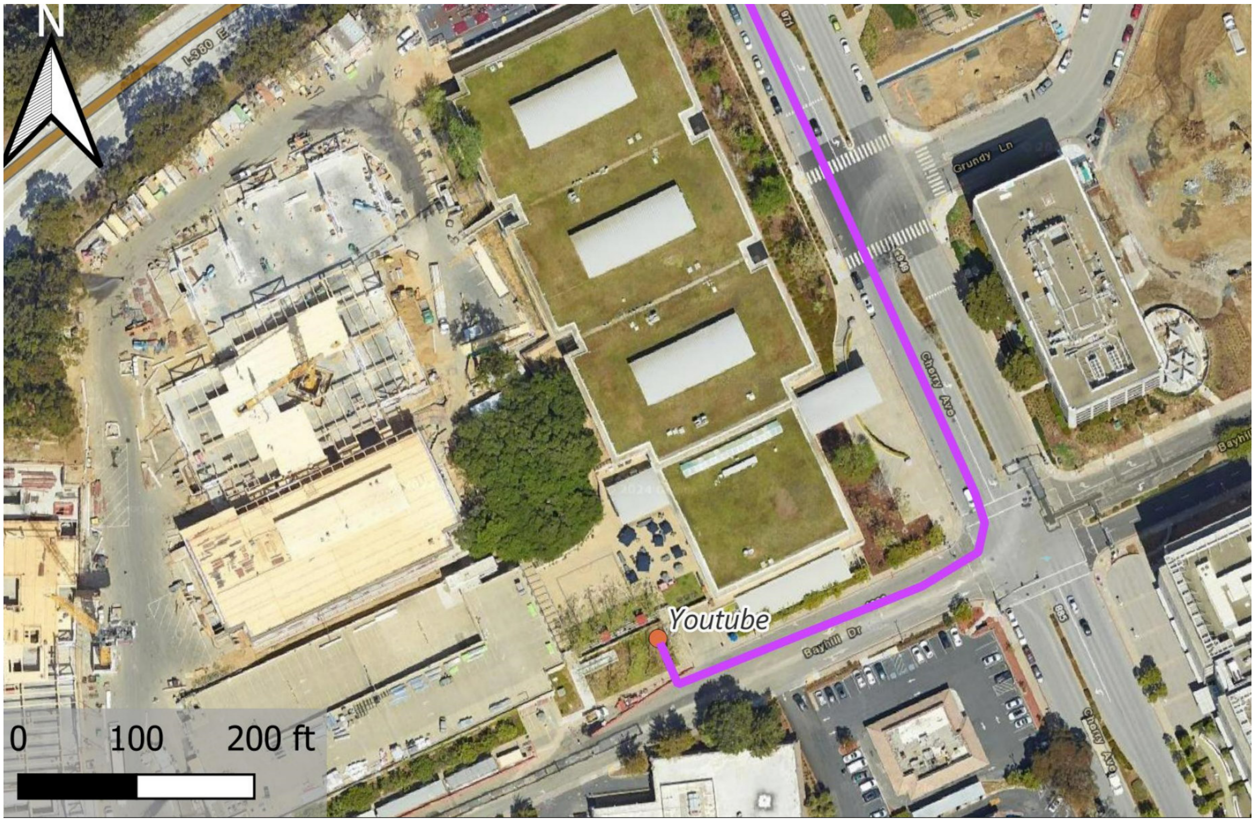


Figure 5.7 Proposed YouTube Tank Site

5.4.3 Costs

The estimated costs for serving Western Customers with recycled water are summarized in Table 5.13.

Table 5.13 Infrastructure Costs for Western Customers

Customer(s)	Total Infrastructure Capital Cost ($)(1)	Total Annual Infrastructure O&M Cost ($)(2)
GGNC	$20,390,000	$143,600
Tanforan(3)	$380,000	$2,900
YouTube(3)	$1,480,000	$10,200
Millbrae Yard(3)	$3,570,000	$15,700
West Customers Total	**$25,900,000**	**$194,300**
West Customers Total – No Millbrae Yard	**$22,330,000**	**$179,300**

Notes:
(1) Total capital costs include pipeline, pump station, and storage costs. Appendix C provides the Basis of Cost assumptions used for this study. Appendix D provides detailed cost estimates documenting cost assumptions and allowances.
(2) O&M costs include pipeline maintenance and pumping energy costs. Appendix D provides detailed cost estimates documenting cost assumptions and allowances.
(3) Tanforan, YouTube, and Millbrae Yard costs represent the additional cost for serving each customer while also serving GGNC. Costs for serving these three customers independently from GGNC were not developed.

5.5 Southern Customer Delivery Infrastructure

The two potential recycled water customers located to the south of SFIA are Bayfront Park and Bay Trail South. Because these customers are near one another and have relatively low demands, serving just one customer alone was not considered. To make the best use of infrastructure investments, both customers would be served simultaneously. The associated infrastructure needs are summarized below.

5.5.1 Pipelines and Pump Stations

The proposed pipe alignment to serve customers south of SFIA is shown in Figure 5.8. As part of the SFIA RWSP, a 12-inch recycled water pipeline will convey finished water from the AWTP to the SFIA terminals. The supply to Southern Customers would branch off from this pipeline near the SFIA terminals and continue southward as a 2-inch pipe. To minimize traffic disruptions, it is assumed that trenchless crossing would be required in the airport terminal access area. Pipeline details are summarized in Table 5.14.

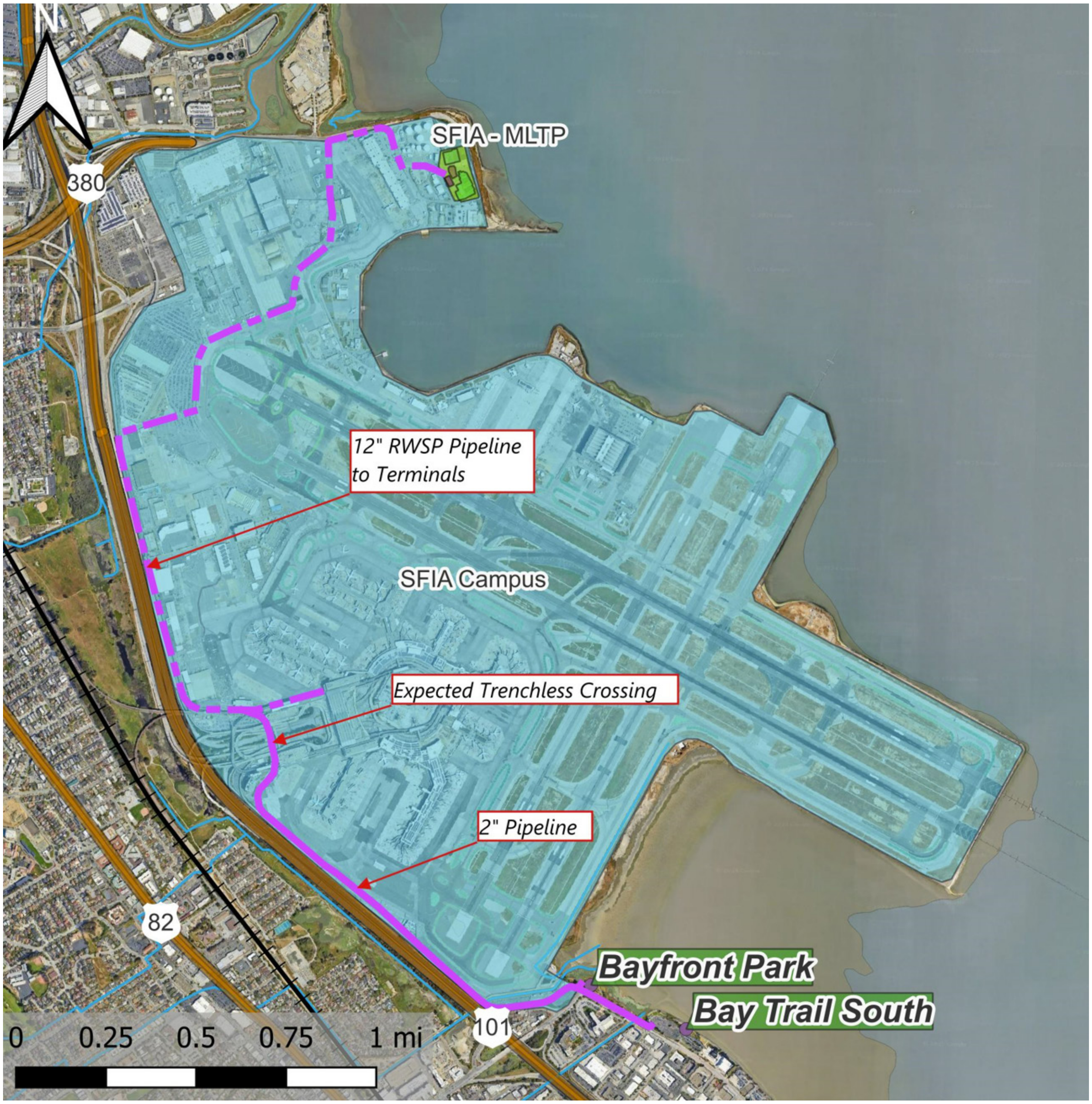


Figure 5.8 Proposed Pipe Alignment for Serving Southern Customers

Table 5.14 Southern Customers Finished Water Delivery Pipeline Details

Pipeline Segment	Pipeline Length (miles)	Design Flow (mgd)	Pipe Diameter (inches)(1)
Terminals to Bayfront Park	1.45	0.032	2
Bayfront Park to Bay Trail South	0.23	0.015	2

Notes:
(1) Pipelines were sized to accommodate the MDD. When MDD exceeds the total available amount of recycled water, pipelines were sized to accommodate a maximum flowrate of 0.9 mgd. Recycled water would be delivered to a tank sized to accommodate the MDD or maximum flow.

Conveyance of finished water to the Southern Customers would require minimal additional pumping capacity at the MLTP, as summarized in Table 5.15. It is assumed that additional pumps would be sited at the MLTP. However, it is likely that the RWSP's recycled water pump station would be sufficiently oversized to handle the pumping needs for the Southern Customers, although capacity would need to be confirmed with the RWSP design-build team.

Table 5.15 Pumping Requirements for Conveyance to Southern Customers

Design Flow (mgd)(1)	Friction Head Loss (feet)	Pressure Head (feet)(2)	Elevation Head (feet)	Minimum Pump Capacity (hp)(2)	Design Pump Capacity (hp)
0.03	102	92.4	16	2.3	3

Notes:
(1) Pumps are sized to accommodate the MDD. When MDD exceeds the total available amount of recycled water, pumps are sized to accommodate a maximum flowrate of 0.9 mgd.
(2) Assumes 40 psi minimum at point of connection and assumes 70 percent pump efficiency.

5.5.2 Storage

Delivery of recycled water to Southern Customers would require construction of storage tanks at both Bayfront Park and Bay Trail South. The storage tank sizes necessary to accommodate approximately one day's worth of MDD flow are provided in Table 5.16. Figure 5.9 and Figure 5.10 show the proposed tank sites and approximate tank footprints at Bayfront Park and Bay Trail South, respectively.

Table 5.16 Tank Dimensions for Bayfront Park and Bay Trail South

Customer	Nominal Tank Size (MG)	Tank Height (feet)	Tank Diameter (feet)
Bayfront Park	0.02	16	15
Bay Trail South	0.015	16	12

Figure 5.9 Proposed Bayfront Park Tank Site

Figure 5.10 Proposed Bay Trail South Tank Site

5.5.3 Costs

The estimated costs for serving Southern Customers with recycled water are summarized in Table 5.17.

Table 5.17 Infrastructure Costs for Southern Customers

Customer(s)	Total Infrastructure Capital Cost ($)(1)	Total Annual Infrastructure O&M Cost ($)(2)
Bayfront Park and Bay Trail South	$4,790,000	$22,800

Notes:
(1) Total capital costs include pipeline, pump station, and storage costs. Pump stion requirement to be confirmed. Appendix C provides the Basis of Cost assumptions used for this study. Appendix D provides detailed cost estimates documenting cost assumptions and allowances.
(2) O&M costs include pipeline maintenance and pumping energy costs. Appendix D provides detailed cost estimates documenting cost assumptions and allowances.

5.6 Cost Summary

The costs associated with implementing offsite NPR from the MLTP are summarized in Table 5.18.

Table 5.18 NPR Implementation Costs Summary

Customer(s)	Project ADD Capacity (mgd)	Project ADD Capacity (AFY)	Total Treatment Capital Cost(1) ($)	Total Infrastructure Capital Cost(2) ($)	Total Project Capital Cost ($)	Annualized Project Capital Cost(3) ($)	Annual Infrastructure O&M Cost(4) ($)	Annual Treatment O&M Cost(5) ($)	Total Annual O&M Cost(4) ($)	$/AF
Genentech - Current	0.22	246.43	$7,400,000	$24,320,000	$31,720,000	$1,725,000	$248,000	$787,800	$1,035,800	$11,203
Genentech - Future	0.90	1008.13	$7,400,000	$37,730,000	$45,130,000	$2,454,000	$370,700	$3,222,800	$3,593,500	$5,999
GGNC	0.631	706.81	$7,400,000	$29,870,000	$37,270,000	$2,026,000	$264,400	$1,318,600	$1,583,000	$5,106
Tanforan(6)	0.009	10.08	$7,400,000	$380,000	$7,780,000	$423,000	$2,900	$18,800	$21,700	-
YouTube(6)	0.026	29.12	$7,400,000	$614,240	$8,014,240	$436,000	$10,200	$93,100	$103,300	-
Millbrae Yard(6)	0.009	10.08	$7,400,000	$3,570,000	$10,970,000	$596,000	$15,700	$18,800	$34,500	-
Western Customers Total	0.675	756.09	$7,400,000	$35,380,000	$42,780,000	$2,326,000	$315,100	$978,300	$1,293,400	$4,787
Western Customers Total - no Millbrae Yard	0.666	746.01	$7,400,000	$31,810,000	$39,210,000	$2,132,000	$300,100	$952,700	$1,252,800	$4,537
Southern Customers	0.03	28.00	$7,400,000	$14,270,000	$21,670,000	$1,178,000	$143,600	$52,200	$195,800	$49,058

Notes:
AFY – acre-feet per year.
(1) Total treatment capital cost includes AWTP expansion and BIOSTYR post-secondary nitrogen removal cost.
(2) Total infrastructure capital cost includes pipelines, pumps, and storage needed for conveyance recycled water to customers and conveyance of secondary effluent from SSF/SB WQCP to MLTP.
(3) Calculated assuming an interest rate of 3.5 percent and annualized over 30 years.
(4) Infrastructure O&M costs include pumping energy, pump, pipeline, and storage maintenance costs for conveyance recycled water to customers and conveyance of secondary effluent from SSF/SB WQCP to MLTP.
(5) Treatment O&M costs include pumping energy, treatment system consumables, and sludge disposal for the expanded AWTP and BIOSTYR post-secondary nitrogen removal system. O&M costs are allocated proportionally to project capacity.
(6) Tanforan, YouTube, and Millbrae Yard costs represent the additional cost for serving each customer while also serving GGNC. Costs for serving these three customers independently from GGNC were not developed. Accordingly, $/AF cost is also not included.

CHAPTER 6 GROUNDWATER RECHARGE OPPORTUNITIES

This chapter defines potential opportunities to utilize MLTP purified water for groundwater recharge. Earlier chapters refer to MLTP treated water as recycled water. The term purified water is used in this chapter to distinguish the potable end use of water for groundwater recharge. The high-level analysis performed herein focuses on the technical aspects of groundwater recharge. Costs are not included for this project option.

6.1 Indirect Potable Reuse via Groundwater Direct Injection

The area surrounding SFIA is a highly developed urban environment and does not have the space available for spreading basins. Further, the use of tertiary recycled water for surface spreading has many additional requirements for water quality and blending compared to direct injection, and therefore is not being considered for this study. Direct injection, the focus of this evaluation, sends purified water directly into the groundwater aquifer via an injection well (typically multiple wells).

Groundwater injection projects for IPR typically involve three sets of wells: injection, monitoring, and extraction. During operation, the injection and extraction wells operate simultaneously. The water withdrawn from extraction wells contains a mixture of both injected and native groundwater. Rather than the three types of wells, a groundwater injection project for IPR can consist of wells that are used for both injection and extraction. This well configuration is considered aquifer storage and recovery (ASR). The ASR process involves three main steps:

- Injection: Advanced purified water is injected into the well
- Hold period: Water is neither injected nor extracted.
- Extraction: Water is extracted.

Both conventional injection-extraction and the ASR option for groundwater injection are depicted in Figure 6.1.

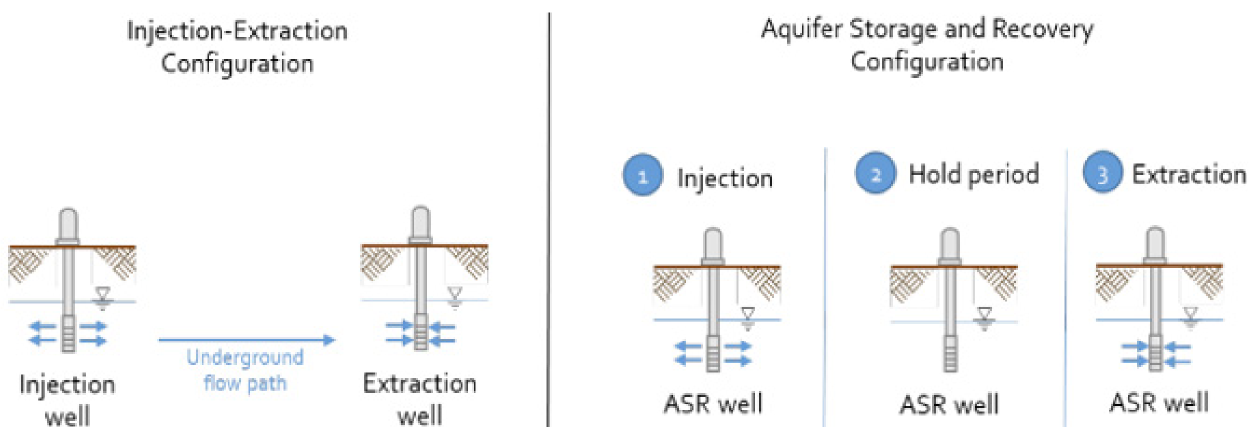
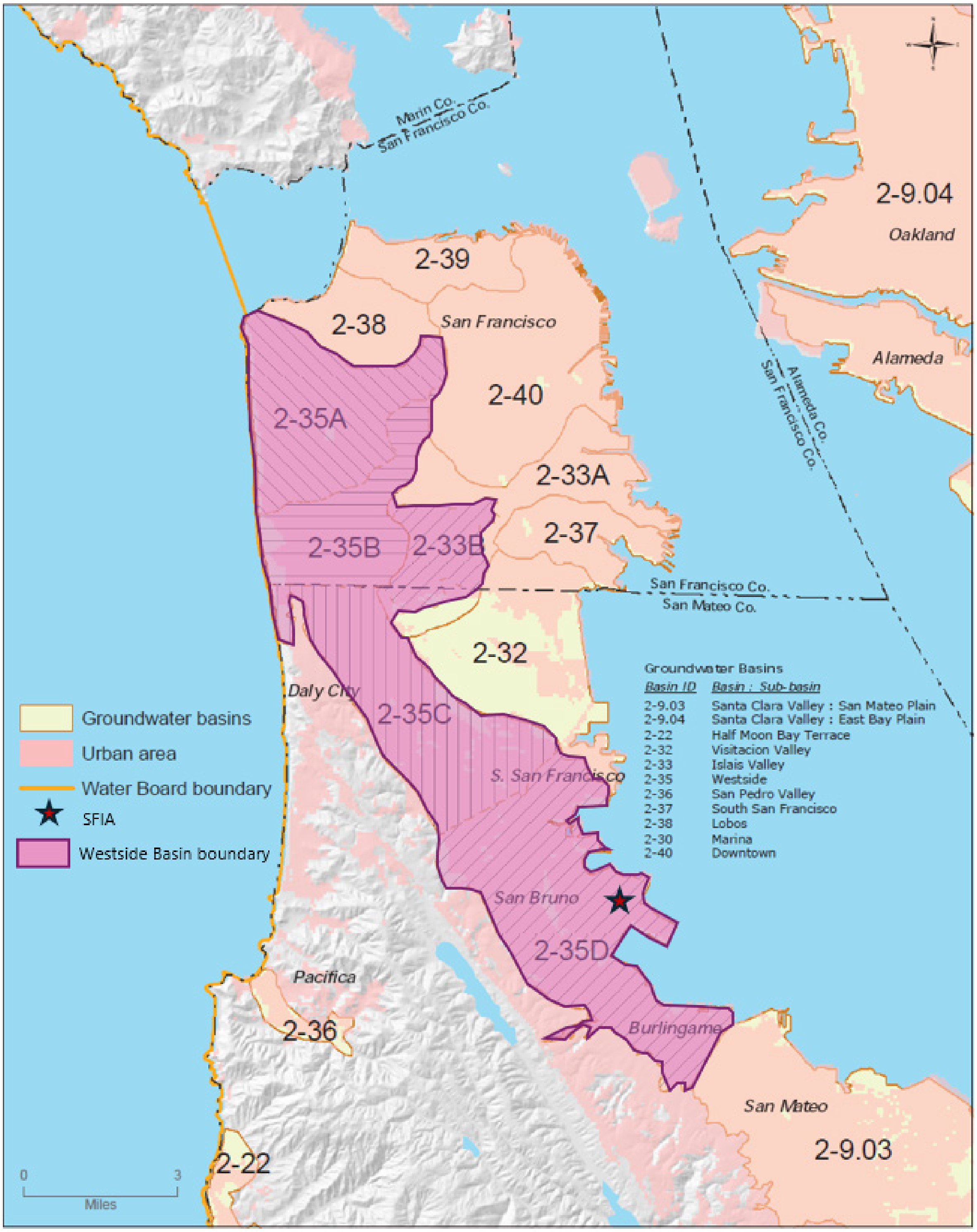


Figure 6.1 Groundwater Injection and Recovery Options: Conventional Injection-Extraction vs. ASR (monitoring wells not shown)

SFIA and the customers identified in Chapter 3 are located within the Westside Groundwater Basin, which is used for drinking water and irrigation supply. Figure 6.2 shows the extent of the Westside Groundwater Basin and location of SFIA.



Source: California RWQCB San Francisco Bay Region 2017.

Figure 6.2 San Francisco Bay Groundwater Basins

Injecting purified water produced at SFIA into the Westside Groundwater Basin would benefit the area by increasing the volume of water stored in the groundwater basin, thereby improving supply reliability during droughts.

IPR via SWA entails augmenting an existing drinking water reservoir with purified water and later treating that water at a water treatment plant before serving it to customers. While SFPUC operates several drinking water reservoirs, SWA was not considered for this study.

6.2 Regulatory Requirements

General regulatory requirements were discussed in Section 1.5. Additional regulations related to groundwater replenishment are outlined in CCR Title 22. More specifically, Article 5.2 applies to subsurface GWR. In addition, the CCR Title 22 requirements, IPR product water must meet the San Francisco Bay RWQCB Basin Plan groundwater objectives for minerals and drinking water maximum contaminant levels (MCL), as well as the Recycled Water Policy requirements including a salt and nutrient management plan, antidegradation, and contaminants of emerging concern (CEC) monitoring.

A summary of the potable reuse regulatory elements related to GWR is provided in Table 6.1.

Table 6.1 Key Regulatory Requires for GWR IPR – Direct Injection

Element	Groundwater Recharge – Direct Injection
Project Structure and Interagency Coordination	Main entity is project sponsor.
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 source water.
Pathogen Control	▪ 12-log enteric virus. ▪ 10-log Giardia. ▪ 10-log Cryptosporidium.
Treatment Train(1)	RO + UV/AOP required.
Chemical Control	Must meet all current drinking water standards, including MCLs, DBPs, and ALs. Quarterly monitoring.
Diluent Water	▪ Maximum purified water TOC contribution of 0.5 mg/L. ▪ Initial purified water contribution can be 100 percent. ▪ No diluent water required
Additional Monitoring	Quarterly sampling of purified water and downgradient groundwater wells for priority pollutants, unregulated chemicals, and NLs.
Environmental Buffer	Minimum aquifer retention time of 2 months.
Operations	No specific requirements in regulations; projects are having requirements written into permits for AWTO Grade 3 operators.
Plans	Operations Optimization Plan.
Reporting	Annual compliance reporting.
Alternative Clause	Alternatives can be used provided the project sponsor demonstrates that the proposed alternative assures at least the same level of protection to public health.(2)

Source: SWRCB 2018b.
Notes:
AL – action level; AWTO – advanced water treatment operator; DBP – disinfection byproduct; NL – notification level; sMCL – secondary maximum contaminant level.
(1) For both spreading and injection projects, 1-log virus credit is granted for each month of travel time in the aquifer.
(2) Alternatives to the requirements can be used if it is demonstrated to DDW that the alternative ensures at least the same level of public protection, receives written approval from DDW, and conducts a public hearing regarding the alternative. For this project, no alternative is proposed.

6.2.1 Treatment Requirements

CCR Title 22 requires that potable reuse projects for groundwater recharge provide a combined level of treatment resulting in 12-log virus, 10-log Giardia, and 10-log Cryptosporidium reduction (12/10/10-log removal). No single process can receive more than 6-log reduction credit and at least three processes must provide at least 1-log reduction.

For each treatment process for which a pathogen credit is sought, validation is required to demonstrate that the proposed log reduction can be achieved. Monitoring must verify performance using microbial, chemical, or physical surrogate parameters.

GWR by means of injection must undergo full advanced treatment with RO and an advanced oxidation process. Since the RWSP AWTP will implement RO and UV, the proposed groundwater recharge project proposes to upgrade the UV system to UV/AOP. While regulations do not require membrane pretreatment ahead of RO (MF/UF), it is necessary to protect the RO membranes. The existing treatment at the AWTP already meets RO requirement and has UF prior to RO as a pretreatment step. Therefore, IPR at the SFIA would not require any additional treatment systems (rather upgrades to planned systems).

6.2.2 Enhanced Source Control

As a part of wastewater collection system source control requirements, the potable reuse project sponsor must administer an industrial pretreatment and pollutant source control program that includes, at a minimum:

- Assessment of the fate of DDW-specified and RWQCB-specified chemicals and contaminants through the wastewater and recycled municipal wastewater treatment systems.
- Chemical and contaminant source investigation and monitoring that focuses on DDW-specified and RWQCB-specified chemicals and contaminants.
- Outreach program to industrial, commercial, and residential communities within the sewage collection agency's service area that flows into the water reclamation plant subsequently supplying the GRRP, with the goal of managing and minimizing the discharge of chemicals and contaminants at the source.
- Current inventory of chemicals and contaminants identified pursuant to this section (§60320.206), including new chemicals and contaminants resulting from new sources or changes to existing sources, which may be discharged into the wastewater system.
- Compliance with the effluent limits established in the wastewater management agency's RWQCB permit.

The existing pretreatment program at SFIA would need to be evaluated and likely bolstered to become an Enhanced Source Control Program for a potable purified water project. An Enhanced Source Control Program is not needed for a non-potable recycled water project.

6.2.3 Water Quality Requirements

The purified water from the AWTP must meet all regulated parameters prior to injection. Consequently, monitoring is required throughout the treatment system. This monitoring includes online and grab sample monitoring for performance indicators, performance surrogates, and a broad range of chemical pollutants including: MCLs, NLs, sMCLs, CEC, PFASs, nitrosamines, DBPs, and Basin Plan Water Quality Objectives. The water quality limits for groundwater recharge with purified water are defined in Appendix A.

In addition, regulations impose limits on TOC of wastewater origin. For GWR via direct injection, the purified water must have TOC concentrations less than 0.5 mg/L.

6.2.4 Monitoring Requirements

Inorganic chemicals (except nitrogen compounds), radionuclides, organic chemicals, DBPs, lead and copper require quarterly monitoring while secondary MCLs require annual monitoring in accordance with CCR §60320.112. Health-based constituents are to be monitored for in the purified product water and prior to RO.

CECs, as defined by the SWRCB (2018a), can be found in personal care products; pharmaceuticals; antimicrobials; industrial, agricultural, and household chemicals; naturally occurring hormones; food additives; transformation products (results from the chemical or biological breakdown of other compounds); inorganic constituents; microplastics; and nanomaterials. In addition, a new bioanalytical screening tool category was added with corresponding constituents. SWRCB's recycled water policy (RWP) addresses CECs and recognizes that the state of knowledge about CEC is incomplete. CEC concentrations in finished water should be minimized through effective source control and treatment programs.

Monitoring requirements per SWRCB's 2018a regulations along with monitoring trigger levels (MTL) are listed in Appendix A.

6.2.5 Groundwater Indirect Potable Reuse Requirements

Groundwater IPR projects require a minimum retention time of two months, which must be verified using a tracer study (either intrinsic or seeded). For project planning purposes, DDW credits retention times as a fraction of the estimated travel time based on the methods used to estimate retention time. The more precise estimation methods (such as tracer studies) receive credited retention times as 67 to 100 percent of the estimated retention time, whereas less precise methods (such as model-based approaches) receive credited retention times as 25 to 50 percent of the estimated retention time. For this study, a target minimum retention time of six months is used, corresponding to a retention time credit of 33 percent. Details regarding this analysis can be found in Section 6.3.1.

The proposed groundwater augmentation for this project, via injection, requires construction of injection and monitoring wells accompanied by the necessary monitoring of wells per regulations. It is assumed existing extraction wells would be used (no new extraction wells).

6.2.6 Monitoring Well Requirements

SWRCB DDW regulations require that groundwater replenishment projects construct at least two monitoring wells down gradient from each injection well. The siting requirements for monitoring wells are as follows:

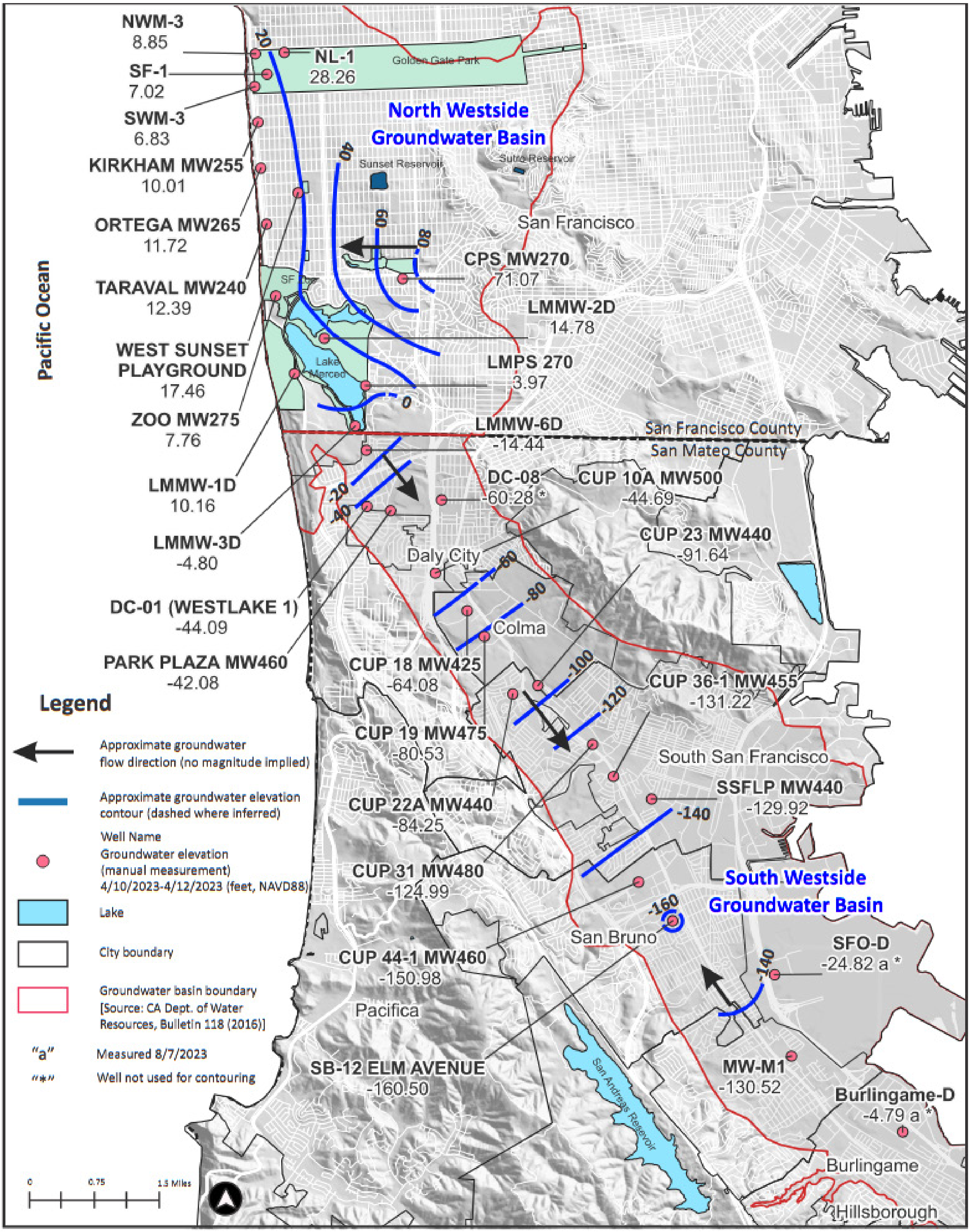
- At least one monitoring well must be located between two weeks and six months of travel time downgradient from the injection well, while also no less than 30 days upgradient from the nearest drinking water well.
- At least one monitoring well must be located between the injection well and the nearest downgradient drinking water well.

6.2.7 Operational Requirements

Prior to operation, a project sponsor shall submit an Operation Optimization Plan (OOP) to the DDW and San Francisco Bay RWQCB. The OOP describes the operations, maintenance, analytical methods, operating procedures, response and action plans, monitoring and reporting, staffing plan and chain of command under normal and extenuating operating conditions to ensure regulatory compliance. The OOP describes how treatment processes will be operated in a manner providing optimal reduction of all chemicals and contaminants including pathogens and regulated and unregulated constituents.

6.3 Westside Groundwater Basin

The Westside Groundwater Basin extends diagonally across the San Francisco Peninsula, as shown in Figure 6.3 (SFPUC 2024). The South Westside Groundwater Basin can be considered the part of the basin located in San Mateo County. Within the South Westside Basin, groundwater levels generally decline towards the southeast, reaching minimum levels near the City of San Bruno before increasing again towards SFIA and Burlingame.



Source: SFPUC 2024.

Figure 6.3 Elevation Contours in the Westside Groundwater Basin, Fall 2023

6.3.1 Injection Well Siting

Based on the groundwater modeling results from the Daly City *Conceptual Alternatives Evaluation Technical Memorandum* (Carollo 2021) Appendix A, a distance of 825 feet would result in at least six months of travel time between the injection and extraction wells. It is assumed that the same travel time would apply in the lower portion of the Westside Basin, although this should be confirmed with additional modeling if a project is carried forward.

The conceptual model used to approximate the 825-foot distance listed above was developed using representative aquifer properties from the calibrated Westside Basin Groundwater Flow Model version 4.1 (Hydrofocus 2017). Steady state groundwater flow was simulated using MODFLOW-USG. Travel time estimates were obtained from particle tracking analyses conducted using mod-PATH3DU. The hydraulic properties used as input for the model are listed in Table 6.2.

Table 6.2 Representative Hydraulic Properties

Hydraulic Property	Value
Horizontal Hydraulic Conductivity, Kh	8 feet/day
Vertical Hydraulic Conductivity, Kz	0.05 feet/day
Porosity, n	0.15
Hydraulic Gradient, i	0.0055

Source: Carollo 2021.

As a rule of thumb, groundwater injection rates are assumed to be between 50 and 75 percent of extraction rates from comparable production wells in the basin. Extraction rates in the Westside basin are typically around 0.5 mgd. Therefore, for planning purposes, a maximum injection rate of 0.25 mgd (174 gpm) is assumed per injection well. The injection capacity would need to be determined using a full-scale injection test. For this evaluation it is assumed that there would be a maximum of 0.9 mgd of purified water available (as estimated in Section 1.2.1) for IPR direct injection thereby requiring four injection wells.

The particle travel distance was evaluated based on two types of direct injection scenarios: ASR and injection-extraction.

For the ASR scenario, injection flow rates were assumed to range from 175 gpm to 500 gpm. The estimated travel distances after two, four, and six months of injection are presented in Table 6.3.

Table 6.3 Estimated Travel Distances, Injection Only

Injection Flow Rate (gpm)	Two-Month Travel Distance (feet)	Four-Month Travel Distance (feet)	Six-Month Travel Distance (feet)
174	18	270	330
348	260	370	460
500	310	440	530

Source: Carollo 2021.

For the injection-extraction scenario, an assumed injection flow rate of 348 gpm with a 500 gpm production well located downgradient of the injection well was simulated. These flow rates were based on nearby reported production well rates (median yield of 330 gpm, maximum yield of 450 gpm). While injection rates can be as low as 50 of percent production rates, the higher end of the range of possible injection flow rates was used for this analysis. It is important to consider the distance between the injection and extraction wells. As wells are sited closer together, the travel distance from the injection well to the extraction well decreases, as does the time of breakthrough (pumping is drawing from the injection well). Therefore, different injection-extraction well spacing scenarios were analyzed.

The estimated travel distances after two, four, and six months of injection and extraction are presented in Table 6.4. Note breakthrough in the table is indicated by a '—' marker. The results indicate that a well spacing of at least 500 feet is needed to prevent breakthrough within two months. However, a spacing of 825 feet is needed to maintain a six-month travel time, the study's conservative target to ensure regulatory requirements (Section 6.2.5).

Table 6.4 Estimated Travel Distances, Injection-Extraction

Injection and Extraction Well Spacing (feet)	Two-Month Travel Distance (feet)	Four-Month Travel Distance (feet)	Six-Month Travel Distance (feet)
1,500	280	410	510
500	410	--	--
660	--	660	--
825	--	--	790

Source: Carollo 2021.

In addition to the 825-foot spacing between injection and extraction wells, a 1,500-foot buffer around any groundwater contamination sites was included as a part of this IPR direct injection evaluation. Figure 6.4 shows the drinking water wells with an 825-foot buffer and the groundwater contamination sites with a 1,500-foot buffer. Injection wells should be placed outside of the periphery of both of these circles.

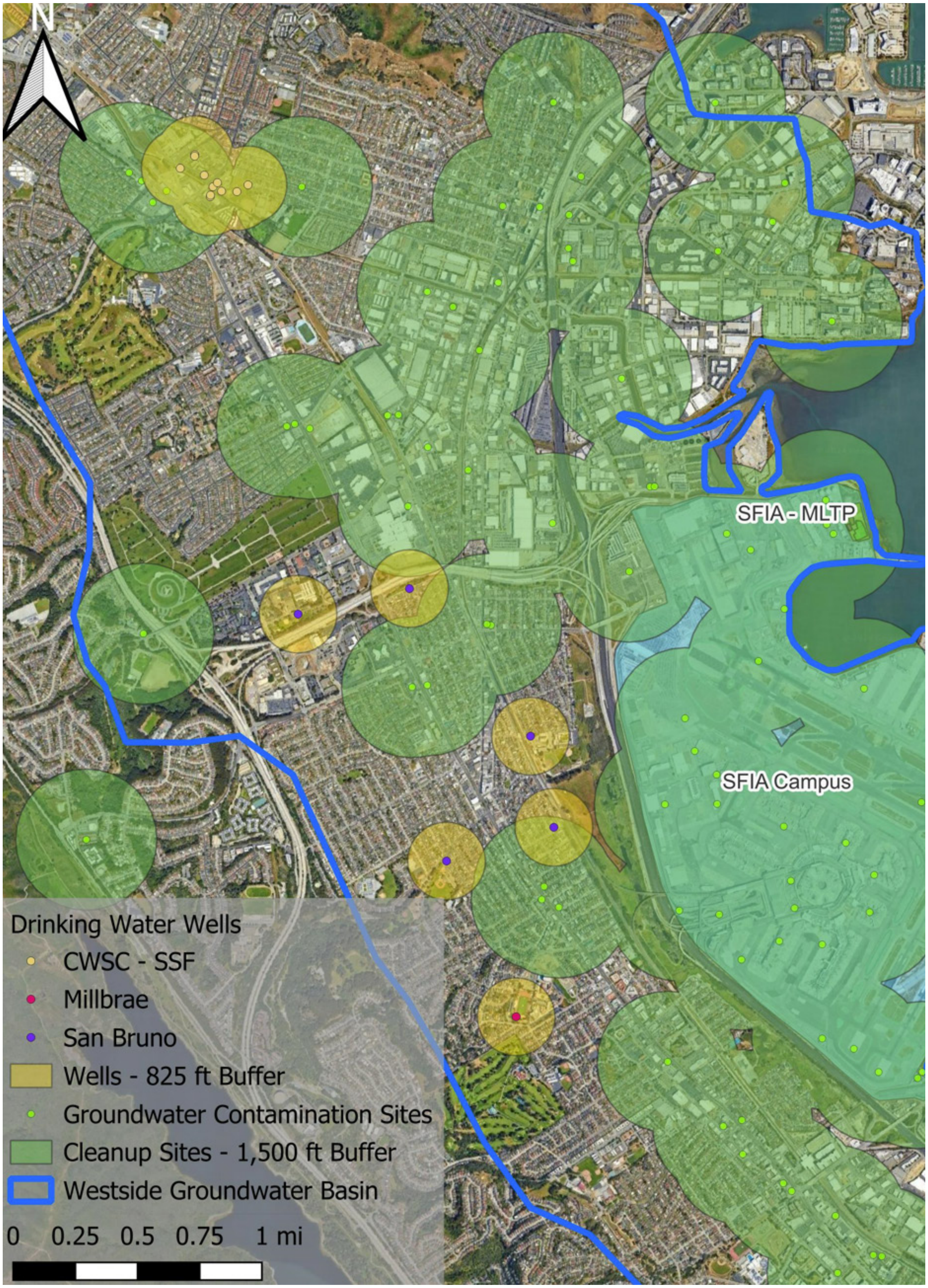


Figure 6.4 Groundwater Injection Well Siting Constraints

6.4 Feasibility of Groundwater Injection Implementation

The following considerations were considered for determining the feasibility of implementing injection and extraction wells as part of a groundwater recharge via direct injection project:

- Identify sites for injection wells that are on unused land accessible by road. Give preference to sites in the SFPUC right of way or open parcels. Note: no new extraction wells are needed.
- Determine spacing between the multiple injection and extraction wells needed for the project.
- Determine the volume of purified water from the AWTP that will be injected into each well.

As part of the first consideration above, an open parcel west of SFIA, across Highway 101, was identified as a potential location for the four injection wells.

Regarding the spacing of injection wells, based on discussions with a groundwater hydrogeologist who worked on the groundwater modeling for the Daly City *Conceptual Alternatives Evaluation Technical Memorandum*, a 500-foot spacing between injection wells was selected as a reasonable target for this evaluation. This spacing is a third siting constraint, along with the 825-foot spacing between injection and extraction wells and the 1,500-foot buffer around groundwater contamination site mentioned above.

Regarding the volume of purified water to be injected, injection rates are typically between 50 and 75 percent of extraction rates. Within the Westside Basin extraction rates are around 0.5 mgd, leading to an estimated injection rate of 0.25 mgd per well. Four injection wells will be needed to inject the 0.9 mgd daily flow of purified water.

Based on the spacing, flow, and number of wells required, all four injection wells could be sited within the open parcel identified west of SFIA. Groundwater could be extracted at either of San Bruno's existing drinking water wells. This scenario is shown in Figure 6.5.

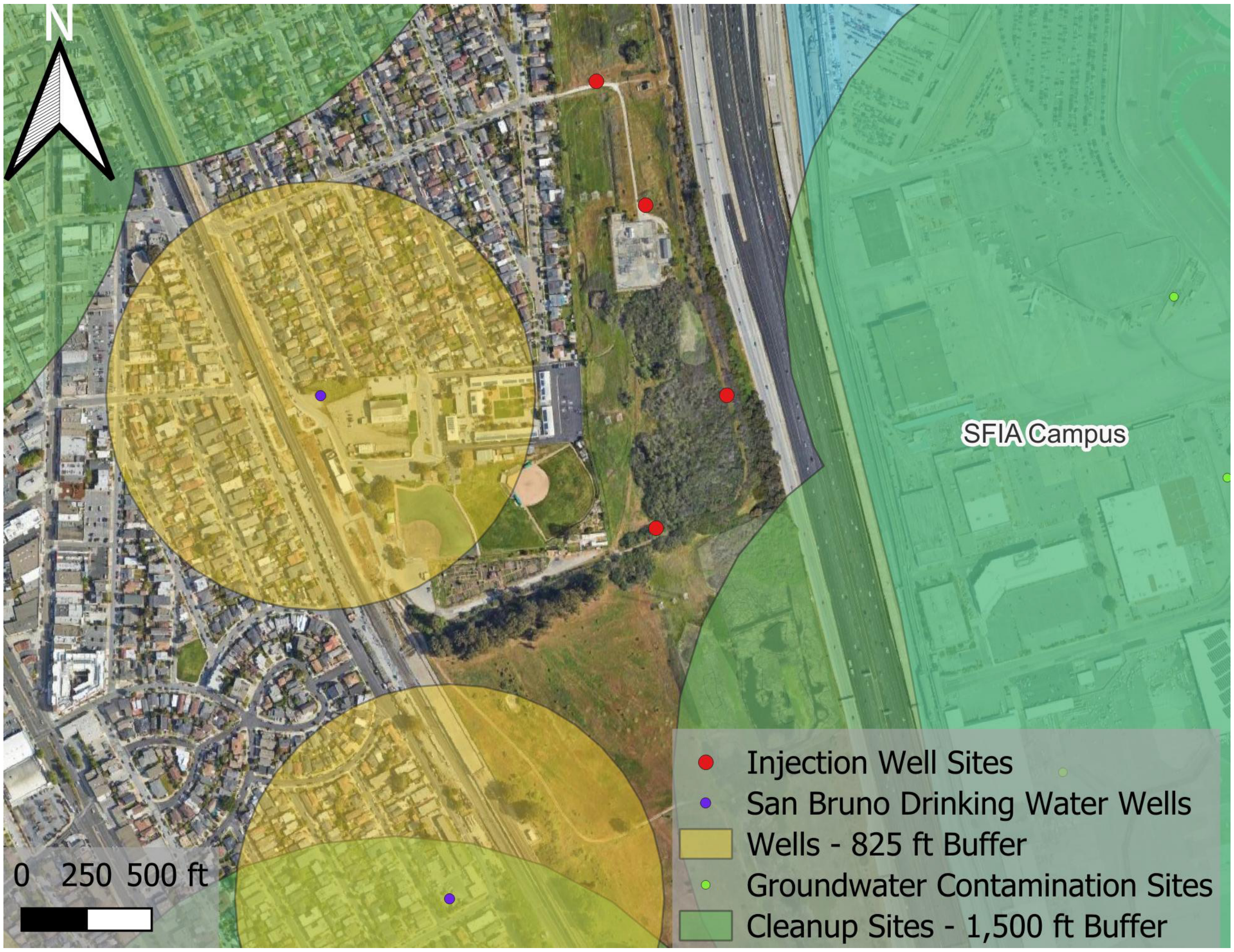


Figure 6.5 Proposed Injection Well Sites

6.4.1 Infrastructure Needs

From a high-level point of view, the infrastructure required for an IPR via direct injection project includes the following:

- Pipelines and pump stations to transport the purified water from the treatment facility to the injection location.
- Injection wells and associated appurtenances.
- Monitoring wells and associated appurtenances.

The costs for IPR implementation are not included in this evaluation.

Figure 6.6 depicts a proposed pipeline alignment for supplying the injection wells. Given their proximity to the SFIA campus, the proposed injection well sites could be served from the planned RWSP recycled water distribution system. The proposed pipeline alignment would also use the existing 84-inch utility tunnel that has already been identified as a viable Highway 101 crossing. Expected pipe sizes and quantities are summarized in Table 6.5.

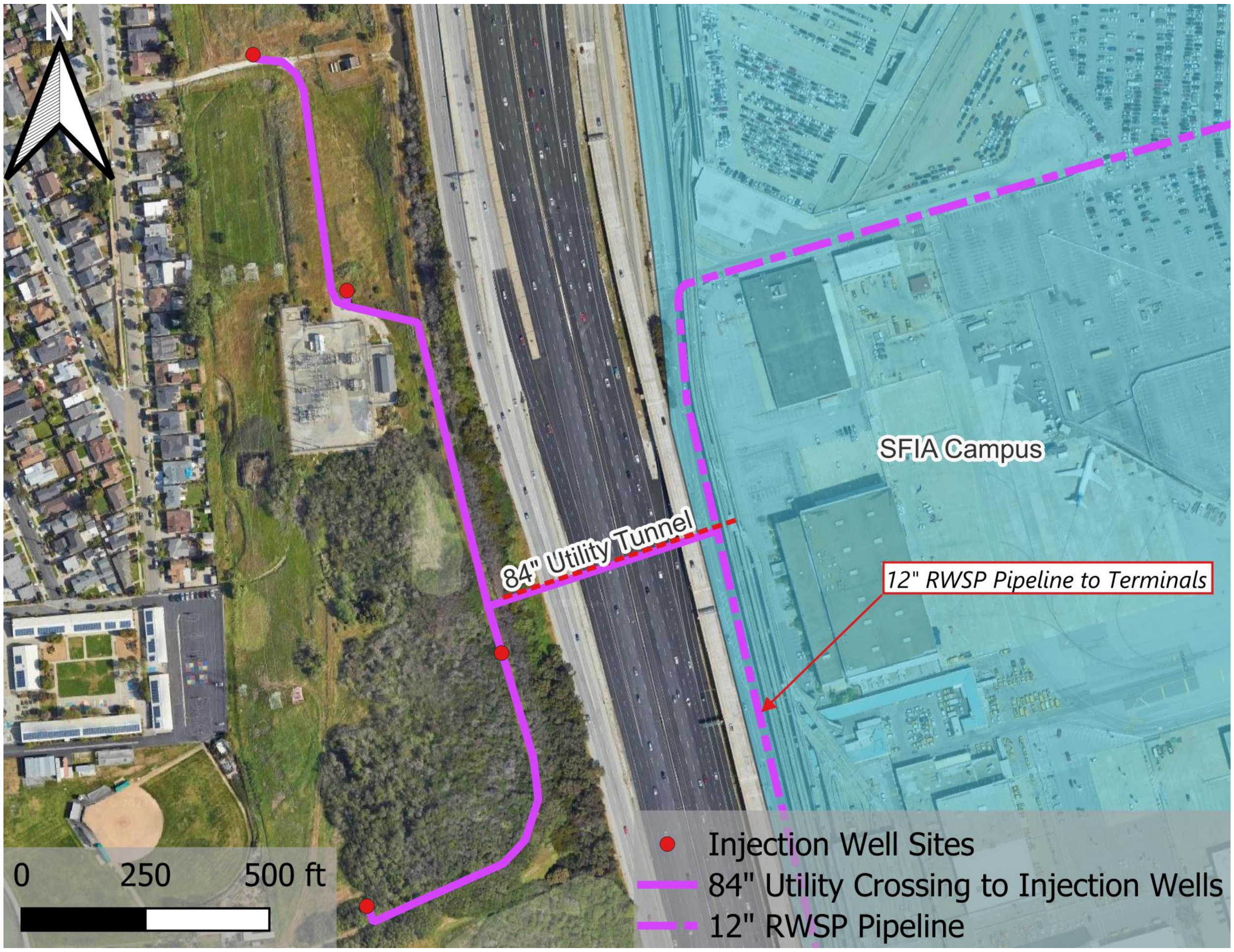


Figure 6.6 Proposed Pipe Alignment for Groundwater Injection

Table 6.5 Expected Pipe Sizes for Supplying Groundwater Injection Wells With Purified Water

Pipe Diameter (inches)	Length of Pipe (feet)
8	490
6	840
4	1380
Total	**2,710**

CHAPTER 7 IMPLEMENTATION OPTIONS

Chapter 4 describes options for treating supplemental feed water from SSF-SB WQCP at SFIA to produce a total of 2.2 mgd of recycled water at MLTP. Chapter 5 lays out a conceptual infrastructure option to convey SSF-SB WQCP supplemental feed water to MLTP, and describes the infrastructure and associated costs needed to supply Northern, Western, and Southern Customer groups with 0.2-0.9 mgd of recycled (or finished) water. Chapter 5 also discusses the costs associated with expanding the AWTP. Chapter 6 describes the requirements and infrastructure needed for IPR via groundwater recharge project. Costs were not performed for this IPR option.

As summarized in Section 5.6, the most cost-effective option, with an estimated cost of $4,537/AF, is to serve all Western Customers except for Millbrae Yard, using recycled water produced at MLTP with SSF-SB WQCP supplemental feed water treated using a post-secondary BioStyr system for nitrogen removal. This cost estimate does not include the costs of pilot testing, which is recommended.

A summary of the treatment and customer options are discussed below.

7.1.1 Treatment Options

Costs were estimated for two options for reducing nitrogen in SSF-SB WQCP secondary effluent before it reaches MLTP's IWTP: Biostyr and Algae-based treatment. Other treatment options presented in Section 4.2.2.1 may be more cost effective but are difficult to cost as this would require significant changes in operations at either SSF-SB WQCP or MLTP. Sending untreated primary effluent to MLTP's SWTP, shown in Figure 4.7, is relatively cost-effective from a capital cost perspective (lower capital cost than both treatment options presented in Table 5.5), but changing operating practices at the SWTP to accommodate the water quality in the primary effluent could have long-lasting operating costs and maintenance impacts that would require further investigation and possible pilot testing. Treating SSF-SB WQCP primary effluent using cloth filters prior to sending it to the AWTP's UF system upstream of the RO units, as shown in Figure 4.9, is another possible low-capital cost option.

7.1.2 Infrastructure Options

If wastewater were to be sent to the MLTP from SSF-SB WQCP a pipeline and pump station would be required. In addition, based on the customer grouping chosen to receive recycled water, corresponding pipelines, pump stations, and potential highway crossings would be required. Depending on which customers are served from the Western Customer grouping, the longest pipeline required will either be for the Northern Customer grouping or the Western Customer grouping (assuming the Western Customer grouping includes GGNC and or Millbrae Yard). Each customer in the Western grouping will require a Highway 101 crossing which drives up costs and likely extends the implementation schedule. The Southern Customer grouping will require the shortest pipeline for recycled water delivery.

7.1.3 Customer Options

In general, only customers that can be entirely served by the 0.9 mgd project capacity are included in the cost tables in Chapter 5. Only Genentech is shown for the Northern Customer grouping. Genentech has current and future implementation cost with the future scenario providing a lower $/AF of treated and transported water ($5,999).

GGNC, Tanforan, YouTube, and Millbrae Yard comprise the Western Customer grouping. CGC is a large customer (approximately 0.4 mgd) that could only be partially served by a project after the other group members were served. Planning for additional capacity to serve future non-irrigation recycled water demands at Tanforan may be beneficial from a development perspective.

Southern Customers include Bayfront Park and Bay Trail South. This customer grouping is small and not recommended to be served given the high unit cost of implementation ($49,058).

Groundwater replenishment via direct injection, described in Chapter 6, may be an appealing and potentially cost-effective alternative to the customer delivery options. It is recommended that groundwater injection be further studied for feasibility and costs comparison identified with NPR customer options.

7.1.4 Next Steps

The options discussed in this study will require further analysis prior to design and implementation. Recommended next steps and possible follow-up studies are listed below.

1. Discuss options for sending SSF-SB WQCP supplemental feed water to MLTP with SSF, San Bruno, SFPUC, and SFIA to determine which options should receive further study, and which would be feasible for SFIA to consider in future planning.
2. Conduct pilot testing on feasible treatment options identified during discussions in number 1 above.
3. Survey potential customers about cost sensitivity and willingness to pay for recycled water. Calculate the $/AF of delivering recycled water and compare to cost of delivering potable water. Consider incentives for each option.
4. Further study the costs of groundwater replenishment via groundwater recharge, as this option may end up being cost competitive and require less coordination with individual customers. Study the feasibility of supplying NPR customers identified in this study with local groundwater.

CHAPTER 8 REFERENCES

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APPENDIX A

DRINKING WATER QUALITY REQUIREMENTS

The water quality limits for groundwater recharge with recycled water, as required, are defined below.

Drinking Water Quality Requirements

Tables A.1 through A.6 constitute the required water quality performance, consistent with 22 CCR (2019). Within each table is a specific reference to the table within the regulation.

Table A.1 Inorganics with Primary MCLs or ALs

Constituents	Primary MCL (in mg/L)
Aluminum	1.0
Antimony	0.006
Arsenic	0.010
Asbestos	7 (million fibers per liter)(1)
Barium	1
Beryllium	0.004
Cadmium	0.005
Chromium VI	0.01
Chromium	0.05
Copper	1.3
Cyanide	0.15
Fluoride	2
Lead	0.015
Mercury	0.002
Nickel	0.1
Nitrate (as N)	10
Nitrite (as N)	1
Nitrate + Nitrite (as N)	10
Perchlorate	0.006
Selenium	0.05
Thallium	0.002
PFOA	0.000004
PFOS	0.000004
PFHxS	0.00001
PFNA	0.00001
HFPO-DA (GenX)	0.00001
HI (PFHxS, PFNA, PFBS, HFPO-DA)(2)	1.0 (unitless)

Source: Based on Table 64431-A and Section 64678.
Notes:
HFPO-DA – hexafluoropropylene oxide dimer acid; HI – hazard index; PFBS – perfluorobutane sulfonate; PHFxS – perfluorohexanesulfonic acid; PFNA – perfluorononanoic acid
(1) Fiber lengths > 10 microns.
(2) $\text{Hazard Index (HI)} = \frac{\text{HFPO-DAppt}}{10\ \text{ppt}} + \frac{\text{PFBSppt}}{2000\text{ppt}} + \frac{\text{PFNAppt}}{10\text{ppt}} + \frac{\text{PFHxSppt}}{10\text{ppt}}$

Table A.2 Radioactivity

Constituents	MCL (in pCi/L)
Uranium	20
Combined radium 226 and 228	5
Gross alpha particle activity(2)	15
Beta/photon emitters	50(1,2)
Strontium-90	8(1)
Tritium	20,000(1)

Source: Based on Tables 64442 and 64443.
Notes:
(1) MCLs are intended to ensure that exposure above 4 millirems per year. does not occur.
(2) Beta/photon emitters MCLs are in unit of millirems per year annual dose equivalent to the total body or any internal organ.

Table A.3 Regulated Organics

Constituents	MCL (mg/L)	Constituents	MCL (mg/L)
Volatile Organic Compounds			
Benzene	0.001	Monochlorobenzene	0.07
Carbon Tetrachloride	0.0005	Styrene	0.1
1,2-Dichlorobenzene	0.6	1,1,2,2-Tetrachloroethane	0.001
1,4-Dichlorobenzene	0.005	Tetrachloroethylene	0.005
1,1-Dichloroethane	0.005	Toluene	0.15
1,2-Dichloroethane	0.0005	1,2,4 Trichlorobenzene	0.005
1,1-Dichloroethylene	0.006	1,1,1-Trichloroethane	0.2
cis-1,2-Dichloroethylene	0.006	1,1,2-Trichloroethane	0.005
trans-1,2-Dichloroethylene	0.01	Trichloroethylene	0.005
Dichloromethane	0.005	Trichlorofluoromethane	0.15
1,3-Dichloropropene	0.0005	1,1,2-Trichloro-1,2,2-Trifluoroethane	1.2
1,2-Dichloropropane	0.005	Vinyl chloride	0.0005
Ethylbenzene	0.3	Xylenes	1.75
MTBE	0.013		
Semi-Volatile Organic Compounds			
Alachlor	0.002	Heptachlor	0.00001
Atrazine	0.001	Heptachlor Epoxide	0.00001
Bentazon	0.018	Hexachlorobenzene	0.001
Benzo(a) Pyrene	0.0002	Hexachlorocyclopentadiene	0.05
Carbofuran	0.018	Lindane	0.0002
Chlordane	0.0001	Methoxychlor	0.03
Dalapon	0.2	Molinate	0.02
Dibromochloropropane	0.0002	Oxamyl	0.05
Di(2-ethylhexyl)adipate	0.4	Pentachlorophenol	0.001

Constituents	MCL (mg/L)	Constituents	MCL (mg/L)
Di(2-ethylhexyl)phthalate	0.004	Picloram	0.5
2,4-D	0.07	Polychlorinated Biphenyls	0.0005
Dinoseb	0.007	Simazine	0.004
Diquat	0.02	Thiobencarb	0.07/0.001(1)
Endothall	0.1	Toxaphene	0.003
Endrin	0.002	1,2,3-Trichloropropane	5x10-6
Ethylene Dibromide	0.00005	2,3,7.8-Tetrachlorodibenzo-p-dioxin	3x10-8
Glyphosate	0.7	2,4,5-TP	0.05

Source: Based on Table 64444-A.
Notes:
MTBE – methyl tertiary-butyl ether.
(1) Second value is listed as a sMCL.

Table A.4 DBPs

Constituents	MCL (mg/L)	Constituents	MCL (mg/L)
Total Trihalomethanes	0.080	Bromate	0.010
Total Haloacetic acids	0.060	Chlorite	1.0

Source: Based on Table 64533-A.

Table A.5 Constituents/Parameters With sMCLs

Constituents(1)	sMCL (in mg/L)
Aluminum	0.2
Chloride(2)	250
Color	15 (units)
Copper	1
Foaming Agents (methylene blue active substances)	0.5
Iron	0.3
Manganese	0.05
MTBE	0.005
Odor Threshold	3 (units)
Silver	0.1
Specific Conductance(2)	900 (microsiemens per centimeter)
Sulfate(2)	250
TDS(2)	500
Thiobencarb	0.001
Turbidity	5 (NTU)
Zinc	5

Notes:
(1) Based on Table 64449-A.
(2) Based on Table 64449-B.

Table A.6 Constituents With NLs(1)

Constituents	NL (in µg/L)	Constituents	NL (in µg/L)
Boron	1,000	Manganese	500
n-Butylbenzene	260	Methyl isobutyl ketone	120
sec-Butylbenzene	260	Naphthalene	17
tert-Butylbenzene	260	N-Nitrosodiethyamine	0.01
Carbon disulfide	160	NDMA	0.01
Chlorate	800	N-Nitrosodi-n-propylamine	0.01
2-Chlorotoluene	140	Propachlor	90
4-Chlorotoluene	140	n-Propylbenzene	260
Diazinon	1.2	Royal Demolition Explosive	0.3
Dichlorodifluoromethane	1,000	Tertiary Butyl Alcohol	12
1,4-Dioxane	1	1,2,4-Trimethylbenzene	330
Ethylene glycol	14,000	1,3,5-Trimethylbenzene	330
Formaldehyde	100	2,4,6-Trinitrotoluene	1
Octogen	350	Vanadium	50
Isopropylbenzene	770		

Source: SWRCB. November 1, 2022. "Drinking Water Notification Levels." California Water Boards. https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/NotificationLevels.html.
Notes:
NDMA – N-nitrosodimethylamine.

Constituents of Emerging Concern With Monitoring Triggering Levels

The SWRCB first adopted its RWP in 2009 and amended it in 2013 to specify monitoring requirements for CECs in recycled water based on the recommendations of an advisory panel.[1] The RWP contains a provision to reconvene a Science Advisory Panel every five years to update the recommendations for CEC monitoring in recycled water. In April 2018, the reconvened Science Advisory Panel published *Monitoring Strategies for Constituents of Emerging Concern (CECs) in Recycled Water* (Southern California Coastal Water Research project). On December 11, 2018, SWRCB adopted resolution No. 2018-0057 to amend the RWP. The amendment took effect in April 2019 when approved by the Office of Administrative Law. The amendment contains a revised list of CECs recommended for monitoring in potable water reuse projects (SWRCB 2018a).

CECs are defined by SWRCB (2018a) as constituents in personal care products; pharmaceuticals; antimicrobials; industrial, agricultural, and household chemicals; naturally occurring hormones; food additives; transformation products; inorganic constituents; microplastics; and nanomaterials.

[1] SWRCB. June 25, 2010. *Monitoring Strategies for Chemicals of Emerging Concern (CECs) in Recycled Water*.

SWRCB 2013[2] CEC monitoring included CECs with health-based significance, CECs that serve as performance indicators, and non-CECs that serve as performance surrogates. SWRCB (2018a) includes revised recommendations for CECs in all three aforementioned categories, as well as the addition of a new category for monitoring – bioanalytical screening tools. Health-based constituents and bioanalytical screening tools are to be monitored for purified product water prior to groundwater injection. Performance indicators are to be monitored in both in the purified product water and prior to RO. Surrogates listed in the RWP are examples – individual projects should determine appropriate surrogates to monitor effectiveness of CEC removal through individual unit processes.

Monitoring requirements for CECs per SWRCB (2013) and SWRCB (2018a) are included in Table A.7 and Table A.8, respectively. The monitoring requirements in SWRCB (2018a) replace those in SWRCB (2013).

Table A.7 Monitoring Requirements for CECs – Groundwater Recharge – Subsurface Application

Constituent	Relevance/Indicator Type	MTL (µg/L)	Example Removal Percentages (%)
17B-estradiol(1)	Health	0.001	--
Caffeine(1)	Health and Performance	0.05	>90
NDMA(1)	Health and Performance	0.002	25-50, >80(3)
Triclosan(1)	Health	0.05	--
N-diethyl-meta-toluamide(1)	Performance	0.05	>90
Sucralose(1)	Performance	0.1	>90
TOC(2)	Surrogate	--	>90
Electrical Conductivity(2)	Surrogate	--	>90

Source: SWRCB 2013.
Notes:
(1) Monitored quarterly.
(2) Continuously monitored.
(3) 25 to 50 percent removal by RO, >80 percent removal by RO followed by UV, depending upon the UV dose.

[2] SWRCB. 2013. Resolution No. 2013-0003: Adoption of an Amendment to the Policy for Water Quality Control for Recycled Water Concerning Monitoring Requirements for Constituents of Emerging Concern. https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2013/rs2013_0003.pdf.

Table A.8 Monitoring Requirements for CECs – Groundwater Recharge – Subsurface Application

Constituent	Relevance	MTL (µg/L)	Example Removal Percentages (%)
1,4-dioxane	Health	1	--
NDMA(1)	Health and Performance	0.002	>25-50, 80
N-nitrosomorpholine(2)	Health	0.002	--
Estrogen receptor alpha	Bioanalytical Methods	0.0005	--
Aryl hydrocarbon receptor	Bioanalytical Methods	0.0005	--
Sulfamethoxazole(2)	Performance	0.01	>90
Sucralose(2)	Performance	0.1	>90
Dissolved Organic Carbon(4)	Surrogate (example)	-	>90
UV Absorbance(4)	Surrogate (example)	-	>50
Electrical Conductivity(4)	Surrogate (example)	-	>90

Source: SWRCB 2018a.
Notes:
(1) Health-based CECs and Bioanalytical Screening to be monitored following treatment.
(2) Performance indicator CECs to be monitored before RO and after treatment.
(3) The value listed is the MCL expected pending finalization of the National Primary Drinking Water Regulation by the end of 2023.
(4) Surrogates are provided as examples. Surrogates should be used to demonstrate the effectiveness of individual processes for removing CECs.

APPENDIX B

GENENTECH MONTHLY NON-POTABLE RECYCLED WATER DEMANDS

Genentech reported the following recycled water demands as of December 2024.

Table B.1 Monthly Total Non-potable Recycled Water Demands (gallons)

Month	Interior (Flushing)	Irrigation	Cooling	Total Non-potable Demand
January	1,168,142	1,554,054	1,360,545	4,082,740
February	1,055,096	2,105,492	1,269,836	4,430,424
March	1,168,142	3,885,134	1,450,398	6,503,674
April	1,130,460	4,887,749	1,458,723	7,476,932
May	1,168,142	5,827,701	1,570,931	8,566,773
June	1,130,460	6,391,672	1,600,619	9,122,751
July	1,168,142	6,216,214	1,679,944	9,064,300
August	1,168,142	5,827,701	1,708,879	8,704,722
September	1,130,460	4,887,749	1,668,602	7,686,811
October	1,168,142	3,496,621	1,663,956	6,328,719
November	1,130,460	2,255,884	1,442,938	4,829,282
December	1,168,142	1,554,054	1,355,023	4,077,218
Total (MG/year)	**13.75**	**48.89**	**18.23**	**80.87**

Table B.2 Monthly Average Non-potable Recycled Water Demands (gallons per day)

Month	Interior (Flushing)	Irrigation	Cooling	Total Non-potable Demand
January	37,682	50,131	43,889	131,701
February	37,682	75,196	45,351	158,229
March	37,682	125,327	46,787	209,796
April	37,682	162,925	48,624	249,231
May	37,682	187,990	50,675	276,348
June	37,682	213,056	53,354	304,092
July	37,682	200,523	54,192	292,397
August	37,682	187,990	55,125	280,797
September	37,682	162,925	55,620	256,227
October	37,682	112,794	53,676	204,152
November	37,682	75,196	48,098	160,976
December	37,682	50,131	43,710	131,523

APPENDIX C BASIS OF COST

C1 Planning Level Cost Estimate

The Association for the Advancement of Cost Engineering International (AACE International) has suggested levels of accuracy for five estimate classes. These five estimate classes are presented in the AACE International Recommended Practice No. 18R-97 (Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Process Industries, 2020). Table C.1 presents a summary of these five estimate classes and their characteristics, including expected accuracy ranges.

Table C.1 Classes of Cost Estimates

Estimate Class	Maturity Level of Project Definition Deliverables(1)	End Usage(2)	Methodology(3)	Expected Accuracy Range(4)
Class 5	0% to 2%	Concept Screening	Capacity factored, parametric models, judgement, or analogy	L: -20% to -50% H: +30% to +100%
Class 4	1% to 15%	Study or Feasibility	Equipment factored or parametric models	L: -15% to -30% H: +20% to +50%
Class 3	10% to 40%	Budget, Authorization, or Control	Semi-detailed unit costs with assembly level line items	L: -10% to -20% H: +10% to +30%
Class 2	30% to 75%	Control or Bid/Tender	Detailed unit cost with forced detailed take-off	L: -5% to -15% H: +5% to +20%
Class 1	65% to 100%	Check Estimate or Bid/Tender	Detailed unit cost with detailed take-off	L: -3% to -10% H: +3% to +15%

Notes:
H – high; L – low.
(1) Expressed as percent of complete definition.
(2) Typical purpose of estimate.
(3) Typical estimating method.
(4) Typical variation in low and high ranges at an 80 percent confidence interval.

The quantity and quality of the information required to prepare an estimate depends on the end use for that estimate. Typically, as a project progresses from the conceptual phase to the study phase, preliminary design and final design, the quantity and quality of information increases, thereby providing data for development of a progressively more accurate cost estimate. A contingency is often used to compensate for lack of detailed engineering data, oversights, anticipated changes, and imperfection in the estimating methods used. As the quantity and quality of data becomes better, smaller contingency allowances are typically utilized. For this project, cost estimates are developed following the AACE International Recommended Practice No. 18R-97 estimate classes 5 and 4.

C.1.2 Capital Cost Basis

Capital costs are based on quantity takeoffs and similar facilities with allowances for civil, mechanical, structural, and electrical improvements, as well as engineering cost.

Construction costs presented typically include an estimating contingency, sales tax, general conditions, and contractor's overhead and profit. The percentages assumed for these factors are shown in Table C.2.

Table C.2 Basis for Estimating Capital Costs

Item	Estimated Cost	Estimated Cost of "A"
Equipment/Infrastructure Cost Total	**"A"**	**100%**
Estimating Contingency	40% of "A"	40%
Direct Cost Total	**"B"**	**140%**
Sales Tax	8.63%(1) of 1/2 "B"	7%
General Conditions	15% of "B + Sales Tax"	22%
Contractor Overhead and Profit	15% of "B+ Sales Tax + General Conditions"	25%
Construction Cost Total	**"C"**	**194%**
Engineering, Legal, and Administrative	20% of "C"	39%
Owner's Reserve for Change Orders	5% of "C"	10%
Project Cost Total	**"D"**	**242%**

Notes:
(1) City of San Francisco 2024 sales tax rate.

Total project costs presented typically include a fee for engineering, legal, and administration, as well as an owner's reserve for change orders. The percentages assumed for these factors are also shown in Table C.2. Note that capital costs do not include land acquisition, escalation to midpoint of construction, and insurance costs.

APPENDIX D

COST ESTIMATE

PROJECT:	SFIA Water Reuse Evaluation Project
JOB NO.:	
DATE:	
BY:	Patrick Hassett - WRE
ALTERNATIVE:	
COST:	Expanded Treatment Cost
DESCRIPTION:	Level 5 Cost Estimate

CAPITAL COST ESTIMATE

Classification		Quantity	Units	Unit Cost	Estimated Cost
UF System					
	Upsize UF Feed Pumps - 50 HP	3	EA	$ 37,500	$ 112,500
	Additional UF Modules	36	EA	$ 3,000	$ 108,000
	Upsize UF Backwash Pumps - 50 HP	2	EA	$ 37,500	$ 75,000
				Subtotal	$ 295,500
RO System					
	Upsize RO Feed Pumps - 50 HP	1	EA	$ 37,500	$ 38,000
	Additional RO Train	1	EA	$ 900,000	$ 900,000
				Subtotal	$ 938,000
UV System					
	Additional Ballasts	4	EA	$ 1,400	$ 6,000
	Additional Lamps	16	EA	$ 700	$ 11,000
				Subtotal	$ 17,000
	TOTAL DIRECT COST				*$ 1,250,500*
	Estimating Contingency	40%			$ 500,000
	Subtotal				*$ 1,750,500*
	Sales Tax (applied to 50% of direct costs)	9%			$ 76,000
	Subtotal				*$ 1,826,500*
	General Conditions	15%			$ 274,000
	Subtotal				*$ 2,100,500*
	Contractor Overhead & Profit	15%			$ 315,000
	Subtotal				*$ 2,415,500*
	TOTAL CONSTRUCTION COST				*$ 2,415,500*
	Engineering, Legal, and Administrative	20%			$ 483,000
	Owners Reserve for Change Orders	5%			$ 121,000
	TOTAL PROJECT COST				**$ 3,020,000**

ANNUAL O&M COST ESTIMATE - 0.9 MGD RW PRODUCTION

Classification		Quantity	Units	Unit Cost	Estimated Cost
Staffing Costs					
	Quality Coordinator	1	EA	$ 240,000	$ 240,000
	AWTO 5: Operations Manager	1	EA	$ 360,000	$ 360,000
	AWTO 3	4	EA	$ 200,000	$ 800,000
				Subtotal	$ 1,400,000
				Off-site Expense	$ 728,300
Consumables Costs					
	PFAS Media Replacement		LS		$ 1,514,634
	UF Membranes		LS		$ 57,293
	RO Membranes		LS		$ 28,098
	UV Consumables		LS		$ 26,451
				Subtotal	$ 1,626,476
Power Costs					
	DAF Feed	23,636	kWh/year	$ 0.17	$ 4,018
	DAF Energy	125,391	kWh/year	$ 0.17	$ 21,316
	DAF Effluent	16,425	kWh/year	$ 0.17	$ 2,792
	Ozone Power	502,765	kWh/year	$ 0.17	$ 85,470
	BAF Energy	163,449	kWh/year	$ 0.17	$ 27,786
	UF Energy	122,186	kWh/year	$ 0.17	$ 20,772
	RO Energy	491,949	kWh/year	$ 0.17	$ 83,631
	UV Energy	533,497	kWh/year	$ 0.17	$ 90,694
				Subtotal	$ 336,481
Other Costs					
	Chemicals		LS		$ 458,780
	Sludge Disposal		LS		$ 9,768
				Subtotal	$ 468,549
	TOTAL O&M COST				**$ 3,160,000**

PROJECT:	SFIA Water Reuse Evaluation Project
JOB NO.:	
DATE:	
BY:	Patrick Hassett - WRE
ALTERNATIVE:	SSF-SB to MLTP Supplemental Feed Water
COST:	Conveyance
DESCRIPTION:	Level 5 Cost Estimate

CAPITAL COST ESTIMATE

Classification		Quantity	Units	Unit Cost	Estimated Cost
Pipeline Cost					
	8" Pipeline - Open Cut	6,659	LF	$ 240	$ 1,598,000
	8" Pipeline - Trenchless Crossing at San Bruno Creek	264	LF	$ 885	$ 234,000
				Subtotal	$ 1,832,000
Pipeline Allowances					
	Valves and Appurtenances			25%	$ 458,000
	Mobilization & Demobilization			5%	$ 91,600
	Shoring & Dewatering			4%	$ 73,280
	Traffic Control			5%	$ 91,600
				Subtotal	$ 714,480
Pump Station Cost					
	Pumps, Piping, and Valves	40	HP	$ 21,500	$ 860,000
	Construction	40	HP	$ 12,950	$ 518,000
				Subtotal	$ 1,378,000
	TOTAL DIRECT COST				*$ 3,924,480*
	Estimating Contingency	40%			$ 1,570,000
	Subtotal				*$ 5,494,480*
	Sales Tax (applied to 50% of direct costs)	9%			$ 237,000
	Subtotal				*$ 5,731,480*
	General Conditions	15%			$ 860,000
	Subtotal				*$ 6,591,480*
	Contractor Overhead & Profit	15%			$ 989,000
	Subtotal				*$ 7,580,480*
	TOTAL CONSTRUCTION COST				*$ 7,580,480*
	Engineering, Legal, and Administrative	20%			$ 1,516,000
	Owners Reserve for Change Orders	5%			$ 379,000
	TOTAL PROJECT COST				**$ 9,480,000**

ANNUAL O&M COST ESTIMATE

Classification		Quantity	Units	Unit Cost	Estimated Cost
Pipeline O&M Costs					
	Pipeline Maintenance		0.50%	$ 4,914,706	$ 24,600
				Subtotal	$ 24,600
Pump Station O&M Costs					
	Pump Energy	259,987	kWh/year	$ 0.37	$ 96,200
	Maintenance		1.00%	$ 2,659,540	$ 26,600
				Subtotal	$ 96,200
	TOTAL O&M COST				**$ 120,800**

PROJECT:	SFIA Water Reuse Evaluation Project
JOB NO.:	
DATE:	
BY:	Patrick Hassett - WRE
ALTERNATIVE:	BioSTYR Duo System
COST:	Post-Secondary Nitrogen Removal
DESCRIPTION:	Level 5 Cost Estimate

CAPITAL COST ESTIMATE

	Classification	Quantity	Units	Unit Cost	Estimated Cost
	Veolia BIOSTYR DUO System		LS		$ 1,813,500
				Subtotal	$ 1,813,500
	TOTAL DIRECT COST				*$ 1,813,500*
	Estimating Contingency	40%			$ 725,000
	Subtotal				*$ 2,538,500*
	Sales Tax (applied to 50% of direct costs)	9%			$ 110,000
	Subtotal				*$ 2,648,500*
	General Conditions	15%			$ 397,000
	Subtotal				*$ 3,045,500*
	Escalation to mid-point(1)	*0.0%*			$ -
	Subtotal				*$ 3,045,500*
	Contractor Overhead & Profit	15%			$ 457,000
	Subtotal				*$ 3,502,500*
	TOTAL CONSTRUCTION COST				*$ 3,500,000*
	Engineering, Legal, and Administrative	20%			$ 700,000
	Owners Reserve for Change Orders	5%			$ 175,000
	TOTAL PROJECT COST				**$ 4,380,000**

ANNUAL O&M COST ESTIMATE

	Classification	Quantity	Units	Unit Cost	Estimated Cost
Power Costs					
	Aeration Power	239,576	kWh/year	$ 0.17	$ 40,728
	Backwash Pumping	16,094	kWh/year	$ 0.17	$ 2,736
	Influent Pumping	113,536	kWh/year	$ 0.17	$ 19,301
				Subtotal	$ 62,765
	TOTAL O&M COST				**$ 63,000**

PROJECT:	SFIA Water Reuse Evaluation Project
JOB NO.:	
DATE:	
BY:	Patrick Hassett - WRE
ALTERNATIVE:	Revolving Algal Biofilm System
COST:	Post-Secondary Nitrogen Removal
DESCRIPTION:	Level 5 Cost Estimate

CAPITAL COST ESTIMATE

Classification	Quantity	Units	Unit Cost	Estimated Cost
Gross-Wen Technologies Revolving Algal Biofilm System		LS		$ 4,091,200
			Subtotal	$ 4,091,200
TOTAL DIRECT COST				*$ 4,091,200*
Estimating Contingency	40%			$ 1,636,000
Subtotal				*$ 5,727,200*
Sales Tax (applied to 50% of direct costs)	9%			$ 247,000
Subtotal				*$ 5,974,200*
General Conditions	15%			$ 896,000
Subtotal				*$ 6,870,200*
Escalation to mid-point(1)	*0.0%*			$ -
Subtotal				*$ 6,870,200*
Contractor Overhead & Profit	15%			$ 1,031,000
Subtotal				*$ 7,901,200*
TOTAL CONSTRUCTION COST				*$ 7,900,000*
Engineering, Legal, and Administrative	20%			$ 1,580,000
Owners Reserve for Change Orders	5%			$ 395,000
TOTAL PROJECT COST				**$ 9,880,000**

ANNUAL O&M COST ESTIMATE

Classification	Quantity	Units	Unit Cost	Estimated Cost
Annual Costs				
Operating Energy	80,300	kWh/year	$ 0.17	$ 13,651
Routine Maintenance Labor		LS		$ 5,520
Spare Part Replacement		LS		$ 96,000
Chemicals		LS		$ 1,850
Savings and Revenue				
Algae Sales		LS		$ (10,950)
Carbon Credits		LS		$ (7,330)
			Subtotal	$ 98,741
TOTAL O&M COST				**$ 99,000**

PROJECT:	SFIA Water Reuse Evaluation Project
JOB NO.:	
DATE:	
BY:	Patrick Hassett - WRE
ALTERNATIVE:	Genentech - Current
COST:	Conveyance and Storage
DESCRIPTION:	Level 5 Cost Estimate

CAPITAL COST ESTIMATE

Classification	Quantity	Units	Unit Cost	Estimated Cost
Pipeline Cost				
4" Pipeline - Open Cut	15,206	LF	$ 143	$ 2,174,000
4" Pipeline - Trenchless Crossing at San Bruno Creek	264	LF	$ 527	$ 139,000
4" Pipeline - Trenchless Crossing at Colma Creek	528	LF	$ 527	$ 278,000
			Subtotal	$ 2,591,000
Pipeline Allowances				
Valves and Appurtenances			25%	$ 647,750
Mobilization & Demobilization			5%	$ 129,550
Shoring & Dewatering			4%	$ 103,640
Traffic Control			5%	$ 129,550
			Subtotal	$ 1,010,490
Pump Station Cost				
Pumps, Piping, and Valves	55	HP	$ 21,500	$ 1,183,000
Construction	55	HP	$ 12,950	$ 712,000
			Subtotal	$ 1,895,000
Storage Tank Cost				
0.25 MG Welded Steel Tank	1	LS		$ 650,000
			Subtotal	$ 650,000
TOTAL DIRECT COST				*$ 6,146,490*
Estimating Contingency	40%			$ 2,459,000
Subtotal				*$ 8,605,490*
Sales Tax (applied to 50% of direct costs)	9%			$ 371,000
Subtotal				*$ 8,976,490*
General Conditions	15%			$ 1,346,000
Subtotal				*$ 10,322,490*
Contractor Overhead & Profit	15%			$ 1,548,000
Subtotal				*$ 11,870,490*
TOTAL CONSTRUCTION COST				*$ 11,870,490*
Engineering, Legal, and Administrative	20%			$ 2,374,000
Owners Reserve for Change Orders	5%			$ 594,000
TOTAL PROJECT COST				**$ 14,840,000**

ANNUAL O&M COST ESTIMATE

Classification	Quantity	Units	Unit Cost	Estimated Cost
Pipeline O&M Costs				
Pipeline Maintenance		0.50%	$ 6,950,876	$ 34,800
			Subtotal	$ 34,800
Pump Station O&M Costs				
Pump Energy	336,154	kWh/year	$ 0.17	$ 57,100
Maintenance		1.00%	$ 2,283,190	$ 22,800
			Subtotal	$ 79,900
Storage Tank O&M Costs				
Routine Maintenance and Inspection		1.0%	$ 1,254,500	$ 12,500
			Subtotal	$ 12,500
TOTAL O&M COST				**$ 127,200**

PROJECT:	SFIA Water Reuse Evaluation Project
JOB NO.:	
DATE:	
BY:	Patrick Hassett - WRE
ALTERNATIVE:	Genentech - Future
COST:	Conveyance and Storage
DESCRIPTION:	Level 5 Cost Estimate

CAPITAL COST ESTIMATE

Classification		Quantity	Units	Unit Cost	Estimated Cost
Pipeline Cost					
	8" Pipeline - Open Cut	15,206	LF	$ 240	$ 3,649,000
	8" Pipeline - Trenchless Crossing at San Bruno Creek	264	LF	$ 885	$ 234,000
	8" Pipeline - Trenchless Crossing at Colma Creek	528	LF	$ 885	$ 467,000
				Subtotal	$ 4,350,000
Pipeline Allowances					
	Valves and Appurtenances			25%	$ 1,087,500
	Mobilization & Demobilization			5%	$ 217,500
	Shoring & Dewatering			4%	$ 174,000
	Traffic Control			5%	$ 217,500
				Subtotal	$ 1,696,500
Pump Station Cost					
	Pumps, Piping, and Valves	75	HP	$ 21,500	$ 1,613,000
	Construction	75	HP	$ 12,950	$ 971,000
				Subtotal	$ 2,584,000
Storage Tank Cost					
	1.0 MG Prestressed Concrete Tank	1	LS		$ 1,094,000
	Site Work, Piping, Electrical and Instrumentation	1	LS		$ 1,979,000
				Subtotal	$ 3,073,000
	TOTAL DIRECT COST				*$ 11,703,500*
	Estimating Contingency	40%			$ 4,681,000
	Subtotal				*$ 16,384,500*
	Sales Tax (applied to 50% of direct costs)	9%			$ 707,000
	Subtotal				*$ 17,091,500*
	General Conditions	15%			$ 2,564,000
	Subtotal				*$ 19,655,500*
	Contractor Overhead & Profit	15%			$ 2,948,000
	Subtotal				*$ 22,603,500*
	TOTAL CONSTRUCTION COST				*$ 22,603,500*
	Engineering, Legal, and Administrative	20%			$ 4,521,000
	Owners Reserve for Change Orders	5%			$ 1,130,000
	TOTAL PROJECT COST				**$ 28,250,000**

ANNUAL O&M COST ESTIMATE

Classification		Quantity	Units	Unit Cost	Estimated Cost
Pipeline O&M Costs					
	Pipeline Maintenance		0.50%	$ 11,669,745	$ 58,300
				Subtotal	$ 58,300
Pump Station O&M Costs					
	Pump Energy	484,960	kWh/year	$ 0.17	$ 82,400
	Maintenance		1.00%	$ 4,987,120	$ 49,900
				Subtotal	$ 132,300
Storage Tank O&M Costs					
	Routine Maintenance and Inspection		1.0%	$ 5,930,890	$ 59,300
				Subtotal	$ 59,300
	TOTAL O&M COST				**$ 249,900**

PROJECT:	SFIA Water Reuse Evaluation Project
JOB NO.:	
DATE:	
BY:	Patrick Hassett - WRE
ALTERNATIVE:	Western Customers - GGNC
COST:	Conveyance and Storage
DESCRIPTION:	Level 5 Cost Estimate

CAPITAL COST ESTIMATE

Classification		**Quantity**	**Units**	**Unit Cost**	**Estimated Cost**
Pipeline Cost					
	12" Pipeline MLTP to US-101 Utility Tunnel - By Others	7,920	LF	N/A	
	8" Pipeline US-101 to Junction - Open Cut	9,230	LF	$ 240	$ 2,215,000
	8" Pipeline US-101 to Junction - Slipline at US-101 Utility Tunnel	528	LF	$ 172	$ 91,000
	8" Pipeline US-101 to Junction - Trenchless Crossing at I-380	528	LF	$ 885	$ 467,000
	8" Pipeline Junction to GGNC - Open Cut	4,979	LF	$ 240	$ 1,195,000
				Subtotal	$ 3,968,000
Pipeline Allowances					
	Valves and Appurtenances			25%	$ 992,000
	Mobilization & Demobilization			5%	$ 198,400
	Shoring & Dewatering			4%	$ 158,720
	Traffic Control			5%	$ 198,400
				Subtotal	$ 1,547,520
Pump Station Cost					
	Pumps, Piping, and Valves	85	HP	$ 21,500	$ 1,828,000
	Construction	85	HP	$ 12,950	$ 1,101,000
				Subtotal	$ 2,929,000
	TOTAL DIRECT COST				*$ 8,444,520*
	Estimating Contingency	40%			$ 3,378,000
	Subtotal				*$ 11,822,520*
	Sales Tax (applied to 50% of direct costs)	9%			$ 510,000
	Subtotal				*$ 12,332,520*
	General Conditions	15%			$ 1,850,000
	Subtotal				*$ 14,182,520*
	Contractor Overhead & Profit	15%			$ 2,127,000
	Subtotal				*$ 16,309,520*
	TOTAL CONSTRUCTION COST				*$ 16,309,520*
	Engineering, Legal, and Administrative	20%			$ 3,262,000
	Owners Reserve for Change Orders	5%			$ 815,000
	TOTAL PROJECT COST				**$ 20,390,000**

ANNUAL O&M COST ESTIMATE

Classification		**Quantity**	**Units**	**Unit Cost**	**Estimated Cost**
Pipeline O&M Costs					
	Pipeline Maintenance		0.50%	$ 10,644,954	$ 53,200
				Subtotal	$ 53,200
Pump Station O&M Costs					
	Pump Energy	324,022	kWh/year	$ 0.17	$ 55,100
	Maintenance		1.00%	$ 3,528,040	$ 35,300
				Subtotal	$ 90,400
	TOTAL O&M COST				**$ 143,600**

PROJECT:	SFIA Water Reuse Evaluation Project
JOB NO.:	
DATE:	
BY:	Patrick Hassett - WRE
ALTERNATIVE:	Western Customers - Tanforan
COST:	Conveyance and Storage
DESCRIPTION:	Level 5 Cost Estimate

CAPITAL COST ESTIMATE

Classification		Quantity	Units	Unit Cost	Estimated Cost
Pipeline Cost					
	2" Service line Junction to Tanforan - Open Cut	510	LF	$ 108	$ 55,000
				Subtotal	$ 55,000
Pipeline Allowances					
	Valves and Appurtenances			25%	$ 13,750
	Mobilization & Demobilization			5%	$ 2,750
	Shoring & Dewatering			4%	$ 2,200
	Traffic Control			5%	$ 2,750
				Subtotal	$ 21,450
Pump Station Cost					
	Pumps, Piping, and Valves	1	HP	$ 21,500	$ 22,000
	Construction	1	HP	$ 12,950	$ 13,000
				Subtotal	$ 35,000
Storage Tank Cost					
	0.015 MG Welded Steel Tank	1	LS		$ 45,000
				Subtotal	$ 45,000
	TOTAL DIRECT COST				*$ 156,450*
	Estimating Contingency	40%			$ 63,000
	Subtotal				*$ 219,450*
	Sales Tax (applied to 50% of direct costs)	9%			$ 9,000
	Subtotal				*$ 228,450*
	General Conditions	15%			$ 34,000
	Subtotal				*$ 262,450*
	Contractor Overhead & Profit	15%			$ 39,000
	Subtotal				*$ 301,450*
	TOTAL CONSTRUCTION COST				*$ 301,450*
	Engineering, Legal, and Administrative	20%			$ 60,000
	Owners Reserve for Change Orders	5%			$ 15,000
	TOTAL PROJECT COST				**$ 380,000**

ANNUAL O&M COST ESTIMATE

Classification		Quantity	Units	Unit Cost	Estimated Cost
Pipeline O&M Costs					
	Pipeline Maintenance		0.50%	$ 147,549	$ 700
				Subtotal	$ 700
Pump Station O&M Costs					
	Pump Energy	3,812	kWh/year	$ 0.17	$ 600
	Maintenance		1.00%	$ 67,550	$ 700
				Subtotal	$ 1,300
Storage Tank O&M Costs					
	Routine Maintenance and Inspection		1.0%	$ 86,850	$ 900
				Subtotal	$ 900
	TOTAL O&M COST				**$ 2,900**

PROJECT:	SFIA Water Reuse Evaluation Project
JOB NO.:	
DATE:	
BY:	Patrick Hassett - WRE
ALTERNATIVE:	Western Customers - Youtube
COST:	Conveyance and Storage
DESCRIPTION:	Level 5 Cost Estimate

CAPITAL COST ESTIMATE

Classification		Quantity	Units	Unit Cost	Estimated Cost
Pipeline Cost					
	2" Service line Cherry Ave. Junction to Youtube - Open Cut	2,647	LF	$ 108	$ 286,000
				Subtotal	$ 286,000
Pipeline Allowances					
	Valves and Appurtenances			25%	$ 71,500
	Mobilization & Demobilization			5%	$ 14,300
	Shoring & Dewatering			4%	$ 11,440
	Traffic Control			5%	$ 14,300
				Subtotal	$ 111,540
Pump Station Cost					
	Pumps, Piping, and Valves	2	HP	$ 21,500	$ 43,000
	Construction	2	HP	$ 12,950	$ 26,000
				Subtotal	$ 69,000
Storage Tank Cost					
	0.034 MG Welded Steel Tank	1	LS		$ 147,700
				Subtotal	$ 147,700
	TOTAL DIRECT COST				*$ 614,240*
	Estimating Contingency	40%			$ 246,000
	Subtotal				*$ 860,240*
	Sales Tax (applied to 50% of direct costs)	9%			$ 37,000
	Subtotal				*$ 897,240*
	General Conditions	15%			$ 135,000
	Subtotal				*$ 1,032,240*
	Contractor Overhead & Profit	15%			$ 155,000
	Subtotal				*$ 1,187,240*
	TOTAL CONSTRUCTION COST				*$ 1,187,240*
	Engineering, Legal, and Administrative	20%			$ 237,000
	Owners Reserve for Change Orders	5%			$ 59,000
	TOTAL PROJECT COST				**$ 1,480,000**

ANNUAL O&M COST ESTIMATE

Classification		Quantity	Units	Unit Cost	Estimated Cost
Pipeline O&M Costs					
	Pipeline Maintenance		0.50%	$ 767,252	$ 3,800
				Subtotal	$ 3,800
Pump Station O&M Costs					
	Pump Energy	13,065	kWh/year	$ 0.17	$ 2,200
	Maintenance		1.00%	$ 133,170	$ 1,300
				Subtotal	$ 3,500
Storage Tank O&M Costs					
	Routine Maintenance and Inspection		1.0%	$ 285,061	$ 2,900
				Subtotal	$ 2,900
	TOTAL O&M COST				**$ 10,200**

PROJECT:	SFIA Water Reuse Evaluation Project
JOB NO.:	
DATE:	
BY:	Patrick Hassett - WRE
ALTERNATIVE:	Western Customers - Millbrae Yard
COST:	Conveyance and Storage
DESCRIPTION:	Level 5 Cost Estimate

CAPITAL COST ESTIMATE

Classification		Quantity	Units	Unit Cost	Estimated Cost
Pipeline Cost					
	2" Service line Caltrain Undercrossing to Millbrae Yard - Open Cut	9,327	LF	$ 108	$ 1,007,000
				Subtotal	$ 1,007,000
Pipeline Allowances					
	Valves and Appurtenances			25%	$ 251,750
	Mobilization & Demobilization			5%	$ 50,350
	Shoring & Dewatering			4%	$ 40,280
	Traffic Control			5%	$ 50,350
				Subtotal	$ 392,730
Pump Station Cost					
	Pumps, Piping, and Valves	1	HP	$ 21,500	$ 22,000
	Construction	1	HP	$ 12,950	$ 13,000
				Subtotal	$ 35,000
Storage Tank Cost					
	0.015 MG Welded Steel Tank	1	LS		$ 45,000
				Subtotal	$ 45,000
	TOTAL DIRECT COST				*$ 1,479,730*
	Estimating Contingency	40%			$ 592,000
	Subtotal				*$ 2,071,730*
	Sales Tax (applied to 50% of direct costs)	9%			$ 89,000
	Subtotal				*$ 2,160,730*
	General Conditions	15%			$ 324,000
	Subtotal				*$ 2,484,730*
	Contractor Overhead & Profit	15%			$ 373,000
	Subtotal				*$ 2,857,730*
	TOTAL CONSTRUCTION COST				*$ 2,857,730*
	Engineering, Legal, and Administrative	20%			$ 572,000
	Owners Reserve for Change Orders	5%			$ 143,000
	TOTAL PROJECT COST				**$ 3,570,000**

ANNUAL O&M COST ESTIMATE

Classification		Quantity	Units	Unit Cost	Estimated Cost
Pipeline O&M Costs					
	Pipeline Maintenance		0.50%	$ 2,701,479	$ 13,500
				Subtotal	$ 13,500
Pump Station O&M Costs					
	Pump Energy	3,812	kWh/year	$ 0.17	$ 600
	Maintenance		1.00%	$ 67,550	$ 700
				Subtotal	$ 1,300
Storage Tank O&M Costs					
	Routine Maintenance and Inspection		1.0%	$ 86,850	$ 900
				Subtotal	$ 900
	TOTAL O&M COST				**$ 15,700**

PROJECT:	SFIA Water Reuse Evaluation Project
JOB NO.:	
DATE:	
BY:	Patrick Hassett - WRE
ALTERNATIVE:	Western Customers
COST:	Conveyance and Storage
DESCRIPTION:	Level 5 Cost Estimate

CAPITAL COST ESTIMATE

Classification		Quantity	Units	Unit Cost	Estimated Cost
Pipeline Cost					
	12" Pipeline MLTP to US-101 Utility Tunnel - By Others	7,920	LF	N/A	
	8" Pipeline US-101 to Sneath Lane Junction - Open Cut	9,230	LF	$ 240	$ 2,215,000
	8" Pipeline US-101 to Sneath Lane Junction - Slipline at US-101 Utility Tunnel	528	LF	$ 172	$ 91,000
	8" Pipeline US-101 to Sneath Lane Junction - Trenchless Crossing at I-380	528	LF	$ 885	$ 467,000
	8" Pipeline Sneath Lane Junction to GGNC - Open Cut	4,979	LF	$ 240	$ 1,195,000
	2" Service line Sneath Lane Junction to Tanforan - Open Cut	510	LF	$ 108	$ 55,000
	2" Service line Cherry Ave. Junction to Youtube - Open Cut	2,647	LF	$ 108	$ 286,000
	2" Service line Caltrain Undercrossing to Millbrae Yard - Open Cut	9,327	LF	$ 108	$ 1,007,000
				Subtotal	$ 5,316,000
Pipeline Allowances					
	Valves and Appurtenances			25%	$ 1,329,000
	Mobilization & Demobilization			5%	$ 265,800
	Shoring & Dewatering			4%	$ 212,640
	Traffic Control			5%	$ 265,800
				Subtotal	$ 2,073,240
Pump Station Cost					
	Pumps, Piping, and Valves	90	HP	$ 21,500	$ 1,935,000
	Construction	90	HP	$ 12,950	$ 1,166,000
				Subtotal	$ 3,101,000
Storage Tank Cost					
	0.015 MG Welded Steel Tank	2	EA	$ 45,000	$ 90,000
	0.034 MG Welded Steel Tank	1	LS		$ 147,700
				Subtotal	$ 237,700
	TOTAL DIRECT COST				*$ 10,727,940*
	Estimating Contingency	40%			$ 4,291,000
	Subtotal				*$ 15,018,940*
	Sales Tax (applied to 50% of direct costs)	9%			$ 648,000
	Subtotal				*$ 15,666,940*
	General Conditions	15%			$ 2,350,000
	Subtotal				*$ 18,016,940*
	Contractor Overhead & Profit	15%			$ 2,703,000
	Subtotal				*$ 20,719,940*
	TOTAL CONSTRUCTION COST				*$ 20,719,940*
	Engineering, Legal, and Administrative	20%			$ 4,144,000
	Owners Reserve for Change Orders	5%			$ 1,036,000
	TOTAL PROJECT COST				**$ 25,900,000**

ANNUAL O&M COST ESTIMATE

Classification		Quantity	Units	Unit Cost	Estimated Cost
Pipeline O&M Costs					
	Pipeline Maintenance		0.50%	$ 14,261,233	$ 71,300
				Subtotal	$ 71,300
Pump Station O&M Costs					
	Pump Energy	344,710	kWh/year	$ 0.17	$ 58,600
	Maintenance		1.00%	$ 5,984,930	$ 59,800
				Subtotal	$ 118,400
Storage Tank O&M Costs					
	Routine Maintenance and Inspection		1.0%	$ 458,761	$ 4,600
				Subtotal	$ 4,600
	TOTAL O&M COST				**$ 194,300**

PROJECT:	SFIA Water Reuse Evaluation Project
JOB NO.:	
DATE:	
BY:	Patrick Hassett - WRE
ALTERNATIVE:	Western Customers, without Millbrae Yard
COST:	Conveyance and Storage
DESCRIPTION:	Level 5 Cost Estimate

CAPITAL COST ESTIMATE

Classification		Quantity	Units	Unit Cost	Estimated Cost
Pipeline Cost					
	12" Pipeline MLTP to US-101 Utility Tunnel - By Others	7,920	LF	N/A	
	8" Pipeline US-101 to Sneath Lane Junction - Open Cut	9,230	LF	$ 240	$ 2,215,000
	8" Pipeline US-101 to Sneath Lane Junction - Slipline at US-101 Utility Tunnel	528	LF	$ 172	$ 91,000
	8" Pipeline US-101 to Sneath Lane Junction - Trenchless Crossing at I-380	528	LF	$ 885	$ 467,000
	8" Pipeline Sneath Lane Junction to GGNC - Open Cut	4,979	LF	$ 240	$ 1,195,000
	2" Service line Sneath Lane Junction to Tanforan - Open Cut	510	LF	$ 108	$ 55,000
	2" Service line Cherry Ave. Junction to Youtube - Open Cut	2,647	LF	$ 108	$ 286,000
				Subtotal	$ 4,309,000
Pipeline Allowances					
	Valves and Appurtenances			25%	$ 1,077,250
	Mobilization & Demobilization			5%	$ 215,450
	Shoring & Dewatering			4%	$ 172,360
	Traffic Control			5%	$ 215,450
				Subtotal	$ 1,680,510
Pump Station Cost					
	Pumps, Piping, and Valves	89	HP	$ 21,500	$ 1,914,000
	Construction	89	HP	$ 12,950	$ 1,153,000
				Subtotal	$ 3,067,000
Storage Tank Cost					
	0.015 MG Welded Steel Tank	1	LS		$ 45,000
	0.034 MG Welded Steel Tank	1	LS		$ 147,700
				Subtotal	$ 192,700
	TOTAL DIRECT COST				*$ 9,249,210*
	Estimating Contingency	40%			$ 3,700,000
	Subtotal				*$ 12,949,210*
	Sales Tax (applied to 50% of direct costs)	9%			$ 559,000
	Subtotal				*$ 13,508,210*
	General Conditions	15%			$ 2,026,000
	Subtotal				*$ 15,534,210*
	Contractor Overhead & Profit	15%			$ 2,330,000
	Subtotal				*$ 17,864,210*
	TOTAL CONSTRUCTION COST				*$ 17,864,210*
	Engineering, Legal, and Administrative	20%			$ 3,573,000
	Owners Reserve for Change Orders	5%			$ 893,000
	TOTAL PROJECT COST				**$ 22,330,000**

ANNUAL O&M COST ESTIMATE

Classification		Quantity	Units	Unit Cost	Estimated Cost
Pipeline O&M Costs					
	Pipeline Maintenance		0.50%	$ 11,559,754	$ 57,800
				Subtotal	$ 57,800
Pump Station O&M Costs					
	Pump Energy	344,710	kWh/year	$ 0.17	$ 58,600
	Maintenance		1.00%	$ 5,919,310	$ 59,200
				Subtotal	$ 117,800
Storage Tank O&M Costs					
	Routine Maintenance and Inspection		1.0%	$ 371,911	$ 3,700
				Subtotal	$ 3,700
	TOTAL O&M COST				**$ 179,300**

PROJECT:	SFIA Water Reuse Evaluation Project
JOB NO.:	
DATE:	
BY:	Patrick Hassett - WRE
ALTERNATIVE:	Southern Customers
COST:	Conveyance and Storage
DESCRIPTION:	Level 5 Cost Estimate

CAPITAL COST ESTIMATE

Classification	Quantity	Units	Unit Cost	Estimated Cost
Pipeline Cost				
12" Pipeline MLTP to SFIA Terminals - By Others	13,221	LF	N/A	
2" Pipeline SFIA Terminals to Junction - Open Cut	6,538	LF	$ 108	$ 706,000
2" Pipeline - Trenchless Crossings at SFIA	1,056	LF	$ 398	$ 420,000
2" Service line to Bayfront Park - Open Cut	77	LF	$ 108	$ 8,000
2" Service line to Bay Trail South - Open Cut	1,235	LF	$ 108	$ 133,000
			Subtotal	$ 1,267,000
Pipeline Allowances				
Valves and Appurtenances			25%	$ 316,750
Mobilization & Demobilization			5%	$ 63,350
Shoring & Dewatering			4%	$ 50,680
Traffic Control			5%	$ 63,350
			Subtotal	$ 494,130
Pump Station Cost				
Pumps, Piping, and Valves	3	HP	$ 25,000	$ 75,000
Construction	3	HP	$ 15,000	$ 45,000
			Subtotal	$ 120,000
Storage Tank Cost				
0.02 MG Welded Steel Tank	1	LS		$ 60,000
0.015 MG Welded Steel Tank	1	LS		$ 45,000
			Subtotal	$ 105,000
TOTAL DIRECT COST				*$ 1,986,130*
Estimating Contingency	40%			$ 794,000
Subtotal				*$ 2,780,130*
Sales Tax (applied to 50% of direct costs)	9%			$ 120,000
Subtotal				*$ 2,900,130*
General Conditions	15%			$ 435,000
Subtotal				*$ 3,335,130*
Contractor Overhead & Profit	15%			$ 500,000
Subtotal				*$ 3,835,130*
TOTAL CONSTRUCTION COST				*$ 3,835,130*
Engineering, Legal, and Administrative	20%			$ 767,000
Owners Reserve for Change Orders	5%			$ 192,000
TOTAL PROJECT COST				**$ 4,790,000**

ANNUAL O&M COST ESTIMATE

Classification	Quantity	Units	Unit Cost	Estimated Cost
Pipeline O&M Costs				
Pipeline Maintenance		0.50%	$ 3,398,981	$ 17,000
			Subtotal	$ 17,000
Pump Station O&M Costs				
Pump Energy	8,768	kWh/year	$ 0.17	$ 1,500
Maintenance		1.00%	$ 231,600	$ 2,300
			Subtotal	$ 3,800
Storage Tank O&M Costs				
Routine Maintenance and Inspection		1.0%	$ 202,650	$ 2,000
			Subtotal	$ 2,000
TOTAL O&M COST				**$ 22,800**