*STAFF REPORT*

**To:** **Coastside County Water District Board of Directors**

**From:** **Mary Rogren, General Manager**

**Agenda:** **September 10, 2024**

**Report Date:** **September 6, 2024**

**Agenda Title**: Receive the "Recycled Water Feasibility Study" Prepared by Waterworks Engineers, LLC.

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**Information Only:**

**Receive the "Recycled Water Feasibility Study" prepared by Waterworks Engineers, LLC.**

**Background:**

As the water retailer for the City of Half Moon Bay, and the surrounding communities of unincorporated San Mateo County, the District is committed to pursuing a resilient, sustainable, and integrated water supply for the Coastside including evaluating options for alternative water supplies involving water reuse. Since the late 1990's, the District has conducted and participated on numerous studies in conjunction with other Coastside agencies (including Sewer Authority Mid- Coastside, the City of Half Moon Bay, Granada Community Services District, and Montara Water & Sanitary District) investigating the possibilities of implementing recycled water on the Coastside.

Given predicted climate change impacts to water resources, projected cost increases of SFPUC wholesale water, and changes in water reuse regulations, in 2023, the District decided to take a fresh look at the feasibility of water reuse . In June 2023, the District entered into an agreement with Water Works Engineers, LLC. ("Waterworks") to conduct a feasibility study to assess the hydrogeology of the region, technical, regulatory, permitting requirements, and economic feasibility in order to derive and evaluate potential alternatives for water reuse.

**Feasibility Study Scope:**

The scope of the study focused on looking at a range of alternatives to diversify the District's water supply portfolio including 1) non-potable reuse; 2) indirect potable reuse; 3) direct potable reuse; 4) projects with environmental benefits. A primary component of the study was the development of a hydrogeologic report prepared by ROUX Associates, Inc. ("ROUX"), an environmental consulting firm subcontracted by Water Works, to determine if using recycled water for environmental benefit and ground water replenishment were feasible options within the Half Moon Bay Terrace Basin as it overlaps the District's boundaries.

The study focused on recycled water uses within the District's jurisdictional boundaries and Skylawn Memorial Park . The average dry weather flow of wastewater attributable to the District's service area between 2018 to 2022 was 1.18 MGD and was assumed as the available flow for purposes of this study. Waterworks considered the geography of the District and land use zoning (e.g., 81% of the land is zoned residential; 18% commercial; 1% agricultural) as well as population trends and land use restrictions given that the District's service area is within the Coastal Zone. Waterworks also reviewed potential customers in the service area for the recycled water.

The options considered for this study by category are included below:

| Non-Potable Reuse | Indirect Potable Reuse | Direct Potable Reuse | Environmental Benefit |
|---|---|---|---|
| Fill Station(s) | Groundwater Replenishment | Direct Potable Reuse at Nunes WTP | Pilarcitos Creek Augmentation or Other Creek Augmentation |
| Landscape Irrigation | Reservoir Augmentation | | Wetland Enhancement |
| Agricultural Irrigation | | | |
| Skylawn Irrigation | | | |
| Ocean Colony Golf Course Irrigation | | | |

Waterworks considered both cost/benefit and non-cost criteria in their analysis of the options. From a cost perspective, Waterworks considered 20-year life cycle costs (including initial capital outlay plus annual O&M costs) and calculated the net present value per million gallons produced over 20 years for purposes of ranking alternatives. Waterworks also considered economic benefits to the District of alternative water sources that could be available for the beneficial use of the District's customers.

Non-cost criteria considered includes 1) environmental and social impacts/benefits; 2) ease of implementation and regulatory compliance; 3) engineering, construction, and operations; and 4) climate hazard and resiliency.

**Study Findings:**

Historically, studies conducted by the District and other Coastside agencies have focused on the possibilities of non-potable reuse centering around irrigation (and potentially the need to install non-potable distribution infrastructure "purple pipe" in the community.) In assessing the non-potable reuse opportunities on the coast, Waterworks concluded that there are very few customers within the District's service area who might be willing to take recycled water given that the cost would be higher than their current sources of water.

A sizable portion of Waterworks' efforts focused on the feasibility of indirect potable reuse options including groundwater replenishment. As such, Waterworks engaged ROUX to conduct a hydrogeological investigation and groundwater modeling. Given the low porosity of the soils and rock in the Half Moon Bay Terrace Groundwater Basin, the slow "seepage velocity" from percolating or injecting recycled water would result in groundwater "mounding" and a lack of effect on recharging downgradient wells in the 60-day water movement radius. ROUX also considered surface water augmentation. Given that there are over 100 water rights on local creeks, such augmentation is difficult given that recycled water cannot impair the quality of a rightsholder's source of irrigation water.

Waterworks overall assessments of the feasibility of recycled water project alternatives are summarized in the table below:

| Alternative | Feasible | Reasoning |
|---|---|---|
| Fill Station(s) | No | Little demand for recycled water within service area. |
| Landscape and Agricultural Irrigation | No | Little demand for recycled water within service area. |
| Skylawn Memorial Park Irrigation | No | Park not within service area, so would not be able to deliver recycled water. |
| Ocean Colony Golf Course and Landscape Irrigation | No | Ocean Colony has other water supplies that are more cost effective than recycled water and therefore, does not have a demand for recycled water. |
| Pilarcitos Creek Augmentation or Other Creek Augmentation | No | Does not offset groundwater use or provide additional water resources from indirect or direct potable reuse. |
| Wetland Enhancement | No | Does not offset groundwater use or provide additional water resources from indirect or direct potable reuse. |
| Groundwater Replenishment | No | 1. There are private wells in the service area that limits where water may be replenished.<br>2. A limited amount of water that can be replenished at one location due to mounding |
| Reservoir Augmentation | No | There is no known partner who has a reservoir available for augmentation. |
| Direct Potable Reuse at Nunes WTP | Further study needed | Next steps are to find potential funding sources and continue technical studies. |

Waterworks offered the following conclusion regarding the study: Of the recycled water alternatives evaluated, direct potable reuse is the only one that should be pursued as it has the potential to provide diversity to the District's water supply portfolio (although further study is needed to determine if it is economically viable.)

In the table below, Waterworks calculated that a $63 Million investment in capital costs is needed to pursue direct potable reuse, and annual O&M costs of $6.19 Million (in 2023 $). The net present value per Million Gallon (MG) over 20 years is $24,000 per Million Gallons. (The District's current cost of raw water from SFPUC is ap. $7,000/MG.) The maximum "delivered water" for direct potable reuse is estimated at .9 MGD.

**Table 15. Life Cycle Costs**

| Alternative | | Capital Cost (a) | Annual O&M Cost | 20 Year Net Present Worth (b) | Delivered Water in 20 Years (MG) | Net Present Worth/ MG | Rank |
|---|---|---|---|---|---|---|---|
| Non-Potable Reuse | Fill Station(s) | $3.50 M | $0.10 M | $5.07 M | 183 | $28,000 | 4 |
| | Landscape and Agricultural Irrigation | $27.2 M | $1.07 M | $44.0 M | 600 | $73,000 | 6 |
| | Skylawn Memorial Park Irrigation | $29.4 M | $1.16 M | $47.6 M | 1,000 | $48,000 | 5 |
| | Ocean Colony Golf Course and Landscape Irrigation | $22.0 M | $1.20 M | $40.9 M | 1,830 | $22,000 | 1 |
| Indirect Potable Reuse | Groundwater Replenishment | $38.8 M | $3.53 M | $94.2 M | 913 | $103,000 | 7 |
| | Reservoir Augmentation | $65.7 M | $4.85 M | $142 M | 6,570 | $22,000 | 1 |
| Direct Potable Reuse | Direct Potable Reuse at Nunes WTP | $63.0 M | $6.19 M | $160 M | 6,570 | $24,000 | 3 |

(a) Costs are in 2023 dollars. Cost estimates are considered Class 5 by AACE International and have an accuracy of +50 percent and -30 percent.
(b) Assumes Inflation is 3%, nominal discount rate is 5.5%, and real discount rate is 2.4%.

In December 2023, the State Water Resources Control Board approved regulations for direct potable reuse allowing water systems to develop treatment protocols to convert wastewater into high quality drinking water. Although direct potable reuse is still in its pilot stages and is mostly being pursued by a few large California water agencies, the District, in conjunction with Sewer Authority Mid-Coast and other local stakeholders should consider implementation of direct potable reuse in long-term ($10^+$ years) planning of drinking water and wastewater facilities.

Waterworks also noted that "to be feasible, proposed recycled water projects need partners that want to collaborate with the District and a reason to pursue the project such as a policy or economic reason." The District recognizes that to pursue recycled water on the Coastside requires collaboration with local stakeholders (Sewer Authority Mid-Coast, member agencies and other Coastside agencies) and broader stakeholders such as SFPUC, BAWSCA, County of San Mateo, and State and Federal agencies to find funding and support for recycled water projects on the Coastside.

Attachments:

Exhibit A: Recycled Water Feasibility Study – Waterworks Engineers, LLC.

Exhibit B: Roux Report – Executive Summary – Roux, Inc.

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EXHIBIT A



# Coastside County Water District
# Recycled Water Feasibility Study

Date: 3/20/2024
Prepared by: Lanie Carl, E.I.T., Cindy Bertsch, PE

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# 1 Executive Summary

Coastside County Water District (CCWD or District) contracted Water Works Engineers to complete a recycled water feasibility study to look at a range of alternatives to diversify their water supply portfolio. The alternatives evaluated include non-potable reuse, indirect potable reuse (IPR), and direct potable reuse (DPR). As part of the feasibility study, a hydrogeologic report was prepared. The purpose of this feasibility study is to provide an adaptable roadmap for the District to implement recycled water projects. Changing water supply reliability and shifting regulatory frameworks will affect the preferred recycled water projects over time.

## 1.1 Alternatives

The below recycled water alternatives were studied.

- Non-potable reuse alternatives included a fill station, landscape irrigation, agricultural irrigation and irrigation of specific areas including the Skylawn Memorial Park and the Ocean Colony Golf Course.
- Indirect potable reuse alternatives included groundwater replenishment and reservoir augmentation.
- Direct potable reuse included adding advanced treated water to the Nunes Water Treatment Plant.
- Environmental benefit alternatives included including creek augmentation or wetland enhancement.

## 1.2 Wastewater

Sewer Authority Mid-Coastside (SAM) provides wastewater treatment services and contract collection maintenance services. The majority of the SAM sewer pump stations convey wastewater generated within the CCWD jurisdictional area except for the Montara and Vallemar pump stations. The Montara pump station transfers wastewater to the Vallemar pump station, so the amount of SAM wastewater that is attributable to CCWD may be determined by subtracting the Vallemar pump station flow from the total influent flow at the SAM wastewater treatment plant. To not include inflow and infiltration, available flows were evaluated during the dry season months of April to September. The average dry weather flow of wastewater attributable to CCWD from 2018 to 2022 was 1.18 MGD. Wastewater is evenly distributed throughout the service area. Because the wastewater is evenly distributed through a large geographic area the potential to harvest wastewater and treat it at a remote location is not feasible since there is not enough raw wastewater at one location to use. Harvesting wastewater was not assessed further.

## 1.3 Half Moon Bay Hydrogeologic Report Summary

The hydrogeologic report was created to determine if using recycled water for environmental benefit or groundwater replenishment options were feasible as discussed below.

### 1.3.1 Environmental Benefit

There are over 100 water rights filed within the Project Area. If CCWD chooses surface water augmentation, there will need to be consideration as to how it will affect existing surface water rights. For example, along Pilarcitos Creek there are six licensed and/or claimed water rights for domestic purposes. Most of these locations are in the upper reaches of the stream between Pilarcitos Lake and Highway 92. If CCWD were to augment Pilarcitos Creek with recycled water, the quality of the recycled water cannot impair an individual’s source of domestic water.

Additionally, the same can be said about irrigation water. Along Pilarcitos Creek there are seven licensed and/or claimed water rights for irrigation purposes. Most of these rights are along the reach of the creek that runs parallel to Highway 92. The users of these irrigation water rights divert water from Pilarcitos Creek for various agricultural purposes, like crops, flowers, Christmas trees, and some irrigated pasture. Although California allows the use of recycled municipal wastewater for agriculture, if CCWD were to augment Pilarcitos Creek with recycled water, the quality of the recycled water cannot impair an individual's source of irrigation water. For example, if the recycled water has salinity levels above a crop's salinity threshold it could negatively impact the yield of a crop.

### 1.3.2 Groundwater Replenishment

The key issues that would affect the physical feasibility of this option include the presence or absence of groundwater wells within a 60-day water movement radius from the site based on California state requirements, and to consider the scale and extent of groundwater mounding as a result of percolation or injection of the recycled water. Because of the absence of site-specific hydraulic information, the analyses were conceptual and actual parameter values could vary widely. Despite these uncertainties, the conditions that lead to a slow seepage velocity and therefore, lack of effect on downgradient wells in the 60-day period, also lead to excessive mounding. If hydraulic conditions are such that the mounding presented would be less than assumed, those conditions would likely also indicate conditions producing a higher seepage velocity, and the greater likelihood of affecting downgradient wells in the 60-day period.

While an expensive, site-specific geotechnical and hydrologic field investigation and associated modeling would refine these analyses and provide greater confidence in this alternative as a feasible option for recharging groundwater using recycled water, the relationships between seepage velocity and mounding lead to this alternative unlikely to be a feasible option.

### 1.3.3 Hydrogeologic Recommendations

There are several data gaps that were identified during the course of this report. These data gaps include:

- The absence of geotechnical or hydrogeologic data in the groundwater replenishment basin area;
- Limited aquifer test data and absence of raw data for previous aquifer tests;
- Limited information relating to effects of faulting on groundwater movement;
- Limited information for much of the basin outside of the Half Moon Bay Terrace Groundwater Basin watershed; and
- Lack of information relating to the number of identified wells that are no longer in use or have been abandoned and where they are located.

To address these issues, three general recommendations were provided to provide information and/or tools for water resource management.

1. The first recommendation is related to the condition whereby private wells (not belonging to CCWD) are allowed within the CCWD service area. Given instances such as in the groundwater replenishment option where distances to domestic wells is a key parameter, the knowledge of which wells are no longer active or have been abandoned could provide substantially more flexibility for decision-making around topics for which there are concerns about domestic wells. A well-canvassing effort is recommended to be

conducted to identify which of those wells are operational and which can be deemed to be unusable or no longer existing to rule out future decisions that may be based on obsolete consideration.

2. The construction of a numerical groundwater flow model is recommended. That would provide CCWD with a tool that could then be used to quantitatively evaluate effects of various groundwater management scenarios that may arise. Numerical groundwater flow modeling not only provides a tool for evaluating groundwater flow and water budget conditions, but also is the only method to evaluate the internal consistency of the assumptions built into the understanding of the groundwater basin. A model would enhance the confidence in construction of new wells or well-fields designed in a manner that reduces well interference and could be used to optimize groundwater use alternatives.
3. The last recommendation is to conduct site-specific hydraulic testing (aquifer testing). The construction of a numerical model would substantially benefit from additional hydraulic testing under controlled pumping and recovery conditions. Thus, evaluating the hydraulic characteristics of aquifer materials in a more widespread area of the Half Moon Bay Terrace Groundwater Basin Watershed.

## 1.4 Alternative Comparison

Alternatives were compared based on non-cost criteria and cost based on the amount of water produced.

### 1.4.1 Non-Cost Criteria

The non-cost criteria were divided into four categories:

- environmental and social impacts/benefits
- ease of implementation and regulatory compliance
- engineering, construction, and operations
- climate hazard and resiliency

Without considering how much recycled water is used the top alternatives are the non-potable fill station, landscape irrigation and agricultural irrigation. However, a project that uses more recycled water is desirable for the District. Therefore, when ranking alternatives based on non-cost criteria and by how much recycled water would be used, then the most desirable alternatives included direct potable reuse, reservoir augmentation, and irrigation of Ocean Colony Golf Course.

### 1.4.2 Cost

The 20-year life cycle costs were developed as well as the cost per million gallons produced over 20 years. Comparing the net present worth per million gallon, the top three alternatives are reservoir augmentation, irrigation at Ocean Colony Golf Course, and direct potable reuse.

## 1.5 Conclusions

To be feasible, proposed recycled water projects need partners that want to collaborate with CCWD and a reason to pursue the project such as a policy or economic reason. The feasibility of the projects with the current conditions are summarized in Table ES-1.

**Table ES-1. Feasibility of Project by Alternative**

| Alternative | Feasible | Reasoning |
|---|---|---|
| Fill Station(s) | No | Little demand for recycled water within service area. |
| Landscape and Agricultural Irrigation | No | Little demand for recycled water within service area. |
| Skylawn Memorial Park Irrigation | No | Park not within service area, so would not be able to deliver recycled water. |
| Ocean Colony Golf Course and Landscape Irrigation | No | Ocean Colony has other water supplies that are more cost effective than recycled water and therefore, does not have a demand for recycled water. |
| Pilarcitos Creek Augmentation or Other Creek Augmentation | No | Does not offset groundwater use or provide additional water resources from indirect or direct potable reuse. |
| Wetland Enhancement | No | Does not offset groundwater use or provide additional water resources from indirect or direct potable reuse. |
| Groundwater Replenishment | No | 1. There are private wells in the service area that limits where water may be replenished.<br>2. A limited amount of water that can be replenished at one location due to mounding |
| Reservoir Augmentation | No | There is no known partner who has a reservoir available for augmentation. |
| Direct Potable Reuse at Nunes WTP | Further study needed | Next steps are to find potential funding sources and continue technical studies. |

Of the recycled water alternatives evaluated, currently the direct potable reuse alternative is the only alternative that should be pursued because the project has potential to provide diversity to the District's water supply portfolio. However, further study is needed for the direct potable reuse alternative to determine if the project is economically viable.

# 2 Introduction

Coastside County Water District (CCWD or District) contracted Water Works Engineers to complete a recycled water feasibility study to look at a range of alternatives to diversify their water supply portfolio. The alternatives evaluated included non-potable reuse, indirect potable reuse (IPR), and direct potable reuse (DPR). As part of the feasibility study, ROUX (as a subconsultant to Water Works Engineers) prepared a hydrogeologic report that is included in Appendix A. The purpose of this feasibility study is to provide an adaptable roadmap for the District to implement recycled water projects. Changing water supply reliability and shifting regulatory frameworks will affect the preferred recycled water projects over time.

## 2.1 Study Area

Per District direction, this study focuses on recycled water uses within the District boundaries or where the water use may benefit the District.

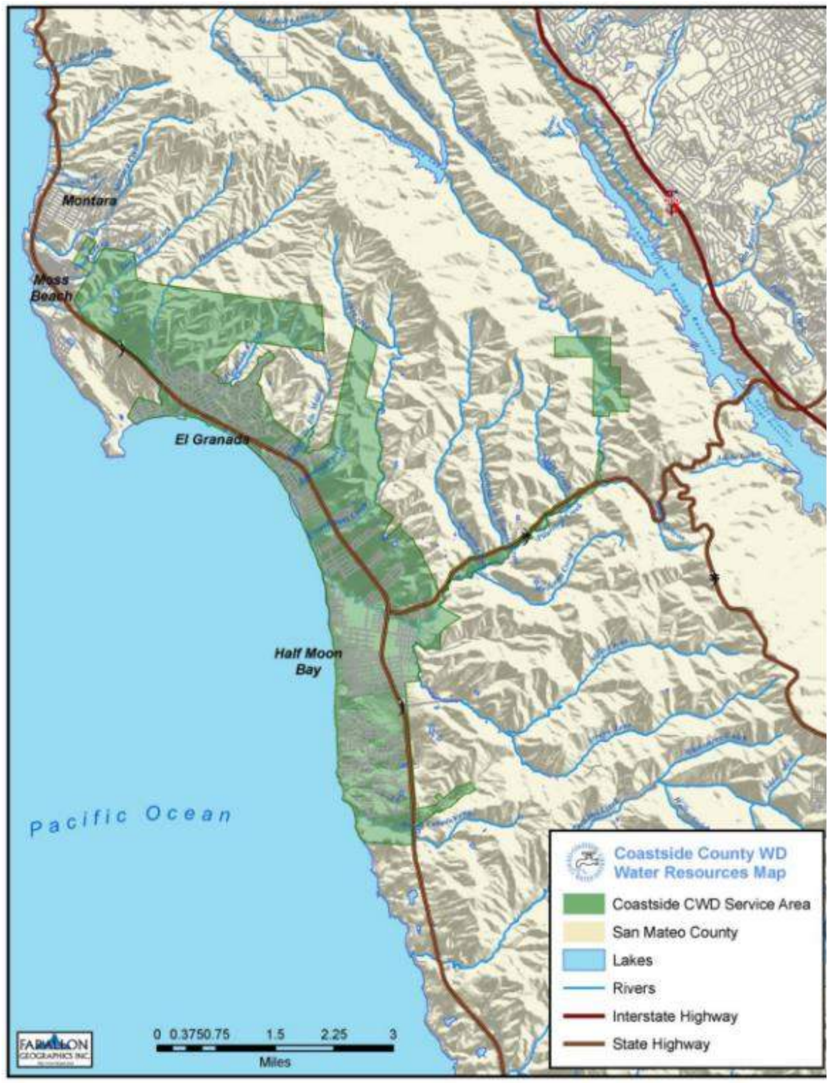



**Figure 1. Coastside County Water District Jurisdictional Area**

## 2.2 District Description

CCWD is an urban water district in San Mateo County. CCWD supplies potable water to the City of Half Moon Bay and the unincorporated communities of El Granada, Miramar, and Princeton by the Sea. The wastewater from these communities is treated by Sewer Authority Mid-Coastside (SAM). SAM is a separate agency from CCWD.

CCWD is located on the coast of the Pacific Ocean, approximately 69 feet above sea level. The areas served by CCWD are about 30 miles south of San Francisco. To the east of the District are the northernmost portion of the Santa Cruz Mountains. The District's boundaries are shown in Figure 1.

## 2.3 Land Use and Land Use Trends

Land use planning within the District is performed by the City of Half Moon Bay and San Mateo County. San Mateo County determines the land use of the unincorporated areas of El Granada, Miramar, and Princeton by the Sea.

Approximately 81% of the land is zoned for residential use. The remainder is about 18% commercial and less than 1% agriculture (floriculture). The commercial zoning is along the highly populated and highly traveled areas near State Route 1 and Highway 92.

Future development within the District has a focus on climate resilient planning and sustainable approaches that support all types of land uses. The City of Half Moon Bay Coastal Land Use Plan prioritizes agricultural and coastal dependent uses over other development types such as visitor-serving commercial recreation facilities.

The District's service area is within the boundaries of the Coastal Zone and the jurisdiction of the California Coastal Commission. Restrictions from Coastal Development Permits issued to the District in 1985 and 2003 prohibit the District from creating more connections or expanding its jurisdictional boundaries until the transportation system on mid-Coastside can meet specific levels of service. As of 2020, the District provided water service to approximately 7,600 interconnections.

Within the City of Half Moon Bay, residential growth is capped at 1.5% per year in downtown units and 1% for the rest of the residential areas in the City. Accessory dwelling units have become common in the City and fall under the City's jurisdiction to approve.

Growth within the unincorporated areas is managed by San Mateo County's Local Coastal Program[1]. For all unincorporated areas of San Mateo County, growth is limited to 125 units/year with only a portion of the unincorporated areas being within the District's jurisdiction. The San Mateo County Local Coastal Program also states that development will not happen without the approval of the District first.

## 2.4 Population Trends

From the District's 2020 Urban Water Management Plan (UWMP)[2], it was estimated that in 2020 the District's service area population was 18,738. The Association of Bay Area Governments (ABAG) 2040 population projection data was used to forecast the population growth that the District will experience. The current and projected populations served by the District are listed in Table 2.

**Table 2. Current and Projected Population**

| Population Served (a) | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|
| | 18,738 | 18,991 | 19,238 | 19,371 | 19,472 |

(a) From 2020 UWMP

## 2.5 Tsunami Zone

A portion of the District and the SAM wastewater treatment plant is within a tsunami zone as shown in Figure 2. The tsunami zone designation may limit future construction and development options. For example, in 2013, the Coastal Commission denied the City of Morro Bay's proposal for redevelopment of their wastewater treatment

[1] Accessed October 9 https://www.smcgov.org/planning/local-coastal-program
[2] Accessed October 9 https://www.coastsidewater.org/reports_and_studies/2020-Urban-Water-Management-Plan.pdf

plant in-place based on inconsistencies regarding avoiding coastal hazards, land use priorities, recycled water provisions, and public view protections[3]. The Commission required that Morro Bay relocate their wastewater treatment plant outside of the tsunami zone instead of retrofitting their existing plant. Because of the requirements Morro Bay faced and the precedence of limiting new construction in a tsunami zone, when possible, alternatives were placed outside of the tsunami zone.

**Figure 2. Tsunami Zone**

## 2.6 Stakeholders

Collaborating with stakeholders is critical to determine the most beneficial use for the water in the region. There are many potential stakeholders for potential recycled water projects as listed below.

- San Mateo County
  - permitting agency including the Local Coastal Program
- SAM and member agencies
  - provides wastewater collection and treatment
- City of Half Moon Bay
  - permitting agency for projects within city limits
- San Mateo County Resource Conservation District
- Regulators
- Elected officials
- Public and Special Interest Groups
- Recycled water users for non-potable water reuse alternatives
  - landscape irrigation
  - agriculture
- San Mateo County Farm Bureau
- San Francisco Public Utilities Commission (SFPUC)
- Individual residential and nonresidential well owners within the CCWD service area
- Bay Area Water Supply and Conservation Agency (BAWSCA)

[3]Accessed October 9 https://morrobaywrf.com/wp-content/uploads/RevisedFinalPlan.pdf

# 3 Water and Wastewater Facilities

## 3.1 Water

CCWD has four water supply sources: Pilarcitos Reservoir, Upper Crystal Springs Reservoir, Pilarcitos Well Field, Denniston Well Field, and Denniston Creek. Approximately 72% of the District's water supply is purchased from SFPUC and comes from Pilarcitos Reservoir and Upper Crystal Springs Reservoir. The remaining 28% is supplied from Pilarcitos Creek Infiltration Well Field and the Denniston supplies, which are owned by CCWD.

### 3.1.1 Treatment and Distribution Facilities

CCWD operates two water treatment plants (WTPs) to provide drinking water to the District.

#### *3.1.1.1 Nunes WTP*

Nunes WTP treats water from Pilarcitos Reservoir, Upper Crystal Springs Reservoir, and Pilarcitos Well Field. Nunes WTP began operating in 1982 with an initial treatment capacity of 2.5 milling gallons per day (MGD). Nunes WTP has since been upgraded and now has a capacity of 4.5 MGD.

#### *3.1.1.2 Denniston WTP*

Denniston WTP treats water supplied by the Denniston Reservoir and Denniston Well Field.

#### *3.1.1.3 Distribution System*

CCWD is responsible for 100 miles of transmission and distribution pipelines. The distribution system has seven pump stations, 660 hydrants, and 79 miles of water mains. CCWD has a program for ongoing replacement of pipelines depending on age and condition. CCWD also owns 9 treated water storage tanks with a combined capacity of 7.8 million gallons. The water facilities are shown in Figure 3.

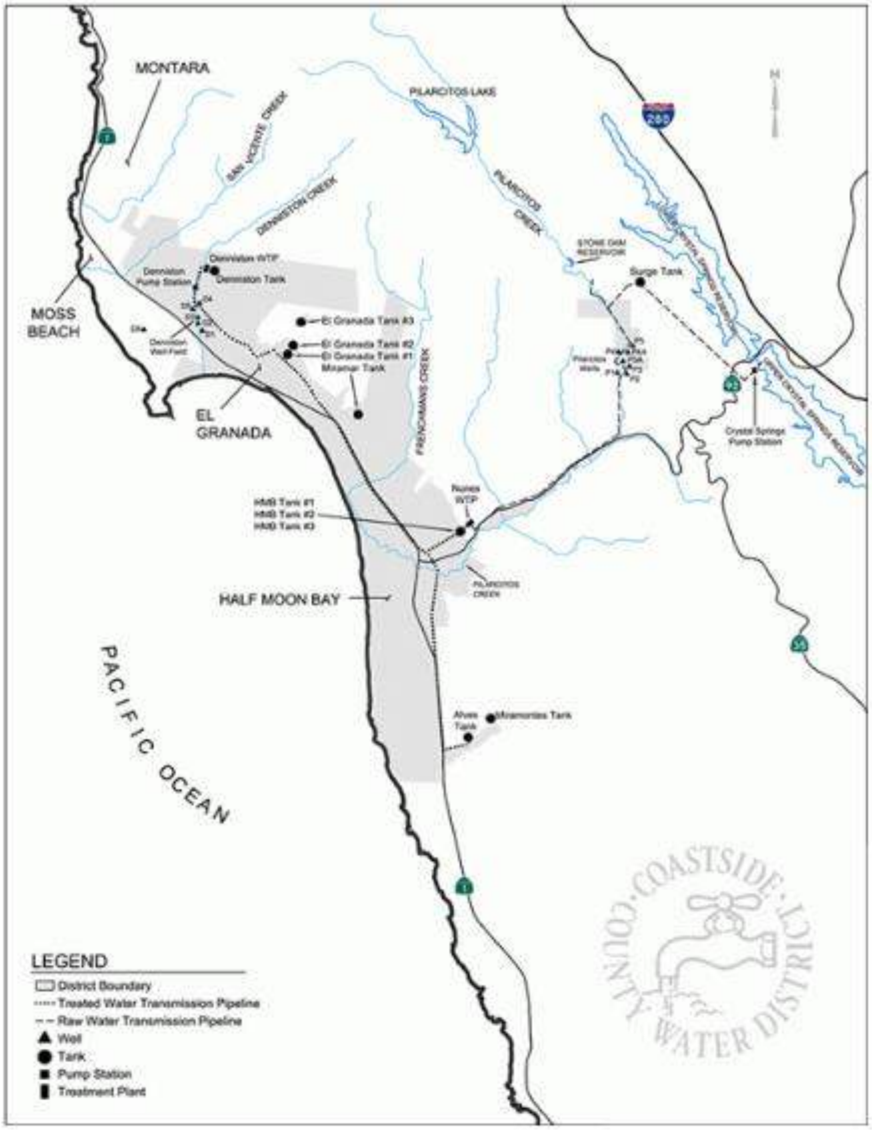



**Figure 3. Map Of CCWD's Major Water Facilities**

## 3.2 Wastewater

SAM provides wastewater treatment services and contract collection maintenance services for a population of approximately 27,000 in the following areas:

- City of Half Moon Bay
- El Granada
- Miramar
- Montara
- Moss Beach
- Princeton Harbor

SAM is a California joint powers authority (JPA) with Montara Water and Sanitary District (MWSD), Granada Community Services District (GCSD), and the City of Half Moon Bay. The SAM wastewater treatment plant produces secondary effluent that is discharged through an ocean outfall. The plant is permitted to treat 4.0 MGD average dry weather flow per NPDES Permit CA0038598[4].

The layout of SAM's intertie pipeline system and pump stations is shown in Figure 4, which is taken from the 2009 *Intertie Pipeline System Review And Evaluation Report*[5]. SAM has flow meter data at the pump stations. Most of the SAM sewer pump stations convey wastewater generated within the CCWD jurisdictional area (Figure 1), except for Montara and Vallemar pump stations. The Montara pump station transfers wastewater to the Vallemar pump station, so the amount of SAM wastewater that is attributable to CCWD may be determined by subtracting the Vallemar pump station flow from the total influent flow at the SAM wastewater treatment plant. To not include inflow and infiltration, available flows were evaluated during the dry season months of April to September. The average dry weather flow of CCWD water is shown in Table 3.

**Table 3. Average Dry Weather Flow of Wastewater Attributable to CCWD**

| Time Period | Average Dry Weather Flow of CCWD Attributable Water (MGD) (a) |
|---|---|
| Apr-Sept 2018 | 1.23 |
| Apr-Sept 2019 | 1.29 |
| Apr-Sept 2020 | 1.15 |
| Apr-Sept 2021 | 1.11 |
| Apr-Sept 2022 | 1.12 |
| **Average** | 1.18 |

(1) Data emailed from SAM on August 11, 2023.

The average dry weather flow of wastewater attributable to CCWD from 2018 to 2022 was 1.18 MGD. Wastewater is evenly distributed throughout the service area. Because the wastewater is evenly distributed through a large geographic area the potential to harvest wastewater and treat it at a remote location is not feasible since there is not enough raw wastewater at one location to use. Harvesting wastewater was not assessed further.

[4] Accessed October 31 https://www.waterboards.ca.gov/sanfranciscobay/board_decisions/adopted_orders/2023/R2-2023-0002.pdf
[5] Accessed October 19 https://samcleanswater.org/vertical/sites/%7B1307B359-C05A-436D-AC1C-9EB8D6FFB4A3%7D/uploads/SAM_Intertie_Pipeline_System_Review_and_Evaluation_SRT_2009.pdf

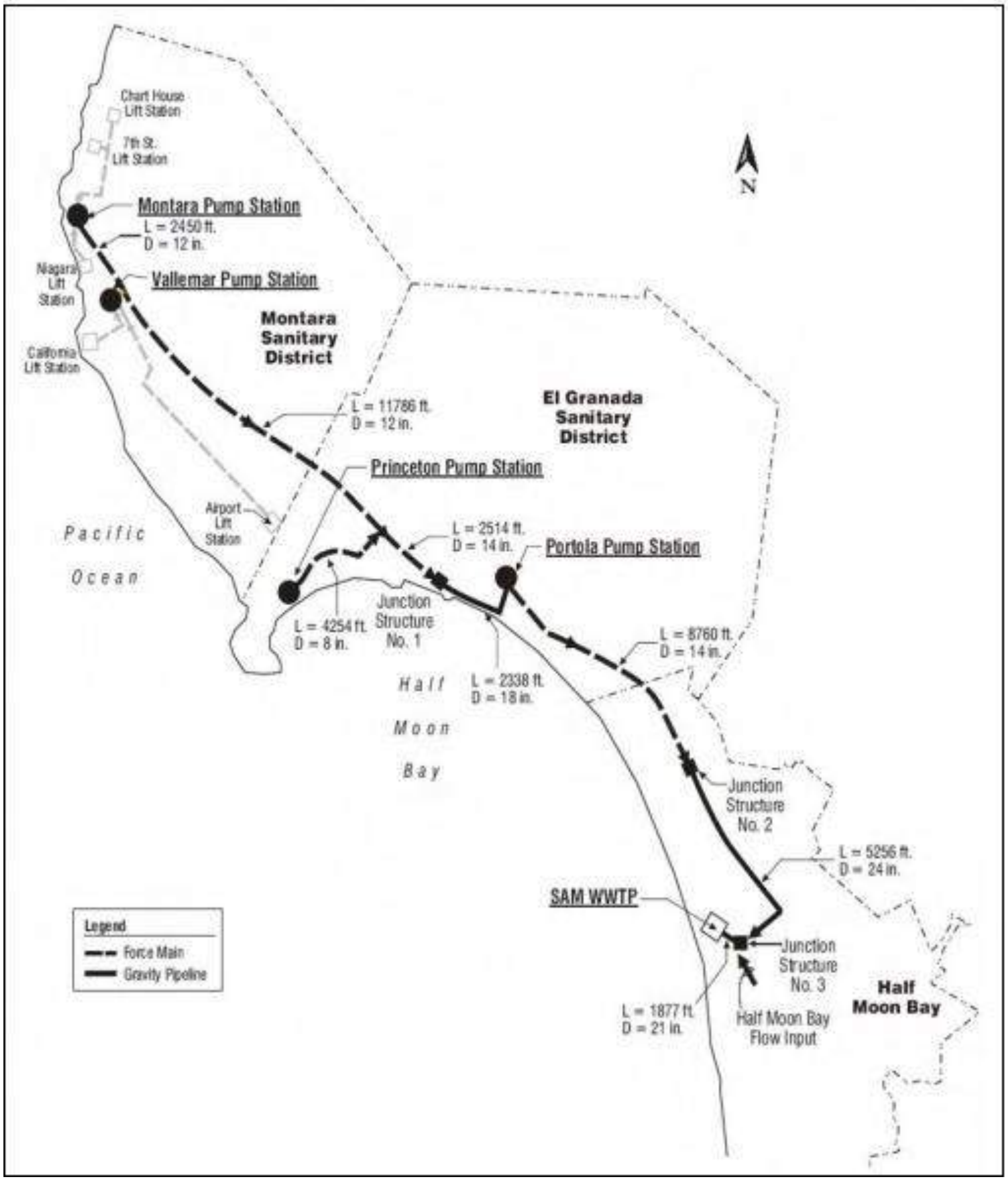



**Figure 4. SAM Collection System Infrastructure**

## 4.1 Half Moon Bay Hydrogeologic Summary

The surface water and groundwater within the study area are discussed in detail in the Hydrogeologic Report in Appendix A. The study area is within the Half Moon Bay Terrace Groundwater Basin and the Pilarcitos Creek Watershed.

The Half Moon Bay Terrace Groundwater Basin watershed drains westward toward Half Moon Bay and the Pacific Ocean. Elevations range from approximately 2,000 feet above mean sea level for Montara Mountain and Kings Mountain to sea level. Vegetation in the Project Area is primarily grassland and herbaceous forest. Most of the land in the Project Area is classified as undeveloped by the CDFW and is privately owned. However, of the land that is developed, most of it is along the stream valleys or the coast.

The hydrogeologic report was created to determine if using recycled water for environmental benefit or groundwater replenishment options were feasible as discussed below.

### 4.1.1 Environmental Benefit

There are over 100 water rights filed within the Project Area. If CCWD chooses surface water augmentation, there will need to be consideration as to how it will affect existing surface water rights. For example, along Pilarcitos Creek there are six licensed and/or claimed water rights for domestic purposes. Most of these locations are in the upper reaches of the stream between Pilarcitos Lake and Highway 92. If CCWD were to augment Pilarcitos Creek with recycled water, the quality of the recycled water cannot impair an individual's source of domestic water.

Additionally, the same can be said about irrigation water. Along Pilarcitos Creek there are seven licensed and/or claimed water rights for irrigation purposes. Most of these rights are along the reach of the creek that runs parallel to Highway 92. The users of these irrigation water rights divert water from Pilarcitos Creek for various agricultural purposes, like crops, flowers, Christmas trees, and some irrigated pasture. Although California allows the use of recycled municipal wastewater for agriculture, if CCWD were to augment Pilarcitos Creek with recycled water, the quality of the recycled water cannot impair an individual's source of irrigation water. For example, if the recycled water has salinity levels above a crop's salinity threshold it could negatively impact the yield of a crop.

### 4.1.2 Groundwater Replenishment

The key issues that would affect the physical feasibility of this option include the presence or absence of groundwater wells within a 60-day water movement radius from the site based on California state requirements, and to consider the scale and extent of groundwater mounding as a result of percolation or injection of the recycled water. Because of the absence of site-specific hydraulic information, the analyses were conceptual and actual parameter values could vary widely. Despite these uncertainties, the conditions that lead to a slow seepage velocity and therefore, lack of effect on downgradient wells in the 60-day period, also lead to excessive mounding. If hydraulic conditions are such that the mounding presented would be less than assumed, those conditions would likely also indicate conditions producing a higher seepage velocity, and the greater likelihood of affecting downgradient wells in the 60-day period.

While an expensive, site-specific geotechnical and hydrologic field investigation and associated modeling would refine these analyses and provide greater confidence in this alternative as a feasible option for recharging groundwater using recycled water, the relationships between seepage velocity and mounding lead to this alternative unlikely to be a feasible option.

### 4.1.3 Hydrogeologic Recommendations

There are several data gaps that were identified during the course of this report. These data gaps include:

- The absence of geotechnical or hydrogeologic data in the groundwater replenishment basin area;
- Limited aquifer test data and absence of raw data for previous aquifer tests;
- Limited information relating to effects of faulting on groundwater movement;
- Limited information for much of the basin outside of the Half Moon Bay Terrace Groundwater Basin watershed; and
- Lack of information relating to the number of identified wells that are no longer in use or have been abandoned and where they are located.

To address these issues, three general recommendations were provided to provide information and/or tools for water resource management.

1. The first recommendation is related to the condition whereby private wells (not belonging to CCWD) are allowed within the CCWD service area. Given instances such as in the groundwater replenishment option where distances to domestic wells is a key parameter, the knowledge of which wells are no longer active or have been abandoned could provide substantially more flexibility for decision-making around topics for which there are concerns about domestic wells. A well-canvassing effort is recommended to be conducted to identify which of those wells are operational and which can be deemed to be unusable or no longer existing to rule out future decisions that may be based on obsolete consideration.
2. The construction of a numerical groundwater flow model is recommended. That would provide CCWD with a tool that could then be used to quantitatively evaluate effects of various groundwater management scenarios that may arise. Numerical groundwater flow modeling not only provides a tool for evaluating groundwater flow and water budget conditions, but also is the only method to evaluate the internal consistency of the assumptions built into the understanding of the groundwater basin. A model would enhance the confidence in construction of new wells or well-fields designed in a manner that reduces well interference and could be used to optimize groundwater use alternatives.
3. The last recommendation is to conduct site-specific hydraulic testing (aquifer testing). The construction of a numerical model would substantially benefit from additional hydraulic testing under controlled pumping and recovery conditions. Thus, evaluating the hydraulic characteristics of aquifer materials in a more widespread area of the Half Moon Bay Terrace Groundwater Basin Watershed.

# 5 Project Alternatives

Recycled water alternatives studied included non-potable reuse, indirect potable reuse, and direct potable reuse as discussed in this section.

## 5.1 Non-Potable Reuse Alternatives

The non-potable reuse alternatives analyzed in this study were fill stations, agricultural irrigation, landscape irrigation, and golf course irrigation. To produce non-potable water for reuse, tertiary treatment would be needed including disc filtration and ultraviolet (UV) disinfection would have to be added, as shown in Figure 5. Disinfected tertiary water would be pumped from the WWTP to the use areas. The non-potable reuse alternatives may be combined when the level of necessary treatment is similar.

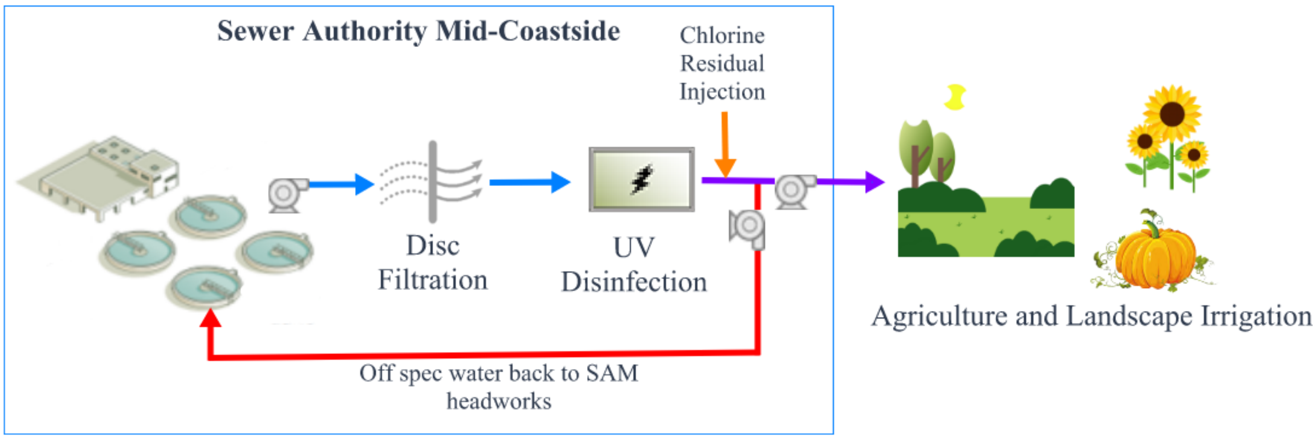



**Figure 5. Non-Potable Reuse Process Flow Diagram**

### 5.1.1 Permitting

Permitting for non-potable reuse is through the San Francisco Regional Water Quality Control Board (RWQCB). To produce non-potable water for reuse, a permit is required from the RWQCB that regulates the treatment process for production of the recycled water.

Non-potable reuse also requires a Water Reclamation Requirements for Recycled Water Use (Order WQ 2016-0068-DDW)[6] permit. This permit regulates the use of the recycled water. For the alternatives that include more than one recycled water user (i.e., fill station and agriculture irrigation), this permit should be obtained by an agency who will function as the permit administrator. The permit administrator should be the agency that is legally responsible for the distribution of the recycled water. This agency would likely be CCWD. For the alternatives that have one main recycled water user, that user may obtain the use permit.

[6] Accessed on Oct 19 wqo2016_0068_ddw (ca.gov)

### 5.1.2 Non-Potable Reuse Projects

#### *5.1.2.1 Fill Station*

One or more fill stations could be located throughout the District area. The fill station(s) would provide disinfected tertiary recycled water for unrestricted use on residential landscaping or construction water. The District could require the use of recycled water for construction water if the project were within a certain distance of the fill station. For example, the city of San Jose requires recycled water to be used for construction water if the project is within five miles of a fill station.

##### 5.1.2.1.1 Advantages and Disadvantages

The advantages and disadvantages for this alternative are shown below.

**Table 4. Fill Station Advantages and Disadvantages**

| Advantages for CCWD | Disadvantages for CCWD |
|---|---|
| • Simple<br>• Combinable with other alternatives<br>• Provides public education<br>• May be used as first step | • Does not offset much potable water use |

##### 5.1.2.1.2 Next Steps

The following steps have been identified to implement this project. Implementation of the project is expected to take up to five years from initial design through final design and not including financing.

1. Identify location for fill station(s) and acquire access to the location through easement or purchasing.
2. Coordinate with SAM.
3. Design and implement treatment processes and distribution system.
4. Permit the treatment, distribution, and use of recycled water.
5. Consider enacting an ordinance require using recycled water for construction water within a certain distance from the fill station(s).
6. Determine a recycled water rate schedule.

#### *5.1.2.2 Agricultural and Landscape Irrigation*

Disinfected tertiary recycled water may be used for row crops such as brussels sprouts and artichokes. In this study, the District wanted to restrict agricultural irrigation to be within District boundaries. There is not much existing agriculture within District boundaries since the District is an urban water supplier. Furthermore, a portion of the existing agriculture within the District boundary is floriculture which may require a higher level of water treatment then disinfected tertiary recycled water. Areas that could potentially support future agriculture are highlighted on the Figure 6 including the Urban Reserve, Open Space Reserve, and Extensive Floriculture zones from the city of Half Moon Bay zoning map. The advantages and disadvantages for this alternative are shown below.

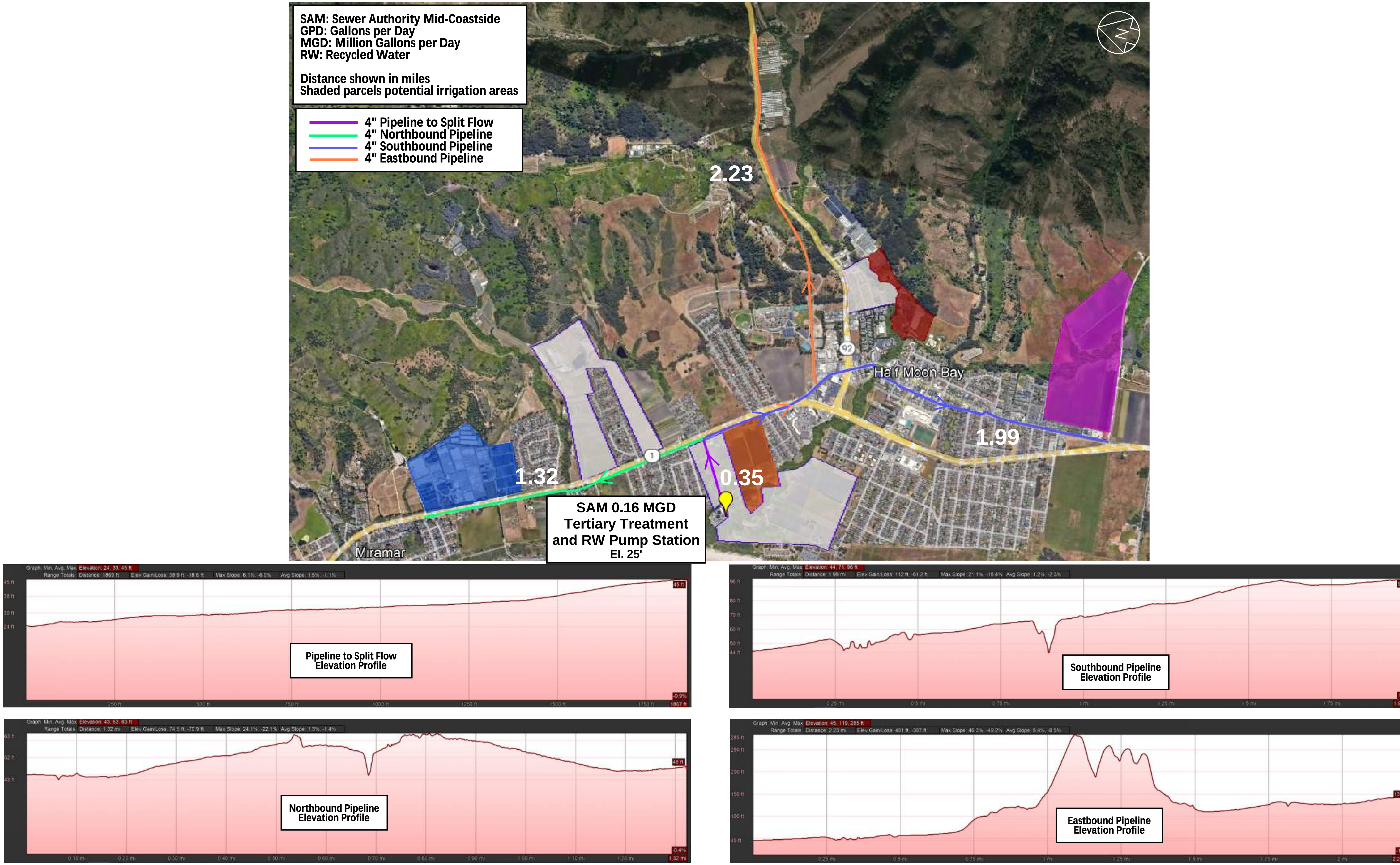
**Table 5. Agricultural and Landscape Irrigation Advantages and Disadvantages**

| Advantages for CCWD | Disadvantages for CCWD |
|---|---|
| • Supports sustainability | • Recycled water only used during dry season<br>• Water could not be used for other purposes in the future<br>• Limited landscaping and agricultural land within District boundaries<br>• Does not offset much potable water use<br>• Within District there is limited irrigation opportunities near a sewer with enough flow to harvest wastewater at a satellite treatment plant<br>• Existing use sites would require retrofitting to meet recycled water standards |

##### 5.1.2.2.1 Next Steps

The following steps have been identified to implement this project. Implementation of the project is expected to take up to 10 years from initial design through final design and not including financing.

1. Identify recycled water users that are interested in recycled water. Confirm if need to stay within District boundary for recycled water deliveries.
2. Coordinate with SAM
3. Design and implement treatment processes and distribution system.
4. Permit the treatment, distribution, and use of recycled water.
5. Determine a recycled water rate schedule.




| CCWD Recycled Water Feasibility Study | Non-Potable Reuse: Landscape and Agriculture Irrigation Proposed Distribution System | WATERWORKS ENGINEERS | FIGURE 6 |
|---|---|---|---|

#### *5.1.2.3 Skylawn Memorial Park Irrigation*

Skylawn Memorial Park (Park) which is outside of CCWD boundaries has large landscape irrigation needs that disinfected tertiary recycled water could be used for. The layout of the recycled water facilities is shown on Figure 7. The Park currently irrigates with the District's surplus raw water. The Park is approximately 5 miles east and 1,100 feet in elevation above the SAM WWTP. The pipeline route would follow existing District pipeline alignments.

##### 5.1.2.3.1 Advantages and Disadvantages

The advantages and disadvantages for this alternative are shown below.

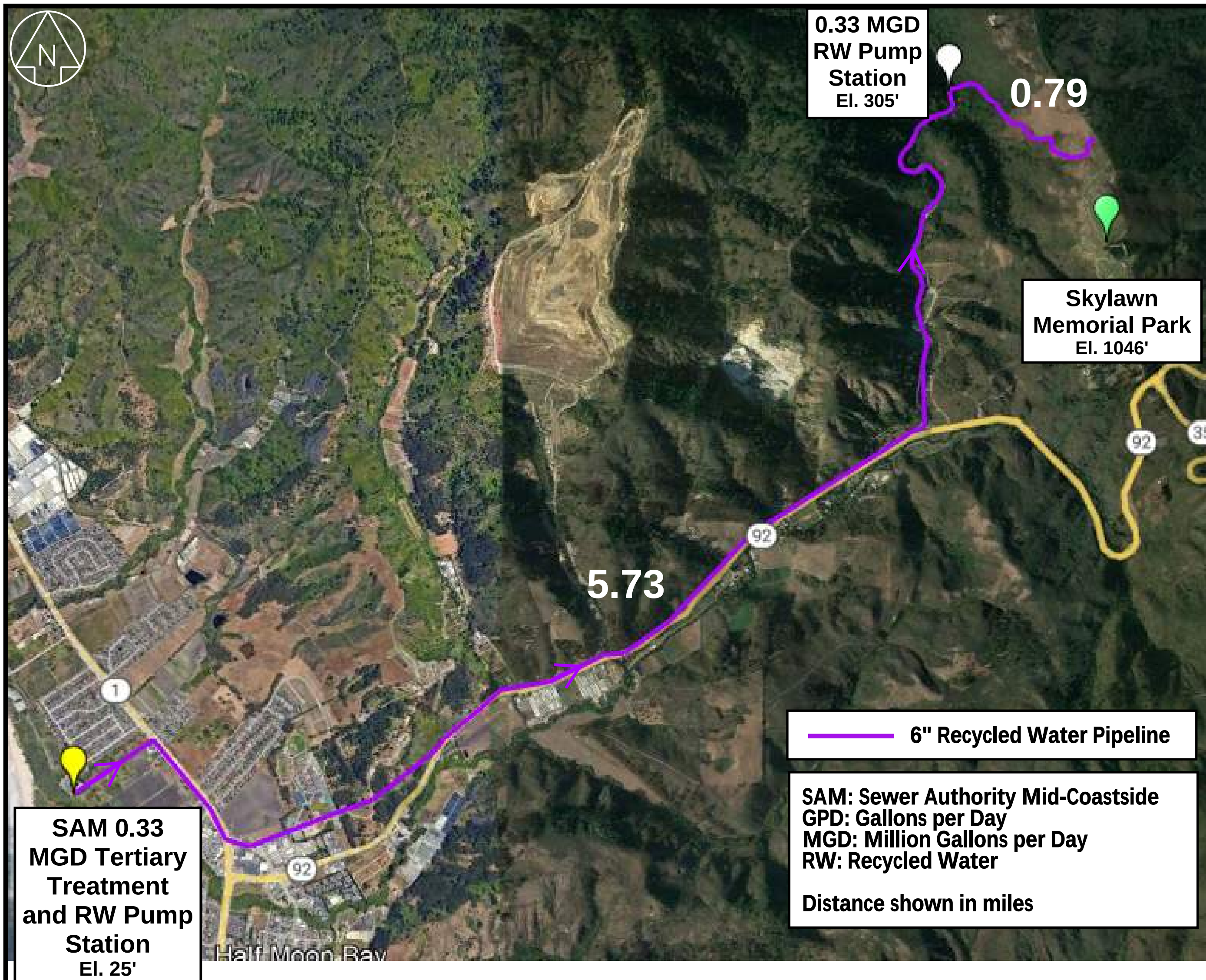
**Table 6. Skylawn Memorial Park Irrigation Advantages and Disadvantages**

| Advantages for CCWD | Disadvantages for CCWD |
|---|---|
| • May generate a source of income | • Long pipeline route<br>• Water only used during dry season<br>• Water could not be used for other purposes in the future<br>• Existing use sites would require retrofitting to meet recycled water standards<br>• Using recycled water would replace the Park's raw water purchases<br>• Harvesting wastewater at a satellite treatment plant is not feasible for this option |

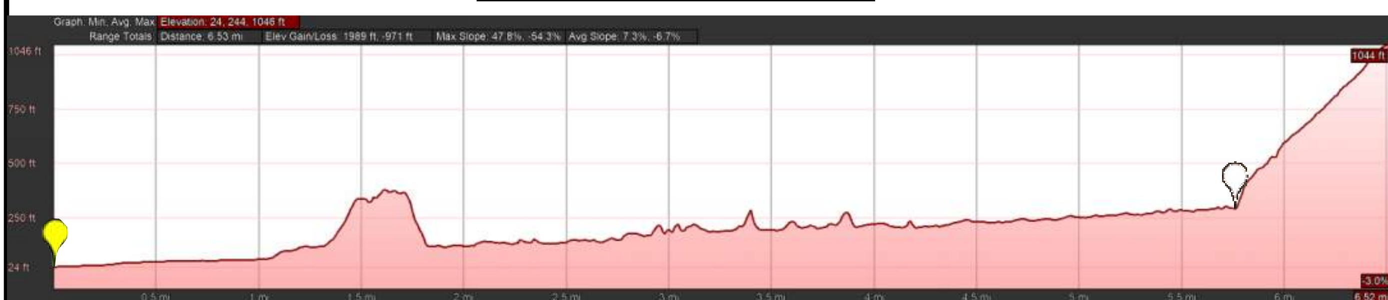
##### 5.1.2.3.2 Next Steps

The following steps have been identified two implement this project. Implementation of the project is expected to take up to 10 years from initial design through final design and not including financing.

1. Coordinate with Skylawn Memorial Park to determine if recycled water makes financial sense for the District and the Park and the quality of water needed for irrigation.
2. Confirm recycled water could be delivered outside of District.
3. Coordinate with SAM.
4. Design and implement treatment processes and distribution system.
5. Permit the treatment, distribution, and use of recycled water.
6. Determine a recycled water rate schedule.




**Pipeline Elevation Profile**




| | | | |
|---|---|---|---|
| CCWD Recycled Water Feasibility Study | Non-Potable Reuse: Skylawn Memorial Park Irrigation Proposed Distribution System | WATERWORKS ENGINEERS | FIGURE 7 |

### *5.1.2.4 Golf Course and Landscape Irrigation*

The landscaping within Ocean Colony neighborhood and the Half Moon Bay Golf Links may be irrigated with disinfected tertiary recycled water. This feasibility study assumes that the total dissolved solids (TDS) levels are not acceptable, and a portion of the effluent flow would need to be treated using reverse osmosis, as shown in Figure 8. The layout of the recycled water facilities is shown in Figure 9. The grasses at golf courses are sensitive to salt, so the TDS in SAM's effluent must be studied prior to final treatment process design, including seasonal TDS fluctuations. There is minimal existing effluent TDS available now.

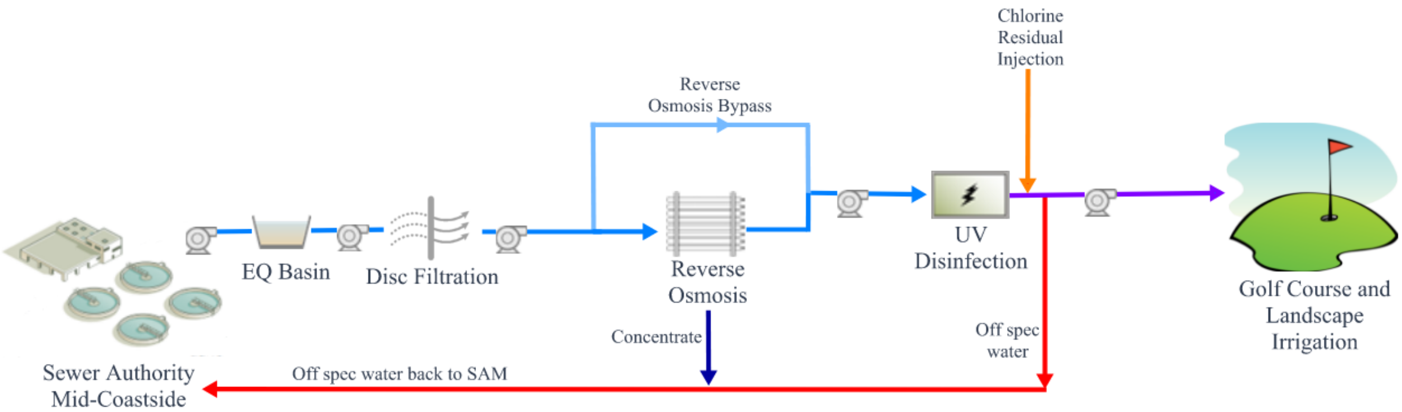



**Figure 8. Non-Potable Reuse Golf Course Irrigation Process Flow Diagram**

#### 5.1.2.4.1 Advantages and Disadvantages

The advantages and disadvantages for this alternative are shown below.

**Table 7. Golf Course and Landscape Irrigation Advantages and Disadvantages**

| Advantages for CCWD | Disadvantages for CCWD |
|---|---|
| • May reduce the amount of groundwater pumping. Note that Ocean Colony has stated that they will retain their wells even if using recycled water. | • Additional wastewater sampling needed to determine level of treatment required for irrigation at course<br>• Water only used during growing season<br>• Water could not be used for other purposes in the future<br>• Limited offset of potable water use. Additional groundwater extraction infrastructure would be needed to take advantage of additional available groundwater<br>• There is not sufficient sewage nearby to harvest locally at a satellite treatment facility<br>• Existing use sites would require retrofitting to meet recycled water standards |

#### 5.1.2.4.2 Next Steps

The following steps have been identified two implement this project. Implementation of the project is expected to take up to 12 years from initial design through final design and not including financing.

1. Coordinate with Ocean Colony on operational concerns to determine if recycled water makes sense

2. Collect wastewater treatment plant total dissolved solids (TDS) samples for a year to determine if there are seasonal TDS differences.
3. Coordinate with SAM.
4. Design and implement treatment processes and distribution system
5. Permit the treatment, distribution, and use of recycled water.
6. Determine a recycled water rate schedule.



| CCWD Recycled Water Feasibility Study | Non-Potable Reuse: Golf Course Irrigation Proposed Distribution System | WATERWORKS ENGINEERS | FIGURE 9 |
|---|---|---|---|

### 5.1.3 Environmental Benefit Projects

#### *5.1.3.1 Pilarcitos Creek Augmentation or Other Creek Augmentation*

Per California Water Code, if recycled water is added to Pilarcitos Creek it may not be used as potable water supply downstream. Therefore, if recycled water is added to Pilarcitos Creek, the recycled water would add environmental benefits such as habitat restoration, but the alternative would not create additional potable water supply.

##### 5.1.3.1.1 Advantages and Disadvantages

The advantages and disadvantages for this alternative are shown below.

**Table 8. Pilarcitos Creek Augmentation or Other Creek Augmentation Advantages and Disadvantages**

| Advantages for CCWD | Disadvantages for CCWD |
|---|---|
| • Supports regional desire for more water in the creek | • Pilarcitos Creek has six licensed water rights claims for domestic purposes and seven licensed water rights for irrigation. The quality of recycled water cannot impact an individual's source of water<br>• Cannot be used as indirect potable reuse as the creek is not considered an environmental buffer like a reservoir or the groundwater aquifer<br>• Environmental studies required<br>• Additional wastewater treatment infrastructure required<br>• Need partner for funding treatment system upgrades<br>• Need funding for annual O&M costs |

##### 5.1.3.1.2 Next Steps

The following steps have been identified two implement this project. Implementation of the project is expected to take up to 25 years from initial design through final design and not including financing.

1. Determine partners who will fund planning, design, and construction.
2. Work with stakeholders to define the project.
3. Determine wastewater treatment location.
4. Work with RWQCB to obtain new NPDES permit.

#### *5.1.3.2 Wetlands Enhancement*

Another alternative that would provide environmental benefit, is to create wetlands. For example, the city of Pacifica added a polishing wetland for the treatment of their tertiary effluent in Calera Creek. The wetland restoration improves the referring waters and wetland ecosystem functions including hydrology, water quality, plant community maintenance and habitat support. The San Mateo County Resource Conservation District has studied the improvement of Pilarcitos Creek as described in the 2008 *Pilarcitos Integrated Watershed Management Plan*.

#### 5.1.3.2.1 Advantages and Disadvantages

The advantages and disadvantages for this alternative are shown below.

**Table 9. Wetlands Enhancement Advantages and Disadvantages**

| Advantages for CCWD | Disadvantages for CCWD |
|---|---|
| • Supports regional desire for more water in the creek | • Environmental studies required<br>• Additional wastewater treatment infrastructure required<br>• Need partner for funding treatment system upgrades<br>• Need funding for annual O&M costs |

#### 5.1.3.2.2 Next Steps

The following steps have been identified two implement this project. Implementation of the project is expected to take up to 25 years from initial design through final design and not including financing.

1. Determine partners who will fund planning, design, and construction.
2. Work with stakeholders to define the project.
3. Determine wastewater treatment location.
4. Work with RWQCB to obtain new NPDES permit.

## 5.2 Indirect Potable Reuse Alternatives

The indirect potable reuse alternatives analyzed in this study were groundwater replenishment and reservoir augmentation. The treatment process flow diagram for indirect potable reuse is shown in Figure 10. Indirect potable reuse would require a new Advanced Purified Water Facility (APWF) consisting of tertiary treatment by disc filters, reverse osmosis (RO), and UV disinfection. It is assumed that this facility would have to be built outside of the tsunami zone based on precedent set by the Coastal Commission with Morro Bay. For the purposes of this feasibility study, an area near the high school was chosen for the APWF because it is outside of this tsunami zone and near the Nunes WTP. Additional studies would be needed to determine the optimal location for the facility.

Secondary effluent pumped from SAM would be treated at the APWF. Approximately 75 percent of the APWF water would be available for use after membrane treatment and 25 percent would be concentrate needing disposal. Concentrate from the membrane filtration would be returned to the SAM treatment plant. There would be no additional TDS load to the ocean outfall compared to if the secondary effluent had been discharged. Any out of specification water from the APWF would also be discharged to the start of the plant.

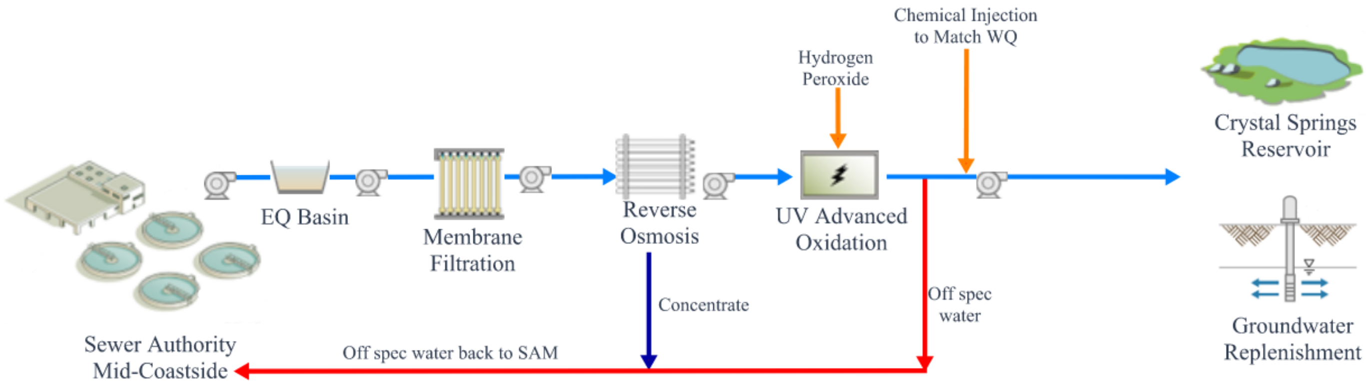



**Figure 10. Indirect Potable Reuse Process Flow Diagram**

### 5.2.1 Groundwater Replenishment

Advanced treated water would be used to replenish groundwater by either injection or infiltration/spreading basins. The key issues that would affect the physical feasibility of this option include (1) the presence or absence of groundwater wells within a 60-day water movement radius from the replenishment site based on California state requirements, and (2) to consider the scale and extent of groundwater mounding as a result of percolation or injection of the recycled water. Because of the absence of site-specific hydraulic information, the analyses were conceptual in nature, and actual parameter values could vary widely. However, despite these uncertainties, the conditions that lead to a slow seepage velocity and therefore, lack of effect on downgradient wells in the 60-day period, also lead to excessive mounding. If hydraulic conditions are such that the mounding presented would be less than assumed, those conditions would likely also indicate conditions producing a higher seepage velocity, and the greater likelihood of affecting downgradient wells in the 60-day period.

While an expensive, site-specific geotechnical and hydrologic field investigation and associated modeling would refine these analyses and provide greater confidence in this alternative as a feasible option for recharging groundwater using recycled water, the relationships between seepage velocity and mounding lead to this alternative unlikely to be a feasible option.

For the purposes of this feasibility study, it was assumed that the groundwater replenishment facility would be located at the APWF. Per the Hydrogeologic Report in Appendix A, only about 125,000 gpd could be replenished without significant mounding. The replenished water would need to be stored in the aquifer for the 60 days before reaching any extraction well, including private domestic wells[7]. Tracer tests and additional studies would be required to ensure the 60-day detention time is met. The layout of the recycled water facilities is shown on Figure 11.

### 5.2.2 Permitting

Indirect potable reuse via groundwater replenishment is regulated by General Waste Discharge Requirements for Aquifer Storage and Recovery Projects that Inject Drinking Water Into Groundwater (Order WQ 2012-0010)[8]. This

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[7] Accessed on Oct 19 View Document - California Code of Regulations (westlaw.com)

[8] Accessed on Oct 19 State Water Resources Control Board Water Quality Order 2012-0010 General Waste Discharge Requirements for Aquifer Storage and Recovery Projects That Inject Drinking Water Into Groundwater (ca.gov)

permit should be obtained by the entity that oversees the advanced treatment and injection of the recycled water which likely would be CCWD.

### 5.2.3 Advantages and Disadvantages

The advantages and disadvantages for this alternative are shown below.

**Table 10. Groundwater Replenishment Advantages and Disadvantages**

| Advantages for CCWD | Disadvantages for CCWD |
| --- | --- |
| • Adds to groundwater supply (although minimal volume and very localized location) | • Extensive studies required<br>• Minimal volume of water can be replenished due to mounding and the water not traveling in the aquifer<br>• Limited locations to replenish water because of the numerous domestic wells throughout the service area. Current regulations would allow new homeowner wells to be built. The water cannot be extracted for at least 60 days by any well<br>• Water may need treatment when pumped out of the aquifer<br>• Infrastructure required to pump the water back out of the ground<br>• Extensive infrastructure and management for indirect potable reuse<br>• Needs extensive public outreach |

### 5.2.4 Next Steps

The following steps have been identified to implement this project. Implementation of the project is expected to take up to 25 years from initial design through final design and not including financing.

1. Complete an existing well survey.
2. Prepare a groundwater aquifer model.
3. Perform aquifer testing.
4. Reassess if groundwater replenishment makes sense.


4" Recycled Water Pipeline

SAM: Sewer Authority Mid-Coastside
MGD: Million Gallons per Day
RW: Recycled Water

Distance shown in miles
Concentrate disposal line not shown

**Pipeline Elevation Profile**


| CCWD Recycled Water Feasibility Study | Indirect Potable Reuse: Groundwater Replenishment Proposed Infrastructure | WATERWORKS ENGINEERS | FIGURE 11 |
|---|---|---|---|

### 5.2.5 Reservoir Augmentation

The closest reservoir to the study area that is large enough for reservoir augmentation is the Lower Crystal Springs Reservoir. SFPUC is also looking to add treated water to the reservoir as part of their future water supply portfolio. However, SFPUC would prefer direct potable reuse compared to putting treated water into the Crystal Springs Reservoir for operational reasons. Crystal Springs Reservoir is used as part of their operational balancing and any additional advanced treated water that is put in the reservoir, would mean less water could be conveyed from the Sierras if the reservoir was full. Before pursuing this alternative further, CCWD should discuss reservoir augmentation possibilities with SFPUC. For this study, it is assumed that SFPUC would credit the amount of water discharged into the reservoir for the District's use. The cost to convey and treat the water from the reservoir at Nunes WTP is not included in this study. The layout of the recycled water facilities is shown on Figure 12.

#### *5.2.5.1 Permitting*

There are no general permits that regulate indirect potable reuse via reservoir augmentation. If this alternative is pursued, CCWD should contact the RWQCB to determine if an individual permit is required[9]. A theoretical retention time of the recycled water in Lower Crystal Springs must be proposed by CCWD and approved by the RWQCB prior to construction[10]. Determining a theoretical retention time would require additional studies.

### 5.2.6 Advantages and Disadvantages

The advantages and disadvantages for this alternative are shown below.

**Table 11. Reservoir Augmentation Advantages and Disadvantages**

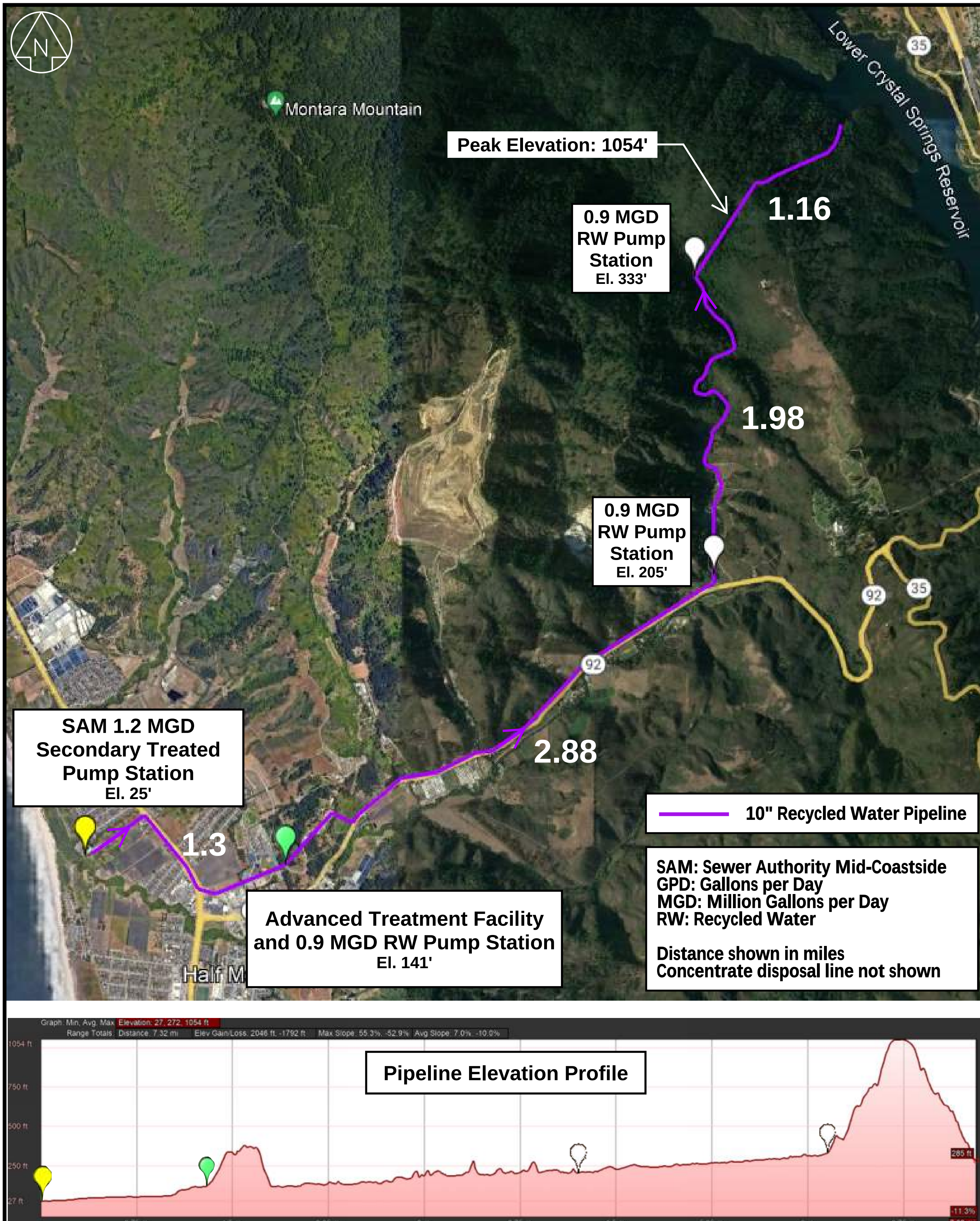
| Advantages for CCWD | Disadvantages for CCWD |
|---|---|
| • Adds a raw water source assuming SFPUC will allow the water to be extracted from reservoir | • Long pipeline route<br>• Extensive infrastructure and management for indirect potable reuse<br>• Infrastructure required to convey and treat additional water from the reservoir<br>• Water would need to be pumped to and from the Lower Crystal Springs Reservoir.<br>• Some water would be lost to evaporation from reservoir |

[9] Accessed on Oct 19 wastewaterrecyclingandreuse | San Francisco Bay Regional Water Quality Control Board (ca.gov)
[10] Accessed on Oct 19
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/swa/apregtext.pdf

### 5.2.7 Next Steps

The following steps have been identified to implement this project. Implementation of the project is expected to take up to 25 years from initial design through final design and not including financing.

1. Coordinate with SFPUC to determine what their requirements will be and if the advanced treated water would be available to use for the District.
2. Start a water planning process including
    a. setting the foundation
    b. establishing direction
    c. developing framework
    d. engaging stakeholders




CCWD Recycled Water Feasibility Study

Indirect Potable Reuse: Reservoir Augmentation Proposed Infrastructure

WATERWORKS ENGINEERS

FIGURE 12

## 5.3 Direct Potable Reuse

### 5.3.1 Distribution and Treatment

The treatment process flow diagram for direct potable reuse is shown in Figure 13 . The treatment process was determined based on regulations from the State Water Resources Control Board. The direct potable reuse alternative requires extensive treatment and source water management. The layout of infrastructure for direct potable reuse is shown in Figure 14. The location of the APWF is the same as what is described in the indirect potable reuse section.

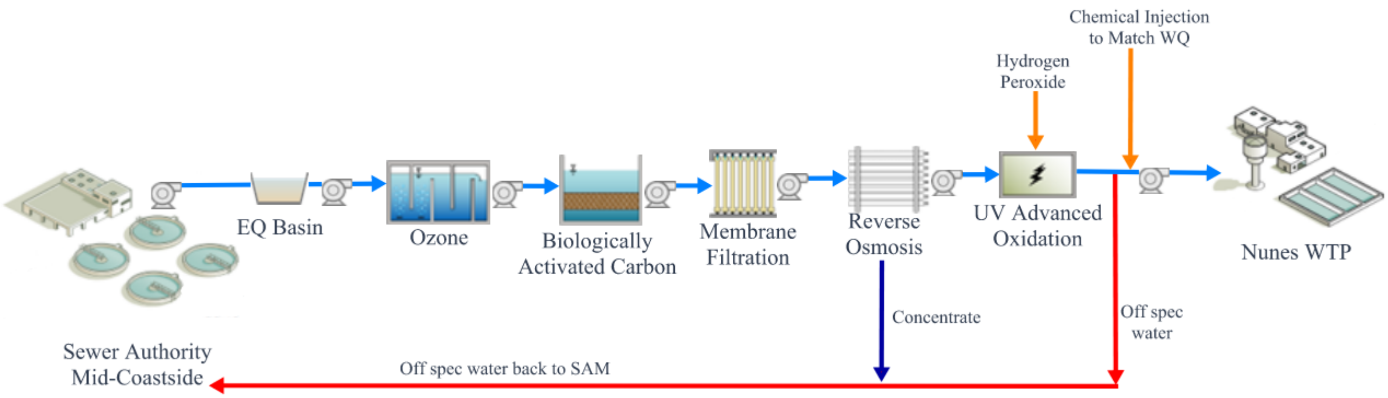



**Figure 13. Direct Potable Reuse Process Flow Diagram**

The water would be conveyed to the Nunes WTP for further treatment. The cost for treatment at Nunes WTP is not included in this study.

### 5.3.2 Permitting

Regulations regarding DPR were published by the State Water Resources Control Board (SWRCB) on December 18, 2023[11].

### 5.3.3 Advantages and Disadvantages

The advantages and disadvantages for this alternative are shown below.

**Table 12. Direct Potable Reuse Advantages and Disadvantages**

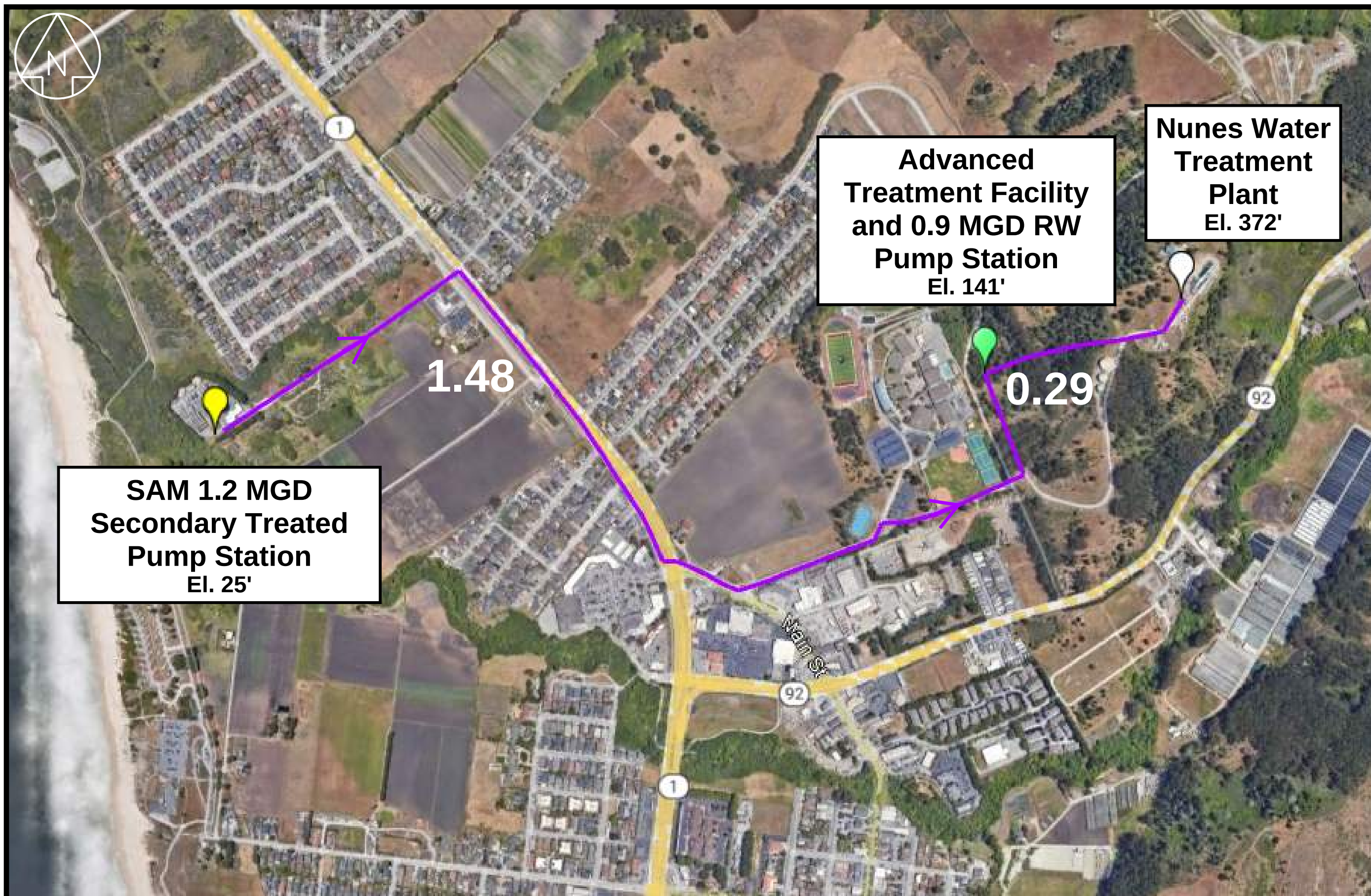
| Advantages for CCWD | Disadvantages for CCWD |
|---|---|
| • Adds a raw water source to the water treatment plant | • Extensive infrastructure and management for direct potable reuse<br>• Infrastructure required to treat additional water<br>• Needs extensive public outreach |

[11] Accessed on Oct 19,2023 Direct Potable Reuse | California State Water Resources Control Board

### 5.3.4 Next Steps

The following steps have been identified two implement this project. Implementation of the project is expected to take up to 30 years from initial design through final design and not including financing.

1. Start a water planning process including
    a. setting the foundation
    b. establishing direction
    c. developing framework
    d. engaging stakeholders
2. Identify funding sources for technical studies and constructing the project.




10" Recycled Water Pipeline

SAM: Sewer Authority Mid-Coastside
GPD: Gallons per Day
MGD: Million Gallons per Day
RW: Recycled Water

Distance shown in miles
Concentrate disposal line not shown

**Pipeline Elevation Profile**

# 6 Non-Cost Alternative Evaluation

Alternatives were evaluated based on non-cost criteria and life cycle costs. The District expressed that the volume of produced water was important for this study, so the alternatives were also evaluated on the amount of water that would be produced over 20 years.

## 6.1 Recycled Water Flow Summary By Alternative

The assumed recycled water flow rates for each alternative are shown in Table 13.

**Table 13. Recycled Water Flow Summary by Alternative**

| Alternative | | Flow Rate (MGD) (a) | Days Per Year | Source |
|---|---|---|---|---|
| **Non-Potable Reuse** | Fill Station(s) | 0.05 | 183 | In design, should be combined with other alternatives. Assumes five 4,000-gallon trucks a day are serviced in a 10-hour period $0.05\ MGD = \frac{5\ trucks\ x\ 4{,}000\frac{gal}{truck}}{10\ hours} * \frac{24\frac{hrs}{day}}{1x10^6 MG}$ |
| | Landscape and Agricultural Irrigation | 0.16 | 183 | Users will need to be identified after clarifying if water needs to stay within District boundaries. Assumed to be 30 MG in 6 months based on Fiscal Year 2023 water usage. |
| | Skylawn Memorial Park Irrigation | 0.27 | 183 | Per CCWD uses about 50 MG/year. Assumes the amount is used in 6 months. |
| | Ocean Colony Golf Course and Landscape Irrigation | 0.5 | 183 | Per information provided by the golf course in September 2023, the average use is 550,000 gallons per day. |
| **Indirect Potable Reuse** | Groundwater Replenishment | 0.125 | 365 | From Hydrogeologic Report |
| | Reservoir Augmentation | 1.2 | 365 | ADWF of the portion of the total SAM wastewater flow from the CCWD service area using 2018 to 2022 SAM flow data. |
| **Direct Potable Reuse** | Direct Potable Reuse at Nunes WTP | 1.2 | 365 | ADWF of the portion of the total SAM wastewater flow from the CCWD service area using 2018 to 2022 SAM flow data. |
| **Environmental Benefit** | Pilarcitos Creek Augmentation or Other Creek Augmentation | 0 | 0 | Does not offset groundwater use. |
| | Wetland Enhancement | 0 | 0 | Does not offset groundwater use. |

(a) Daily recycled water produced multiplied by the days in service per year and multiplied by twenty years. Recycled water would offset groundwater use or be used for indirect or direct potable reuse.

Without considering how much recycled water is used the top alternatives are the non-potable fill station, landscape irrigation and agricultural irrigation. However, a project that uses more recycled water is desirable for the District. Therefore, when ranking alternatives based on non-cost criteria and by how much recycled water would be used, then the most desirable alternatives included direct potable reuse, reservoir augmentation, and irrigation of Ocean Colony Golf Course.

## 6.2 Non-Cost Criteria

The alternatives were ranked on a scale of 1 (least desirable) to 3 (most desirable) based on which alternative was most desirable based on non-cost criteria. Each alternative's score was also weighted by the amount of water produced. The non-cost criteria were divided into four categories:

- environmental and social impacts/benefits
- ease of implementation and regulatory compliance
- engineering, construction, and operations
- climate hazard and resiliency

Each non-cost criteria category had subcategories which are defined below.

### 6.2.1 Environmental and Social Impacts/Benefits

The subcategories analyzed in this category are distribution system energy use, treatment system energy, and public/political acceptance. Higher distribution system and treatment system energy use is less desirable. Public/political acceptance is desired because it reduces the amount of public outreach required for an alternative.

### 6.2.2 Ease of Implementation and Regulatory Compliance

The subcategories analyzed in this category are whether a stakeholder(s) interested in collaborating, design readiness, and recycled water permit requirements. These subcategories relate to the ease of designing and permitting a recycled water system.

### 6.2.3 Engineering, Construction, and Operations

The subcategories analyzed in this category are land/easement acquisition, ease of operation, and ease of pipeline construction. These subcategories consider the difficulty in constructing and operating a recycled water system.

### 6.2.4 Climate and Hazard Resiliency

The subcategories analyzed in this category are tsunami zone construction and susceptibility to climate change. Susceptibility to climate change analyzed how susceptible an alternative is to effects of climate change such as increased flooding, landslides, wildfires, and sea level rise. This subcategory considers the risk of the project compared to potential hazards.

Non-cost criteria are defined in Table B-1 in Appendix B and the full non-cost criteria comparison is shown in Table B-2 in Appendix B. The non-cost criteria are summarized in Table 14.

A higher non-cost criteria score is better. Without taking into account how much recycled water is used then the top alternatives are non-potable reuse including the fill station, landscape irrigation and agricultural irrigation. However, a project that uses more recycled water is desirable. Therefore, when ranking alternatives based on non-cost criteria and by how much recycled water would be used, then the most desirable alternatives include direct potable reuse, reservoir augmentation and irrigation of the golf course.

**Table 14. Summary of Non-Cost Criteria**

| Alternative | Criteria / Sub-criteria | Delivered Water in 20 Years (Million Gallons) (a) | Total Non-Cost Criteria Score | Rank by Non-Cost Score | (Total score) x (delivered water per 20 years)/ (10,000) (b) | Weighted Rank by Produced Water |
|---|---|---|---|---|---|---|
| Non-Potable Reuse | Fill Station(s) | 183 | 30 | 1 | 0.5 | 8 |
| | Landscape Irrigation | 600 | 26 | 2 | 1.6 | 6 |
| | Agricultural Irrigation | 600 | 26 | 2 | 1.6 | 6 |
| | Skylawn Memorial Park Irrigation | 1,000 | 21 | 5 | 2.0 | 4 |
| | Ocean Colony Golf Course and Landscape Irrigation | 1,830 | 25 | 4 | 4.6 | 3 |
| Indirect Potable Reuse | Groundwater Replenishment | 913 | 18 | 7 | 1.6 | 5 |
| | Reservoir Augmentation | 6,570 | 15 | 10 | 9.9 | 2 |
| Direct Potable Reuse | Direct Potable Reuse at Nunes WTP | 6,570 | 19 | 6 | 12.5 | 1 |
| Environmental Benefit | Pilarcitos Creek Augmentation or Other Creek Augmentation | 0 | 18 | 7 | 0.0 | 9 |
| | Wetland Enhancement | 0 | 18 | 7 | 0.0 | 9 |

(a) Daily recycled water produced multiplied by the days in service per year and multiplied by twenty years. Recycled water would offset groundwater use or be used for indirect or direct potable reuse.
(b) Weighting total score so alternatives that produce more water are higher rated.

## 6.3 Alternative Summary

The following alternatives are considered further in the next section for their cost.

- Fill Station(s)
- Landscape and Agricultural Irrigation
- Skylawn Memorial Park Irrigation
- Ocean Colony Golf Course and Landscape Irrigation
- Groundwater Replenishment
- Reservoir Augmentation
- Direct Potable Reuse at Nunes WTP

The following alternatives are not considered further because they do not offset groundwater use or provide additional water resources from indirect or direct potable reuse.

- Pilarcitos Creek Augmentation or Other Creek Augmentation Next Steps
- Wetlands Enhancement Option

# 7 Costs

Planning-level lifecycle costs were estimated for each alternative and shown in Table 15. More detailed cost estimates are shown in Appendix C. Cost estimates are considered Class 5 by AACE International and have an accuracy of plus 50 percent and minus 30 percent.

## 7.1 Capital Costs

Capital costs include design, construction, and startup of new facilities. Capital costs are estimated based on information from manufacturers and previous projects. The following assumptions were made during the development of the capital cost estimates.

- The new pump stations were located to try to maintain 200 psi or less of pressure in the pipelines.
- SAM WWTP secondary effluent is the source for all advanced treatment processes.
- Treatment processes were based on industry-standard processes by recycled water use.
- Return of the concentrate to SAM is assumed to be by gravity and no pump is included.

## 7.2 Operational Costs

Operational costs include distribution system and treatment energy costs, replacement of equipment, maintenance, compliance testing and security, labor, and source control costs. The following assumptions were used in the analysis.

- Power cost is 39.3 cents per kilowatt hour.
- The distribution system energy cost is based on pump horsepower.
- The treatment energy costs are estimated on pump horsepower to provide the necessary pressure for the treatment processes.
- For non-potable uses, the pumps are assumed to be run 12 hours a day for six months year.
- For indirect potable reuse and direct potable reuse, the pumps are assumed to run 24 hours a day and 365 days a year.
- The pump efficiency is assumed to be 50 percent.
- Chemical costs are based on the chemicals used for each process.
- Replacement of equipment is assumed to be at 2% of the treatment process capital costs.
- Maintenance costs are assumed to be 1.7% of the treatment process capital costs.
- Compliance Testing and Security costs are based on the type of water being produced and the type of use.
- Labor costs are based on the number of full-time equivalent employees.
- Annual source control costs are based on the type of recycled water produced.

The operational costs and estimated staffing requirements for each alternative are shown in Appendix C.

### 7.2.1 Life Cycle Costs

A 20-year life cycle cost are shown in Table 15 and the costs per million gallons produced over 20 years are also included. The parameters that were used for the life cycle cost evaluation are listed in Table 16. Comparing the net present worth per million gallon, the top three alternatives are reservoir augmentation, irrigation at Ocean Colony Golf Course and direct potable reuse.

**Table 15. Life Cycle Costs**

| Alternative | | Capital Cost (a) | Annual O&M Cost | 20 Year Net Present Worth (b) | Delivered Water in 20 Years (MG) | Net Present Worth/ MG | Rank |
|---|---|---|---|---|---|---|---|
| Non-Potable Reuse | Fill Station(s) | $3.50 M | $0.10 M | $5.07 M | 183 | $28,000 | 4 |
| | Landscape and Agricultural Irrigation | $27.2 M | $1.07 M | $44.0 M | 600 | $73,000 | 6 |
| | Skylawn Memorial Park Irrigation | $29.4 M | $1.16 M | $47.6 M | 1,000 | $48,000 | 5 |
| | Ocean Colony Golf Course and Landscape Irrigation | $22.0 M | $1.20 M | $40.9 M | 1,830 | $22,000 | 1 |
| Indirect Potable Reuse | Groundwater Replenishment | $38.8 M | $3.53 M | $94.2 M | 913 | $103,000 | 7 |
| | Reservoir Augmentation | $65.7 M | $4.85 M | $142 M | 6,570 | $22,000 | 1 |
| Direct Potable Reuse | Direct Potable Reuse at Nunes WTP | $63.0 M | $6.19 M | $160 M | 6,570 | $24,000 | 3 |

(a) Costs are in 2023 dollars. Cost estimates are considered Class 5 by AACE International and have an accuracy of +50 percent and -30 percent.
(b) Assumes Inflation is 3%, nominal discount rate is 5.5%, and real discount rate is 2.4%.
(c) Flow rate for fill station, irrigation, and flow rate available after advanced water treatment accounting for concentrate.
(d) Assumes irrigation and fill station use occurs for 6 months of the year. Assumes indirect and direct potable reuse occur year-round.

**Table 16. Net Present Worth Values**

| Parameter | Value | Notes |
|---|---|---|
| Inflation | 3.0% | |
| Nominal Discount Rate | 5.5% | |
| Real Discount Rate | 2.4% | ((1+discount rate)/(1+inflation rate))-1 |
| Years | 20 | |
| Present Worth Factor | 15.70 | |

# 8 Conclusions

To be feasible, proposed recycled water projects need partners that want to collaborate with CCWD and a reason to pursue the project such as a policy or economic reason. The feasibility of each alternative is discussed in this section.

## 8.1 Fill Station

### 8.1.1 Potential Partners

Potentially the fill station could offset the use of potable water for construction water. However, there is not much construction water use in the District.

### 8.1.2 Project Driver

Since there would be little demand for the recycled water, there is no economic driver for this project.

### 8.1.3 Feasibility

This project is currently considered infeasible because there are no partners, and the project is not economically viable. CCWD should consider whether adding a fill station is useful for other reasons such as public outreach about recycled water.

## 8.2 Landscape and Agricultural Irrigation

### 8.2.1 Potential Partners

Within the District there is limited landscaping or agricultural irrigation that could be offset by recycled water use.

### 8.2.2 Project Driver

Since there would be little demand for the recycled water, there is no economic driver for this project.

### 8.2.3 Feasibility

This project is currently considered infeasible because there are no partners, and the project is not economically viable. CCWD should determine if recycled water could be served outside of District boundaries to potentially develop a larger customer base.

## 8.3 Skylawn Memorial Park Irrigation

### 8.3.1 Potential Partners

Since the Park is outside of District boundaries, recycled water cannot be delivered and used there. Therefore, there is no partner for this project.

### 8.3.2 Project Driver

There is no economic driver for this project since there is no partner to sell the water to.

### 8.3.3 Feasibility

This project is currently considered infeasible because there are no partners, and the project is not economically viable. CCWD should determine if recycled water could be used outside of District boundaries.

## 8.4 Ocean Colony Golf Course and Landscape Irrigation

### 8.4.1 Potential Partners

Ocean Colony has other water supplies that are more cost effective than recycled water so does not have a demand for recycled water.

### 8.4.2 Project Driver

Since there is no demand for the recycled water at the golf course and associated landscaping, there is no economic driver for this project.

### 8.4.3 Feasibility

This project is currently considered infeasible because there are no partners, and the project is not economically viable. CCWD should check in with the Ocean Colony periodically to see if their water needs have changed.

## 8.5 Pilarcitos Creek Augmentation or Other Creek Augmentation Next Steps

### 8.5.1 Potential Partners

There are currently no partners for this alternative. CCWD would need to identify partners if there is an interest in creek augmentation. An example of potential partners would be local environmental protection groups.

### 8.5.2 Project Driver

There is no economic reason to pursue this project.

### 8.5.3 Feasibility

This project is currently considered infeasible because there are no partners, and the project is not economically viable. CCWD should periodically check with neighboring agencies to see if there is an interest in creek augmentation.

## 8.6 Wetlands Enhancement Option

### 8.6.1 Potential Partners

There are currently no partners for this alternative. CCWD would need to identify partners if there is an interest in wetland enhancement.

### 8.6.2 Project Driver

There is no economic reason to pursue this project.

### 8.6.3 Feasibility

This project is currently considered infeasible because there are no partners, and the project is not economically viable. CCWD should periodically check with neighboring agencies to see if there is an interest in wetlands enhancement.

## 8.7 Groundwater Replenishment

### 8.7.1 Potential Partners

There are currently no partners for this alternative. CCWD would need to identify partners if there is an interest in groundwater replenishment. Local private well users will need to be a partner if this project is to be feasible.

### 8.7.2 Project Driver

There is no economic reason to pursue this project as it would add a limited quantity of new water supply to the District.

### 8.7.3 Feasibility

This project is currently considered infeasible because there are no partners, and the project is not economically viable.

## 8.8 Reservoir Augmentation

### 8.8.1 Potential Partners

There is no known partner who has a reservoir available for augmentation. SFPUC may be a potential partner.

### 8.8.2 Project Driver

The project driver is providing a new water source to the District's water supply portfolio.

### 8.8.3 Feasibility

This project is currently considered infeasible because there is no reservoir available to augment. CCWD should discuss potential reservoir augmentation alternatives with SFPUC.

## 8.9 Direct Potable Reuse at Nunes WTP

### 8.9.1 Potential Partners

Partners would need to be defined to make this alternative feasible.

### 8.9.2 Project Driver

The project driver is providing a new water source to the District's water supply portfolio.

### 8.9.3 Feasibility

Further study is needed to determine if this project is an economically viable alternative to add a new water supply to the District's water portfolio.

## 8.10 Summary

The feasibility of the projects with the current conditions are present summarized in Table 17.

**Table 17. Feasibility of Project by Alternative**

| Alternative | Feasible | Reasoning |
|---|---|---|
| Fill Station(s) | No | Little demand for recycled water within service area |
| Landscape and Agricultural Irrigation | No | Little demand for recycled water within service area |
| Skylawn Memorial Park Irrigation | No | Park not within service area, so would not be able to deliver recycled water. |
| Ocean Colony Golf Course and Landscape Irrigation | No | Ocean Colony has other water supplies that are more cost effective than recycled water and therefore, does not have a demand for recycled water. |
| Pilarcitos Creek Augmentation or Other Creek Augmentation | No | Does not offset groundwater use or provide additional water resources from indirect or direct potable reuse. |
| Wetland Enhancement | No | Does not offset groundwater use or provide additional water resources from indirect or direct potable reuse. |
| Groundwater Replenishment | No | 1. There are private wells in the service area that limits where water may be replenished.<br>2. A limited amount of water that can be replenished at one location due to mounding |
| Reservoir Augmentation | No | There is no known partner who has a reservoir available for augmentation. |
| Direct Potable Reuse at Nunes WTP | Further study needed | Next steps are to find potential funding sources and continue technical studies. |

Of the recycled water alternatives evaluated, currently the direct potable reuse alternative is the only alternative that should be pursued because the project has potential to provide diversity to the District's water supply portfolio. However, further study is needed for the direct potable reuse alternative to determine if the project is economically viable.

1. Start a water planning process including
    a. setting the foundation
    b. establishing direction
    c. developing framework
    d. engaging stakeholders
2. Establish contracts with partners
3. Identify funding source for the studies and construction of the project.
4. Collaborate with stakeholders to further define the project and perform the required studies necessary for final design.
5. Implement an extensive public education program.
6. Design the advanced water treatment plant
7. Construct the improvements.
8. Complete permitting.
9. Increased staffing to operate the new facilities.

# 9 References

Carollo Engineers, 2002. Preliminary Economic Feasibility Study, Water Reclamation Program. Prepared for CCWD, dated December 2002.

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DWR, 2020. California's Groundwater, State of California Department of Water Resources Bulletin 118, Update 2020.

Kennedy-Jenks, 2015. Phase 1 Recycled Water Project – Water Quality and Quantity Evaluation, prepared for CCWD, dated 15 December 2015.

Kennedy-Jenks, 2016. Phase 1 Recycled Water Project – Conveyance Facilities, prepared for CCWD, dated 21 March 2016.

PWA, 2018. Pilarcitos Integrated Watershed Management Plan prepared for San Mateo County Resource Conservation District and California State Water Resources Control Board, dated 24 October 2008.

SFPUC, 2018. Amended and Restated Water Supply Agreement between the City and County of San Francisco and Wholesale Customers in Alameda County, San Mateo and Santa Clara County, prepared by SFPUC, dated November 2018.

SRT Consultants, 2015. 2015 Update of the 2010 Recycled Water Facilities Planning Study, prepared for SAM, dated 12 August 2015.

West Yost, 2021. Coastside County Water District 2020 Urban Water Management Plan, prepared for CCWD, dated 10 June 2021.

# Appendix A – Hydrogeologic Report

(Provided under separate cover)

# Appendix B – Alternative Comparison Using Non-Cost Criteria

**Table B-1. Decision Matrix Criteria and Ranking Definitions**

| Criteria | Sub-criteria | Score range/scale | | |
|---|---|---|---|---|
| | | 1 | 2 | 3 |
| 1. Environmental and social impacts/benefits | Distribution system energy use | • Highest energy use compared to other alternatives. | • Average energy use. | • Lowest energy use compared to other alternatives. |
| | Treatment system energy use | • Highest energy use compared to other alternatives. | • Average energy use. | • Lowest energy use compared to other alternatives. |
| | Public/political acceptance | • Known public unease with potable reuse or known public unease with proposed use of site(s) for new facilities. | • Public support neutral or unknown. | • Known public support of elements of potable reuse plans and/or proposed use of site(s) for new facilities. |
| 2. Ease of implementation and regulatory compliance | Willing stakeholder(s) interested in collaborating | • Stakeholders have not communicated in past about collaboration. Unsure of how willing partners will be to collaborate. | • Stakeholders have communicated in the past and have expressed interest. | • Stakeholders have communicated recently and direct interest has been expressed. |
| | SAM collaboration | • Majority of new facilities will be at SAM, so CCWD has little control over recycled water quality. Requires more coordination with SAM. | • Part of new facilities will be at SAM, so CCWD has little control over recycled water quality. Requires more coordination with SAM. | • All new facilities will not be located at SAM. SAM only required for flow diversion approval and use of outfall for concentrate. |
| | Design readiness | • Alternative requires further testing (tracer studies) and alternative specific feasibility studies before design can begin. | • Alternative requires further research before design can begin. | • Alternative may begin design. |
| | Recycled water permit requirements | • Permitting requirements have not been defined. | • Permitting is known to be difficult. | • Permitting is known to be straight forward. |
| 3. Engineering, construction, and operations | Land and easement acquisition | • Land for treatment is not currently available for use and has known litigation or zoned for other uses.<br>• Many easements need to be acquired for distribution system. | • Land for treatment is not currently available for use. Land is held privately and will need to be purchased.<br>• Some easements need to be acquired for distribution system. | • No known land acquisition issues other than price negotiation.<br>• Little to no easements need to be acquired for distribution system. |
| | Ease of operation | • Facility operation requires more technical expertise.<br>• Operator must be on call 24/7. | • Facility operation requires moderate technical expertise. | • Facility operation is simple. |
| | Ease of pipeline construction | • Proposed pipeline alignments have significant potential construction or engineering challenges, such as Caltrans longitudinal highway piping, creek crossings, and steep grades. | • Proposed pipeline alignments have moderate potential construction or engineering challenges. | • Proposed pipeline construction is straightforward.<br>• Majority of pipeline construction is not longitudinally on Caltrans highway. |
| 4. Climate and hazard resiliency | Tsunami Zone Construction | • Majority of construction in tsunami zone. | • Some of construction in tsunami zone. | • Majority of construction not in tsunami zone. |
| | Susceptibility to Climate Change (a) | • At risk of serious damage. | • Moderate risk. | • Little to no risk. |

Acronyms
SAM - Sewer Authority Mid-Coastside
WTP - Water Treatment Plant

Notes:
(a) How will the project be effected by increased flooding, landslides, wildfires, and sea level rise.

**Table B-2. Non-Cost Criteria**

| Alternative | Criteria | 1. Environmental and social impacts/benefits | | | 2. Ease of implementation and regulatory compliance | | | 3. Engineering, construction, and operations | | | 4. Climate and hazard resiliency | | Delivered Water in 20 Years (Million Gallons) (a) | Total non-cost criteria score | Rank by non-cost score | (Total score) x (delivered water per 20 years)/ (10,000) (b) | Weighted rank by produced water |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sub-criteria | Distribution system energy use | Treatment system energy use | Public/ political acceptance | Willing stakeholder(s) interested in collaborating | Design readiness | Recycled water permit requirements | Land and easement acquisition | Ease of operation | Ease of pipeline construction | Tsunami zone construction | Susceptibility to climate change | | | | | |
| Non-Potable Reuse | Fill Station(s) | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 183 | 30 | 1 | 0.5 | 8 |
| | Landscape Irrigation | 3 | 3 | 3 | 1 | 3 | 3 | 2 | 3 | 2 | 1 | 2 | 600 | 26 | 2 | 1.6 | 6 |
| | Agricultural Irrigation | 3 | 3 | 3 | 1 | 3 | 3 | 2 | 3 | 2 | 1 | 2 | 600 | 26 | 2 | 1.6 | 6 |
| | Skylawn Memorial Park Irrigation | 1 | 3 | 3 | 2 | 2 | 3 | 1 | 2 | 1 | 1 | 1 | 1,000 | 20 | 5 | 2.0 | 4 |
| | Ocean Colony Golf Course and Landscape Irrigation | 3 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 1 | 2 | 1,830 | 25 | 4 | 4.6 | 3 |
| Indirect Potable Reuse | Groundwater Replenishment | 2 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 3 | 2 | 913 | 18 | 7 | 1.6 | 5 |
| | Reservoir Augmentation | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 1 | 3 | 1 | 6,570 | 15 | 10 | 9.9 | 2 |
| Direct Potable Reuse | Direct Potable Reuse at Nunes WTP | 2 | 1 | 1 | 3 | 1 | 1 | 1 | 1 | 2 | 3 | 3 | 6,570 | 19 | 6 | 12.5 | 1 |
| Environmental Benefit | Pilarcitos Creek Augmentation or Other Creek | 3 | 1 | 3 | 1 | 1 | 2 | 1 | 1 | 3 | 1 | 1 | 0 | 18 | 7 | 0.0 | 9 |
| | Wetland Enhancement | 3 | 1 | 3 | 1 | 1 | 2 | 1 | 1 | 3 | 1 | 1 | 0 | 18 | 7 | 0.0 | 9 |

Scoring

See Table B-1. with 1 being less desirable and 3 being more desirable

Acronyms

SAM - Sewer Authority Mid-Coastside

WTP - Water Treatment Plant

Notes:

(a) Daily recycled water produced multiplied by the days in service per year and multiplied by twenty years. Recycled water would offset groundwater use or be used for indirect or direct potable reuse.

(b) Weighting total score so alternatives that produce more water are higher rated.

# Appendix C - Cost Opinions

WATERWORKS ENGINEERS

| | Title: | Summary of Costs |
|---|---|---|
| | Date: | 10/31/2023 |

| Alternative | | Capital Cost (a) | Annual O&M Cost | 20 Year Net Present Worth (b) | Delivered Water (MGD) (c) | Days in Service per Year (d) | Delivered Water in 20 Years (MG) | Net Present Worth/ MG | Rank |
|---|---|---|---|---|---|---|---|---|---|
| **Non-Potable Reuse** | Fill station(s) for unrestricted residential or commercial use | $3.50 M | $0.10 M | $5.07 M | 0.05 | 183 | 183 | $28,000 | 4 |
| | Landscape and agricultural irrigation with disinfected tertiary recycled water | $27.2 M | $1.07 M | $44.0 M | 0.16 | 183 | 600 | $73,000 | 6 |
| | Skylawn Memorial Park irrigation with disinfected tertiary recycled water | $29.4 M | $1.16 M | $47.6 M | 0.27 | 183 | 1,000 | $48,000 | 5 |
| | Ocean Colony golf course and landscape irrigation with reverse osmosis treated water | $22.0 M | $1.20 M | $40.9 M | 0.50 | 183 | 1,830 | $22,000 | 1 |
| **Indirect Potable Reuse** | Groundwater replenishment with advanced treated water | $38.8 M | $3.53 M | $94.2 M | 0.125 | 365 | 913 | $103,000 | 7 |
| | Reservoir augmentation with advanced treated water | $65.7 M | $4.85 M | $142 M | 0.90 | 365 | 6,570 | $22,000 | 1 |
| **Direct Potable Reuse** | Advanced treated water to Nunes WTP | $63.0 M | $6.19 M | $160 M | 0.90 | 365 | 6,570 | $24,000 | 3 |

Acronyms:
MG - Million Gallons
MGD - Million Gallons per Day
O&M - Operations and Maintenance
WTP - Water Treatment Plant

Notes:
(a) Costs are in 2023 dollars. Cost estimates are considered Class 5 by AACE International and have an accuracy of +50 percent and -30 percent.
(b) Assumes Inflation is 3%, nominal discount rate is 5.5%, and real discount rate is 2.4%.
(c) Flow rate for fill station, irrigation, and flow rate available after advanced water treatment accounting for concentrate.
(d) Assumes irrigation and fill station use occurs for 6 months of the year. Assumes indirect and direct potable reuse occur year round.

| | | | | |
|---|---|---|---|---|
| WATERWORKS ENGINEERS | | | Title: | CCWD Recycled Water Feasibility Study |
| | | | Date: | 10/31/2023 |

**Distribution - Fill Station**

| ITEM | QUANTITY | UNIT | UNIT COST | TOTAL COST |
|---|---|---|---|---|
| 50,000 Gallon Equalization Basin at SAM | 50,000 | Gallon | $2 | $100,000 |
| Pump Station at SAM | 5 | Horsepower | $5,000 | $25,000 |
| 3" Pipeline to Fill Station | 0.35 | Mile | $2,000,000 | $700,000 |
| 50,000 Gallon Tank at Fill Station | 50,000 | Gallon | $2 | $100,000 |
| **Construction Subtotal** | | | | **$900,000** |
| Project Preliminary Design Contingency | | | 30% | $300,000 |
| **Subtotal** | | | | **$1,200,000** |
| Contractor General, Mobilization, Overhead & Profit | | | 15% | $200,000 |
| General Conditions, Bonds, Insurance & Taxes | | | 4% | $48,000 |
| **PROBABLE CONSTRUCTION COST** | | | | **$1,448,000** |
| Construction Contingency | | | 10% | $140,000 |
| Design and Services During Construction | | | 12% | $170,000 |
| Permitting (effort and fees) | | | 2% | $30,000 |
| **TOTAL CAPITAL PROJECT COST** | | | | **$1,800,000** |

Acronyms:

SAM - Sewer Authority Mid-Coastside

Notes:

1. No cost escalation is used.
2. No land or easement acquisition is included.
3. Assumed pipeline distance as the location of the fill station needs to be determined.

| WATERWORKS ENGINEERS | | | Title: | CCWD Recycled Water Feasibility Study |
|---|---|---|---|---|
| | | | Date: | 10/31/2023 |

**Distribution - Landscape and Agricultural Irrigation**

| ITEM | QUANTITY | UNIT | UNIT COST | TOTAL COST |
|---|---|---|---|---|
| 50,000 Gallon Equalization Basin at SAM | 50,000 | Gallon | $2 | $100,000 |
| 50,000 Gallon Storage Tank at SAM | 50,000 | Gallon | $2 | $100,000 |
| Pump Station at SAM | 10 | Horsepower | $5,000 | $50,000 |
| 4" Pipeline to Flow Split | 0.35 | Mile | $2,000,000 | $700,000 |
| 4" Recycled Water Pipe North of SAM | 1.32 | Mile | $2,000,000 | $2,640,000 |
| 4" Recycled Water Pipe East of SAM | 2.23 | Mile | $2,000,000 | $4,460,000 |
| 4" Recycled Water Pipe South of SAM | 1.99 | Mile | $2,000,000 | $3,980,000 |
| 4"/8" Pipe-Bore and Jack | 1,000 | Linear feet | $600 | $600,000 |
| **Construction Subtotal** | | | | **$12,600,000** |
| Project Preliminary Design Contingency | | | 30% | $3,800,000 |
| **Subtotal** | | | | **$16,400,000** |
| Contractor General, Mobilization, Overhead & Profit | | | 15% | $2,500,000 |
| General Conditions, Bonds, Insurance & Taxes | | | 4% | $700,000 |
| **PROBABLE CONSTRUCTION COST** | | | | **$19,600,000** |
| Construction Contingency | | | 10% | $1,960,000 |
| Design and Services During Construction | | | 12% | $2,350,000 |
| Permitting (effort and fees) | | | 2% | $390,000 |
| **TOTAL CAPITAL PROJECT COST** | | | | **$24,300,000** |

Acronyms:

SAM - Sewer Authority Mid-Coastside

Notes:

1. Does not include the cost to retrofit the recycled water use sites.
2. No cost escalation is used.
3. No land or easement acquisition is included.

| WATERWORKS ENGINEERS | Title: | CCWD Recycled Water Feasibility Study |
|---|---|---|
| | Date: | 10/31/2023 |

**Distribution - Golf Course Irrigation**

| ITEM | | QUANTITY | UNIT | UNIT COST | TOTAL COST |
|---|---|---|---|---|---|
| | 50,000 Gallon Equalization Basin at SAM | 50,000 | Gallon | $2 | $100,000 |
| | Pump Station at SAM | 50 | Horsepower | $5,000 | $250,000 |
| | 6"/10" Pipe-Bore and Jack | 600 | Linear Feet | $600 | $360,000 |
| | 6" Recycled Water Pipe South of SAM | 3.54 | Mile | $2,000,000 | $7,080,000 |
| | | | **Construction Subtotal** | | **$7,800,000** |
| | | | Project Preliminary Design Contingency | 30% | $2,300,000 |
| | | | **Subtotal** | | **$10,100,000** |
| | | | Contractor General, Mobilization, Overhead & Profit | 15% | $1,500,000 |
| | | | General Conditions, Bonds, Insurance & Taxes | 4% | $400,000 |
| **PROBABLE CONSTRUCTION COST** | | | | | **$12,000,000** |
| | | | Construction Contingency | 10% | $1,200,000 |
| | | | Design and Services During Construction | 12% | $1,440,000 |
| | | | Permitting (effort and fees) | 2% | $240,000 |
| **TOTAL CAPITAL PROJECT COST** | | | | | **$14,900,000** |

Acronyms:

SAM - Sewer Authority Mid-Coastside

Notes:

1. Does not include the cost to retrofit the recycled water use sites.
2. No cost escalation is used.
3. No land or easement acquisition is included.
4. Assumes storage is available at golf course ponds.

| WATERWORKS ENGINEERS | Title: | CCWD Recycled Water Feasibility Study |
|---|---|---|
| | Date: | 10/31/2023 |

**Distribution - Skylawn Memorial Park Irrigation**

| ITEM | | QUANTITY | UNIT | UNIT COST | TOTAL COST |
|---|---|---|---|---|---|
| | 50,000 Gallon Equalization Basin at SAM | 50,000 | Gallon | $2 | $100,000 |
| | Pump Station at SAM | 50 | Horsepower | $5,000 | $250,000 |
| | 6" Pipeline to Pump Station 1 | 5.73 | Mile | $2,000,000 | $11,460,000 |
| | Pump Station 1 | 90 | Horsepower | $5,000 | $450,000 |
| | 6" Pipeline to Skylawn | 0.79 | Mile | $2,000,000 | $1,580,000 |
| | | | **Construction Subtotal** | | **$13,700,000** |
| | | | Project Preliminary Design Contingency | 30% | $4,100,000 |
| | | | **Subtotal** | | **$17,800,000** |
| | | | Contractor General, Mobilization, Overhead & Profit | 15% | $2,700,000 |
| | | | General Conditions, Bonds, Insurance & Taxes | 4% | $700,000 |
| **PROBABLE CONSTRUCTION COST** | | | | | **$21,200,000** |
| | | | Construction Contingency | 10% | $2,120,000 |
| | | | Design and Services During Construction | 12% | $2,540,000 |
| | | | Permitting | 3% | $640,000 |
| **TOTAL CAPITAL PROJECT COST** | | | | | **$26,500,000** |

Acronyms:

SAM - Sewer Authority Mid-Coastside

Notes:

1. Does not include the cost to retrofit the recycled water use sites.
2. No cost escalation is used.
3. No land or easement acquisition is included.
4. Assumes storage is available in Skylawn Pond.

| WATERWORKS ENGINEERS | Title: | CCWD Recycled Water Feasibility Study | | |
|---|---|---|---|---|
| | Date: | 10/31/2023 | | |

**Distribution - Reservoir Augmentation**

| ITEM | QUANTITY | UNIT | UNIT COST | TOTAL COST |
|---|---|---|---|---|
| Pump station at SAM to APWF | 70 | Horsepower | $5,000 | $350,000 |
| 10" Pipeline to APWF | 1.30 | Mile | $2,000,000 | $2,600,000 |
| 4" Concentrate Pipeline | 1.48 | Mile | $2,000,000 | $2,960,000 |
| APWF Influent Equalization Basin | 250,000 | Gallons | $2 | $500,000 |
| Pump station at APWF to Pump Station 1 | 80 | Horsepower | $5,000 | $400,000 |
| 10" Pipeline to Pump Station 1 | 2.88 | Mile | $2,000,000 | $5,760,000 |
| Pump station 1 | 40 | Horsepower | $5,000 | $200,000 |
| 10" Pipeline to Pump Station 2 | 1.98 | Mile | $2,000,000 | $3,960,000 |
| Pump station 2 | 280 | Horsepower | $5,000 | $1,400,000 |
| 10" Pipeline to Reservoir | 1.16 | Mile | $2,000,000 | $2,320,000 |
| | | **Construction Subtotal** | | **$20,500,000** |
| | | Project Preliminary Design Contingency | 30% | $6,200,000 |
| | | **Subtotal** | | **$26,700,000** |
| | | Contractor General, Mobilization, Overhead & Profit | 15% | $4,000,000 |
| | | General Conditions, Bonds, Insurance & Taxes | 4% | $1,100,000 |
| **PROBABLE CONSTRUCTION COST** | | | | **$31,800,000** |
| | | Construction Contingency | 10% | $3,180,000 |
| | | Design and Services During Construction | 12% | $3,820,000 |
| | | Permitting | 3% | $950,000 |
| **TOTAL CAPITAL PROJECT COST** | | | | **$39,800,000** |

Acronyms:

SAM - Sewer Authority Mid-Coastside

APWF - Advanced Purified Water Facility

Notes:

1. No cost escalation is used.
2. No land or easement acquisition is included.
3. Does not include cost to convey or treat the additional water from Crystal Springs Reservoir.

| WATERWORKS ENGINEERS | Title: | CCWD Recycled Water Feasibility Study |
|---|---|---|
| | Date: | 10/31/2023 |

**Distribution - Groundwater Replenishment**

| ITEM | | QUANTITY | UNIT | UNIT COST | TOTAL COST |
|---|---|---|---|---|---|
| | Pump station at SAM to APWF | 20 | Horsepower | $5,000 | $100,000 |
| | 4" Pipeline to APWF | 1.48 | Mile | $2,000,000 | $2,960,000 |
| | APWF Influent Equalization Basin | 250,000 | Gallons | $2 | $500,000 |
| | 4" Concentrate Pipeline | 1.48 | Mile | $2,000,000 | $2,960,000 |
| | Pump station at APWF to Replenishment | 20 | Horsepower | $5,000 | $100,000 |
| | **Construction Subtotal** | | | | **$6,600,000** |
| | Project Preliminary Design Contingency | | | 30% | $2,000,000 |
| | **Subtotal** | | | | **$8,600,000** |
| | Contractor General, Mobilization, Overhead & Profit | | | 15% | $1,300,000 |
| | General Conditions, Bonds, Insurance & Taxes | | | 4% | $300,000 |
| **PROBABLE CONSTRUCTION COST** | | | | | **$10,200,000** |
| | Construction Contingency | | | 10% | $1,020,000 |
| | Design and Services During Construction | | | 12% | $1,220,000 |
| | Permitting | | | 4% | $410,000 |
| **TOTAL CAPITAL PROJECT COST** | | | | | **$12,900,000** |

Acronyms:

SAM - Sewer Authority Mid-Coastside

APWF - Advanced Purified Water Facility

Notes:

1. Does not include the cost to inject or percolate water.
2. No cost escalation is used.
3. No land or easement acquisition is included.
4. Assumes percolation/injection at APWF for replenishment.

| | Title: | CCWD Recycled Water Feasibility Study |
|---|---|---|
| WATERWORKS ENGINEERS | Date: | 10/31/2023 |

**Distribution - Direct Potable Reuse**

| ITEM | QUANTITY | UNIT | UNIT COST | TOTAL COST |
|---|---|---|---|---|
| Pump Station at SAM to APWF | 180 | Horsepower | $5,000 | $900,000 |
| 12" Pipeline to APWF | 1.48 | Mile | $2,000,000 | $2,960,000 |
| APWF Influent Equalization Basin | 250,000 | Gallons | $2 | $500,000 |
| 4" Concentrate Pipeline | 1.48 | Mile | $2,000,000 | $2,960,000 |
| Pump station at APWF to Nunes WTP | 90 | Horsepower | $5,000 | $450,000 |
| 10" Pipeline to Nunes WTP | 0.29 | Mile | $2,000,000 | $580,000 |
| **Construction Subtotal** | | | | **$8,400,000** |
| Project Preliminary Design Contingency | | | 30% | $2,500,000 |
| **Subtotal** | | | | **$10,900,000** |
| Contractor General, Mobilization, Overhead & Profit | | | 15% | $1,600,000 |
| General Conditions, Bonds, Insurance & Taxes | | | 4% | $400,000 |
| **PROBABLE CONSTRUCTION COST** | | | | **$12,900,000** |
| Construction Contingency | | | 10% | $1,290,000 |
| Design and Services During Construction | | | 12% | $1,550,000 |
| Permitting | | | 4% | $520,000 |
| **TOTAL CAPITAL PROJECT COST** | | | | **$16,300,000** |

Acronyms:

SAM - Sewer Authority Mid-Coastside

WTP - Water Treatment Plant

APWF - Advanced Purified Water Facility

Notes:

1. No cost escalation is used.
2. No land or easement acquisition is included.
3. Does not include cost for treatment of additional water at Nunes WTP.

| WATERWORKS ENGINEERS | | Title: | CCWD Recycled Water Feasibility Study |
|---|---|---|---|
| | | Date: | 10/31/2023 |

**Non-Potable Reuse Treatment: Fill Station**

| | ITEM | COST | |
|---|---|---|---|
| | Treatment Processes | | $400,000 |
| | Process Equipment Install | 25% | $100,000 |
| | Site Work | 5% | $20,000 |
| | Electrical and Instrumentation | 30% | $120,000 |
| | Mechanical | 15% | $60,000 |
| | Piping and Valves | 20% | $80,000 |
| | **Construction Subtotal** | | **$800,000** |
| | Project Preliminary Design Contingency | 30% | $200,000 |
| | **Subtotal** | | **$1,000,000** |
| | Contractor General, Mobilization, Overhead & Profit | 15% | $200,000 |
| | General Conditions, Bonds, Insurance & Taxes | 4% | $40,000 |
| **PROBABLE CONSTRUCTION COST** | | | **$1,240,000** |
| | Construction Contingency | 10% | $120,000 |
| | Design and Services During Construction | 12% | $150,000 |
| | Construction Management | 10% | $120,000 |
| | Permitting | 2% | $20,000 |
| **TOTAL CAPITAL COST (Construction Total + Implementation Total)** | | | **$1,700,000** |

Notes:

1. No cost escalation is used.
2. No land or easement acquisition is included.
3. No public outreach is included.

| | | |
|---|---|---|
| WATERWORKS ENGINEERS | Title: | CCWD Recycled Water Feasibility Study |
| | Date: | 10/31/2023 |

**Non-Potable Reuse Treatment: Landscape and Agriculture Irrigation**

| ITEM | | COST | |
|---|---|---|---|
| | Treatment Processes | | $700,000 |
| | Process Equipment Install | 25% | $180,000 |
| | Site work | 5% | $40,000 |
| | Electrical and Instrumentation | 30% | $210,000 |
| | Mechanical | 15% | $110,000 |
| | Piping and Valves | 20% | $140,000 |
| | **Construction Subtotal** | | **$1,400,000** |
| | Project Preliminary Design Contingency | 30% | $400,000 |
| | **Subtotal** | | **$1,800,000** |
| | Contractor General, Mobilization, Overhead & Profit | 15% | $300,000 |
| | General Conditions, Bonds, Insurance & Taxes | 4% | $100,000 |
| **PROBABLE CONSTRUCTION COST** | | | **$2,200,000** |
| | Construction Contingency | 10% | $220,000 |
| | Design and Services During Construction | 12% | $260,000 |
| | Construction Management | 10% | $220,000 |
| | Permitting | 2% | $40,000 |
| **TOTAL CAPITAL COST (Construction Total + Implementation Total)** | | | **$2,900,000** |

Notes:

1. No cost escalation is used.
2. No land or easement acquisition is included.
3. No public outreach is included.

| | |
|---|---|
| WATERWORKS ENGINEERS | Title: CCWD Recycled Water Feasibility Study |
| | Date: 10/31/2023 |

**Non-Potable Reuse Treatment: Golf Course Irrigation**

| ITEM | COST | |
|---|---|---|
| Treatment Processes | | $1,600,000 |
| Process Equipment Install | 25% | $400,000 |
| Site work | 5% | $80,000 |
| Electrical and Instrumentation | 50% | $800,000 |
| Mechanical | 15% | $240,000 |
| Piping and Valves | 20% | $320,000 |
| **Construction Subtotal** | | **$3,400,000** |
| Project Preliminary Design Contingency | 30% | $1,000,000 |
| **Subtotal** | | **$4,400,000** |
| Contractor General, Mobilization, Overhead & Profit | 15% | $700,000 |
| General Conditions, Bonds, Insurance & Taxes | 4% | $200,000 |
| **PROBABLE CONSTRUCTION COST** | | **$5,300,000** |
| Construction Contingency | 10% | $530,000 |
| Design and Services During Construction | 12% | $640,000 |
| Construction Management | 10% | $530,000 |
| Permitting | 2% | $110,000 |
| **TOTAL CAPITAL COST (Construction Total + Implementation Total)** | | **$7,110,000** |

Notes:

1. No cost escalation is used.
2. No land or easement acquisition is included.
3. No public outreach is included.

| WATERWORKS ENGINEERS | | |
|---|---|---|
| Title: | CCWD Recycled Water Feasibility Study | |
| Date: | 10/31/2023 | |

**Indirect Potable Reuse Treatment**

| ITEM | | COST |
|---|---|---|
| Treatment Processes | | $4,900,000 |
| Process Equipment Install | 25% | $1,230,000 |
| Site Work | 15% | $740,000 |
| Electrical and Instrumentation | 50% | $2,450,000 |
| Mechanical | 15% | $740,000 |
| Piping and Valves | 20% | $980,000 |
| Upfront Source Control | | $400,000 |
| Treatment Building | | $1,500,000 |
| **Construction Subtotal** | | **$12,900,000** |
| Project Preliminary Design Contingency | 30% | $3,900,000 |
| **Subtotal** | | **$16,800,000** |
| Contractor General, Mobilization, Overhead & Profit | 15% | $1,900,000 |
| General Conditions, Bonds, Insurance & Taxes | 4% | $500,000 |
| **PROBABLE CONSTRUCTION COST** | | **$19,200,000** |
| Construction Contingency | 10% | $1,920,000 |
| Engineering | 20% | $3,840,000 |
| Permitting (effort and fees) | 4% | $770,000 |
| Construction Management | 10% | $190,000 |
| **TOTAL CAPITAL COST (Construction Total + Implementation Total)** | | **$25,900,000** |

Notes:

1. No cost escalation is used.
2. No land or easement acquisition is included.
3. No public outreach is included.

| | | |
|---|---|---|
| WATERWORKS ENGINEERS | Title: | CCWD Recycled Water Feasibility Study |
| | Date: | 10/31/2023 |

**Direct Potable Reuse Treatment**

| ITEM | | COST |
|---|---|---|
| Treatment Processes | | $8,600,000 |
| Process Equipment Install | 25% | $2,150,000 |
| Site work | 15% | $1,290,000 |
| Electrical and Instrumentation | 60% | $5,160,000 |
| Mechanical | 15% | $1,290,000 |
| Piping and Valves | 20% | $1,720,000 |
| Upfront Source Control | | $500,000 |
| Treatment Building | | $2,500,000 |
| **Construction Subtotal** | | **$23,200,000** |
| Project Preliminary Design Contingency | 30% | $7,000,000 |
| **Subtotal** | | **$30,200,000** |
| Contractor General, Mobilization, Overhead & Profit | 15% | $3,500,000 |
| General Conditions, Bonds, Insurance & Taxes | 4% | $900,000 |
| **PROBABLE CONSTRUCTION COST** | | **$34,600,000** |
| Construction Contingency | 10% | $3,460,000 |
| Engineering | 20% | $6,920,000 |
| Permitting (effort and fees) | 4% | $1,380,000 |
| Construction Management | 10% | $350,000 |
| **TOTAL CAPITAL COST (Construction Total + Implementation Total)** | | **$46,700,000** |

Notes:

1. No cost escalation is used.
2. No land or easement acquisition is included.
3. No public outreach is included.

| | Title: | CCWD Recycled Water Feasibility Study |
|---|---|---|
| WATERWORKS ENGINEERS | Date: | 10/31/2023 |

**Operational and Maintenance Costs**

| Alternative | | Distribution System Energy Costs | Treatment Energy Costs | Treatment Chemical Costs | Equipment Replacement (a) | Maintenance Costs (b) | Other Costs (c) | Labor Costs | Annual Source Control Costs | Total Annual O&M Cost |
|---|---|---|---|---|---|---|---|---|---|---|
| **Non-Potable Reuse** | Fill station(s) for unrestricted residential or commercial use | $ 3,200 | $ 40,000 | $ 25,000 | $ 8,000 | $ 7,000 | $ 5,000 | $ 10,000 | $ - | **$ 100,000** |
| | Landscape and agricultural irrigation with disinfected tertiary recycled water | $ 6,400 | $ 90,000 | $ 25,000 | $ 14,000 | $ 12,000 | $ 25,000 | $ 900,000 | $ - | **$ 1,070,000** |
| | Skylawn Memorial Park irrigation with disinfected tertiary recycled water | $ 90,000 | $ 90,000 | $ 25,000 | $ 14,000 | $ 12,000 | $ 25,000 | $ 900,000 | $ - | **$ 1,160,000** |
| | Ocean Colony golf course and landscape irrigation with reverse osmosis treated water | $ 32,000 | $ 150,000 | $ 35,000 | $ 32,000 | $ 27,000 | $ 25,000 | $ 900,000 | $ - | **$ 1,200,000** |
| **Indirect Potable Reuse** | Groundwater replenishment with advanced treated water | $ 51,000 | $ 80,000 | $ 100,000 | $ 98,000 | $ 83,000 | $ 100,000 | $3,000,000 | $20,000 | **$ 3,530,000** |
| | Reservoir augmentation with advanced treated water | $1,000,000 | $ 450,000 | $ 100,000 | $ 98,000 | $ 83,000 | $ 100,000 | $3,000,000 | $20,000 | **$ 4,850,000** |
| **Direct Potable Reuse** | Advanced treated water to Nunes WTP | $ 620,000 | $1,100,000 | $ 150,000 | $ 172,000 | $ 146,000 | $ 150,000 | $3,800,000 | $50,000 | **$ 6,190,000** |

Notes:

(a) 2% of treatment processes cost.

(b) 1.7% of treatment processes cost.

(c) Compliance Testing and Security

| | Title: | CCWD Recycled Water Feasibility Study |
|---|---|---|
| WATERWORKS ENGINEERS | Date: | 10/31/2023 |

**Staff Requirements: Full-Time Equivalents (FTE)**

| Alternative | | Advanced Purified Water Facility | Senior Maintenance Staff | Maintenance Staff | Senior Instrumentation Tech | Senior Lab Staff | Lab Staff | Regulatory and Compliance | Other Administrative | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Non-Potable Reuse | FTE | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | |
| | Salary | $ 252,000 | $ 252,000 | $ 210,000 | $ 252,000 | $ 252,000 | $ 210,000 | $ 210,000 | $ 252,000 | |
| | Cost | $ - | $ 252,000 | $ 210,000 | $ 252,000 | $ - | $ - | $ 210,000 | $ - | $ 900,000 |
| Indirect Potable Reuse | FTE | 2 | 1 | 1 | 1 | 1 | 4 | 2 | 1 | |
| | Salary | $ 252,000 | $ 252,000 | $ 210,000 | $ 252,000 | $ 252,000 | $ 210,000 | $ 210,000 | $ 252,000 | |
| | Cost | $ 504,000 | $ 252,000 | $ 210,000 | $ 252,000 | $ 252,000 | $ 840,000 | $ 420,000 | $ 252,000 | $ 3,000,000 |
| Direct Potable Reuse | FTE | 5 | 1 | 1 | 1 | 1 | 4 | 2.5 | 1 | |
| | Salary | $ 252,000 | $ 252,000 | $ 210,000 | $ 252,000 | $ 252,000 | $ 210,000 | $ 210,000 | $ 252,000 | |
| | Cost | $ 1,260,000 | $ 252,000 | $ 210,000 | $ 252,000 | $ 252,000 | $ 840,000 | $ 525,000 | $ 252,000 | $ 3,800,000 |

EXHIBIT B

ROUX

# Half Moon Bay Terrace Groundwater Basin Watershed Hydrogeologic Report

Half Moon Bay, California

January 31, 2024

Prepared for:

**Coastside County Water District**


Prepared by:

**Roux Associates, Inc.**

555 12th Street, Suite 250

Oakland, California 94607


3918.0002S100ICVR

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# Executive Summary

This hydrogeologic report supporting a feasibility study related to proposed water recycling by Coastside County Water District (Coastside CWD) was prepared by Roux Associates, Inc. (Roux) on behalf of Water Works Engineers (WWE), the prime contractor for the feasibility study. The report covers conditions within the watershed of the Half Moon Bay Terrace Groundwater Basin (Groundwater Basin Number 2-22).

The goal of the overall project is to identify a preferred project for recycled water use within the Coastside CWD service area. Recycled water would serve as a supplemental source of water supply to meet Coastside CWD's anticipated future needs and reduce dependency during drought periods on water imported through the San Francisco Public Utilities Commission's (SFPUC's) Regional Water System (RWS), for example Crystal Springs Reservoir.

Currently, Coastside CWD gets water from the following sources: (1) imported water from SFPUC (Crystal Springs Reservoir and Pilarcitos Reservoir); (2) local surface water (e.g., Pilarcitos Creek); and (3) groundwater. While these sources are anticipated to be sufficient to meet existing and future water demands in normal years, significant water-supply shortages may occur during periods of drought. The addition of recycled water would both diversify and supplement the water portfolio available to Coastside CWD.

Three alternatives are being considered for recycled water including non-potable reuse, indirect potable reuse, and direct potable reuse. For the non-potable reuse option, recycled water could be used at a new fill station, habitat restoration, and/or landscape irrigation. For the indirect potable reuse option, recycled water could serve to replenish the groundwater aquifer or could be used for surface water augmentation. For the direct potable reuse option, this would involve introducing the recycled water back to the existing potable water system.

For this report, the study area is within the Half Moon Bay Terrace Groundwater Basin (groundwater basin) and surrounding Pilarcitos Creek Watershed (watershed for the groundwater basin).[1] This area will be referred to as the "Half Moon Bay Terrace Groundwater Basin Watershed" or "Project Area" throughout this report (Figure 1.1).

Roux has prepared this technical report which not only provides a primer on key groundwater concepts that relate to the Proposed Recycled Water Project, but also provides a description of the proposed project and conceptual groundwater model of the Half Moon Bay Terrace Groundwater Basin Watershed. The technical report focuses on areas affected by the Proposed Recycled Water Project inclusive of surface water characteristics, water rights/uses, groundwater inflows and outflows, hydraulic characteristics of groundwater units, storage characteristics, permitting requirements, and the identification of data gaps, and recommendations.

The recommendations not only include alternative-specific technical considerations, regulatory considerations, and discussion of hydrogeologic feasibility, but also provide recommendations for Coastside CWD to consider. Thus, providing information for Coastside CWD to evaluate future groundwater management in a more granular means, beyond the conceptual discussions that have been presented in this and prior hydrogeologic reports.

[1] Note, in some reports the Pilarcitos Creek Watershed is also referred to as the Arroyo Leon Watershed.

# 1. Introduction

This hydrogeologic report supporting a feasibility study related to proposed water recycling by Coastside County Water District (Coastside CWD) was prepared by Roux Associates, Inc. (Roux) on behalf of Water Works Engineers (WWE). WWE is the prime contractor for the feasibility study. The report covers conditions within the watershed of the Half Moon Bay Terrace Groundwater Basin (Groundwater Basin Number 2-22).

The goal of the overall project is to identify a preferred project for recycled water use within the Coastside CWD service area. Recycled water would serve as a supplemental source of water supply to meet Coastside CWD's anticipated future needs, provide resiliency to the coastline during natural disasters and emergencies, and reduce dependency during drought periods on water imported through the San Francisco Public Utilities Commission's (SFPUC's) Regional Water System (RWS), for example Crystal Springs Reservoir.

***Proposed Recycled Water Project***

Currently, the Coastside CWD uses water from the following sources:

- Imported water from SFPUC (Crystal Springs Reservoir and Pilarcitos Reservoir);
- Local surface water (e.g., Pilarcitos Creek); and,
- Groundwater.

While these sources are anticipated to be sufficient to meet existing and future water demands in normal years, significant water-supply shortages may occur during periods of drought. The addition of recycled water would both diversify and supplement the water portfolio available to Coastside CWD. Three alternatives are being considered for recycled water including non-potable reuse, indirect potable reuse, and direct potable reuse.

## 1.1 Current Scope of Work

The scope of work described below was designed to anticipate issues based on the proposed water-recycling scenarios and to provide hydrogeological background to the feasibility investigation. Additionally, data gaps were identified for refining key aspects of the hydrogeological investigation inclusive of a review of water rights along streams considered for flow augmentation. The current proposed work is foundational to more detailed groundwater modeling that may be required should the groundwater replenishment remain an option after the completion of the feasibility study.

Numerous technical studies have been conducted relating to aspects of the groundwater system that include conceptual model reports, discussions relating to additional groundwater production, water recycling and other aspects of the groundwater basin. These will be discussed in the report in the sections for which their conclusions and recommendations are most relevant. For the purposes of this hydrogeologic review, the current scope of work comprises the following tasks listed below.

***Data Review***

Roux reviewed hydrogeologic conditions in the Half Moon Bay Terrace Groundwater Basin within San Mateo County, California (Figure 1.1) inclusive of aspects of the groundwater conceptual model. These aspects included inflow and outflow components, hydraulic characteristics of principal water-bearing units, geologic structures, surface flow, and water quality of stream waters considered for flow augmentation. Additionally, a review of water rights along those streams was conducted.

***Field Visit***

Roux conducted field reconnaissance visits to observe and evaluate key areas of importance relating to proposed project alternatives and the information developed in the data review task. The focus of the field visits was visiting stream reaches where potential recycled water could be used to supplemental flow, and potential recharge areas. Additionally, areas of key hydrogeologic importance were visited as identified during the data and literature search and review.

***Regulatory Review***

Roux conducted a regulatory review of potential discharge permitting requirements that would be required including additional investigations for a potential stream augmentation scenario for the recycle water. This included a water rights review as they related to the streams where potential recycled water could be used to supplement flow.

***Reporting***

Roux prepared this technical report which not only provides a primer on key groundwater concepts that relate to the Proposed Recycled Water Project but also provides a description of the proposed project and conceptual groundwater model of the Half Moon Bay Terrace Groundwater Basin Watershed. The technical report focuses on areas affected by the Proposed Recycled Water Project inclusive of surface water characteristics, water rights/uses, groundwater inflows and outflows, hydraulic characteristics of groundwater units, storage characteristics, identification of data gaps, and recommendations. Additionally, in the case of groundwater replenishment either through percolation or injection, the potential extent of groundwater mounding is considered and discussed with respect to groundwater conditions including potential water quality considerations. Climate change effects have also been reviewed and are discussed.

## 1.2 Location and Physiographic Setting

For this report, the study area is within the Half Moon Bay Terrace Groundwater Basin (groundwater basin) and surrounding Pilarcitos Creek watershed (watershed for the groundwater basin).[2] This area will be referred to as the "Half Moon Bay Terrace Groundwater Basin watershed" or "Project Area" throughout this report (Figure 1.1).[3]

The Half Moon Bay Terrace Groundwater Basin watershed is bounded by the Pacific Ocean on the west, Martini Creek on the north, Tunitas Creek on the south, and by the Montara Mountains/Santa Cruz Mountains to the east. Elevations in the Project Area range from zero at the Pacific coastline, to 2,080 feet above mean sea level (amsl) at King Mountain. Numerous creeks cross the Project Area (see Section 2), with Pilarcitos Creek being the most prominent with the largest watershed.

The Half Moon Bay Terrace Groundwater Basin as defined by the California Department of Water Resources (DWR), is comprised of the basin-fill deposits extending from the base of the Santa Cruz Mountains on the east, to the Pacific coastline on the west (California DWR, 2014). While the groundwater basin (as defined by DWR) covers an area of approximately 9,000 acres, the watershed for the basin covers an area of approximately 18,400 acres (Figure 1.2).

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[2] Note, in some reports the Pilarcitos Creek Watershed is also referred to as the Arroyo Leon Watershed.

[3] Roux was initially asked to focus our efforts solely on Pilarcitos Creek for this report. However, to gather a greater understanding of the area, Roux decided to look at all the sections of the creeks in the area that falls within the Pilarcitos Creek Watershed and the Half Moon Bay Terrace Groundwater Basin (Figure 1.1).

## 1.3 Climate

The Project Area has been described as having a Mediterranean climate with precipitation generally in the form of winter and spring rains. Summers are typically dry, although regional fog moderates temperatures, reducing evapotranspiration, and meeting some moisture requirements for plants (California DWR, 1999; California DWR, 2014).

The average annual precipitation at the Half Moon Bay Terrace station (period of record from 1939 through 2016) at an elevation of approximately 40 feet amsl is 26.2 inches, with more than half of that precipitation falling during November through February. The average maximum high temperature is 62.2°F and average minimum is 47.1°F. Mean monthly high temperatures range from 58.4°F in January to 66.8°F in September. Mean monthly low temperatures in Half Moon Bay range from 42.9°F in January to 52.7°F in August. Generally, temperatures decrease, and precipitation increases in the surrounding mountains with increasing elevation.

### 1.3.1 Climate Change Effects

The effects of climate change in California are generally assumed to result in warmer, higher intensity storms that produce more frequent flash flood runoff events, greater evapotranspiration (from both warmer temperatures and longer growing seasons), and reduced groundwater recharge resulting from these described phenomena. These changes are anticipated to be incremental in nature, but of sufficient significance to account for these future climate-related impacts in long-term groundwater management planning. Rising sea level may also result in landward movement of the fresh-salt groundwater interface, resulting in saltwater intrusion to the groundwater basin.

According to the California DWR Sustainable Groundwater Management Act (SGMA) Data Viewer (California DWR, 2023a), the Half Moon Bay Terrace Groundwater Basin has among the highest density (on a percentage basis) of domestic wells that are susceptible to going dry. The decreased groundwater recharge that would be anticipated could exacerbate this issue, if indeed drying domestic wells remains, or is, an issue. Generally, groundwater levels have been relatively stable in the basin so the reduction of groundwater recharge as a result of climate change would need to be of sufficient scale to noticeably affect groundwater levels that lead to the drying of wells.

Roux applied the Cal-Adapt climate data tool (Cal-Adapt, 2023) to develop a Half Moon Bay Local Climate Change Snapshot Report for the Project Area that is provided in Appendix 1.1. The climate report is consistent with observations above, with significant average temperature increases anticipated in the next 40 years of 2 to 4 degrees Fahrenheit while precipitation remains relatively constant. The San Francisco Bay Area Regional Climate Change Assessment (Ackerley et.al., 2018) indicates that the effect of warming temperatures on the presence of the marine-layer clouds and fog and their buffering effects on warm temperatures is still unclear, but that during recent heat waves, marine fogs were absent.

With respect to sea-level rise (that has corresponding effects on groundwater levels inland within the Half Moon Bay Terrace Groundwater Basin and inland migration of the freshwater/seawater interface), the Statewide Summary Report – California's Fourth Climate Change Assessment (Bedsworth, et.al., 2018) and the San Francisco Bay Area Regional Climate Change Assessment presents an analysis of sea-level rise in southern California indicating 3 to more than 6 feet of sea level rise by the end of the century, with values dependent on the emissions assumptions used in the analysis (Ackerley, 2018). Effects of sea-level rise on groundwater elevations and the freshwater-seawater interface could be evaluated more robustly using numerical groundwater modeling tools.

## 1.4 Land Use

The land use within the Project Area is quite diverse, ranging from mixed use (which contains residential properties) to agricultural, industrial, recreational, and open space (Figure 1.3). In San Mateo County, definitions for land use are provided in the Zoning Regulations by the Planning and Building Department (County of San Mateo, 2022). In addition to San Mateo County's land use definitions, the City of Half Moon Bay has its own zoning regulations (Half Moon Bay Municipal Code, 2023).

For the Feasibility Study, Coastside CWD will need to consider the land use surrounding their proposed recycled water project. For example, if proposing to use the recycled water for agricultural irrigation – where are those agricultural lands located and how far will the recycled water get from the proposed treatment plant to the agricultural land? Will groundwater mounding from groundwater replenishment of recycled water affect surface, or near-surface infrastructure? Additionally, Coastside CWD will need to address how the land use and proposed project might affect nearby water rights (which is discussed further in this report in Section 4.2).

The following sub-sections explain the land use within the Half Moon Bay Terrace Groundwater Basin and the Pilarcitos Creek Watershed (Figure 1.2).

### 1.4.1 Half Moon Bay Terrace Groundwater Basin

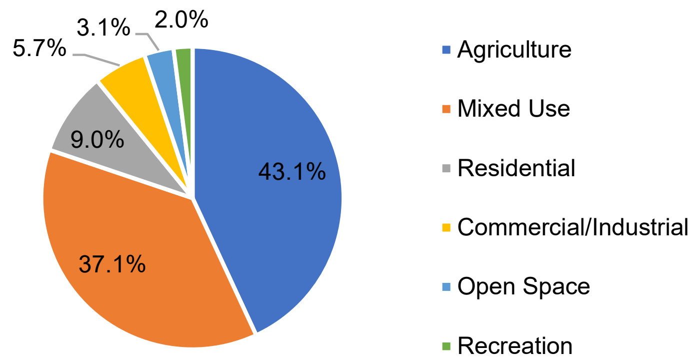
In the Half Moon Bay Terrace Groundwater Basin, the land use is primary agricultural – accounting for over 40% of the total basin, followed closely by mixed use at around 37% (Table 1.1). Mixed use zoning contains a mixture of commercial and residential land. After mixed use, is residential, commercial/industrial (combined),[4] open space, and then recreational (Figure 1.3).

**Table 1.1. Half Moon Bay Terrace Groundwater Basin Land Use**

| Land Use Type | Approximate Acreage | Land Use Percentage |
|---|---|---|
| Agriculture | 3,884 | 43.1% |
| Mixed Use | 3,343 | 37.1% |
| Residential | 808 | 9.0% |
| Airport | 314 | 3.5% |
| Open Space | 282 | 3.1% |
| Recreation | 183 | 2.0% |
| Industrial | 109 | 1.2% |
| Institutional | 67 | 0.7% |
| Commercial | 27 | 0.3% |
| **Total** | **9,017** | **100%** |

[4] For commercial/industrial land use, the following land use types were combined: airport, industrial, institutional, and commercial.

**Figure 1.4. Half Moon Bay Terrace Groundwater Basin Land Use – Combined**



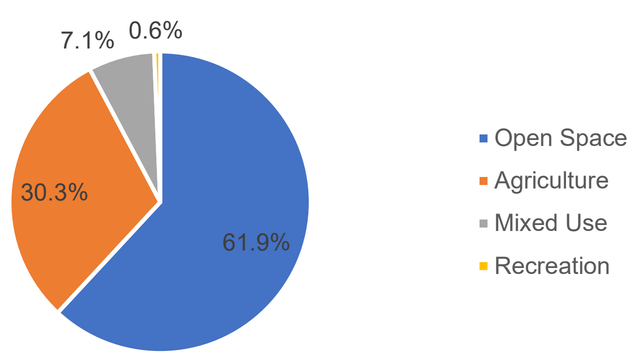

### 1.4.2 Pilarcitos Creek Watershed Basin

In the Pilarcitos Creek Watershed Basin (also known as the Arroyo Leon Watershed Basin [USGS, 2023i]), the land use is primary open space – accounting for over 60% of the total basin, followed by agricultural at around 30%. After agricultural, is mixed use then recreation (Table 1.2 and Figure 1.5).

**Table 1.2. Pilarcitos Creek Watershed Basin Land Use**

| Land Use Type | Approximate Acreage | Land Use Percentage |
|---|---|---|
| Open Space | 11,384 | 61.9% |
| Agriculture | 5,580 | 30.3% |
| Mixed Use | 1,310 | 7.1% |
| Recreation | 119 | 0.6% |
| **Total** | **18,392** | **100%** |

**Figure 1.5. Pilarcitos Creek Watershed Basin Land Use**




## 1.5 Water Rights

In California, there are two types of water with respect to the law: groundwater and surface water. Water flowing in a subterranean stream is treated as surface water in California; however, percolating water is not treated as surface water (California SWRCB, 2020; California SWRCB, 2022; TPL, 2003). A general discussion of the water rights related to groundwater and surface water is provided in Appendix 1.4.

Additionally, a brief summary of the water rights located within the Project Area is included. The implications of existing water rights as they relate to the Proposed Recycled Water use options are described in Section 4.

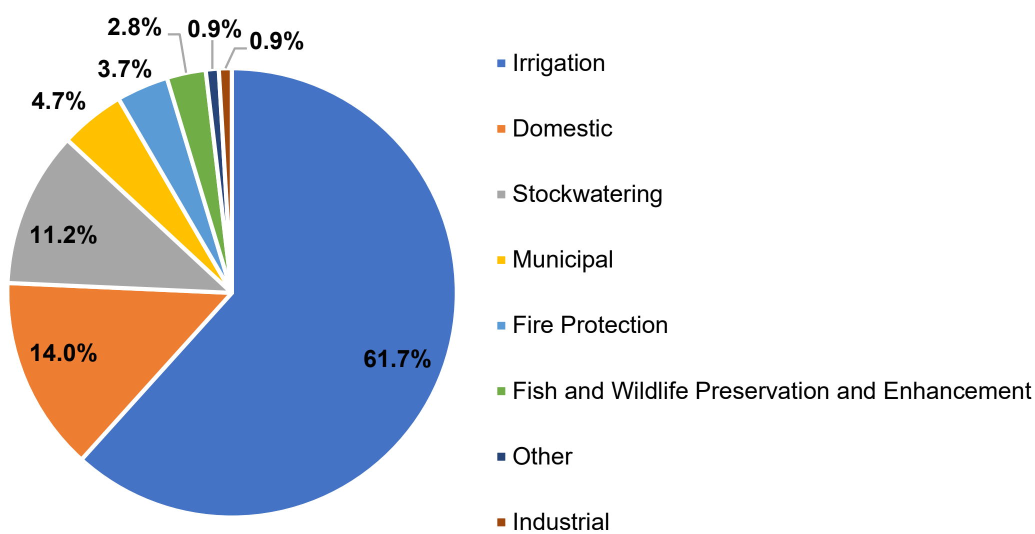
### 1.5.1 Water Rights in the Project Area

Within the Project Area there are 107 posted water rights, with 77 unique application identification numbers (California SWRCB, 2023a; California SWRCB, 2023b).[5] Of the 107 posted water rights, 50 are located within the Pilarcitos Creek Watershed outside of the groundwater basin boundary, 32 are located within the Half Moon Bay Terrace Groundwater Basin outside of the Pilarcitos Creek Watershed, and the remaining are located in the area overlapped by both the Pilarcitos Creek Watershed and the Half Moon Bay Terrace Groundwater Basin.

Around half (52%) the water rights within the Project Area are appropriative rights. The remaining water rights include temporary permits (around 4%) and statements of intended diversion and use (around 44%).[6] The water rights associated with the statements of intended diversion and use include a mix of riparian and appropriative water rights. A list of these water rights is included on Table 1.3, and if available, corresponding documentation for the water rights is included within Appendix 1.2. The locations of these water rights are provided in Figure 1.6 and Appendix 1.3.

Of the water rights within the Project Area, the water is used for the following beneficial uses: irrigation, domestic, stockwatering, municipal, fire protection, fish and wildlife preservation and enhancement, other, and industrial. Figure 1.7 below breaks down the percentages for each of these beneficial uses. As you can see, within the Project Area, most water rights are used for irrigation purposes (over 60%).

**Figure 1.7. Beneficial Uses of Water Rights within the Project Area**

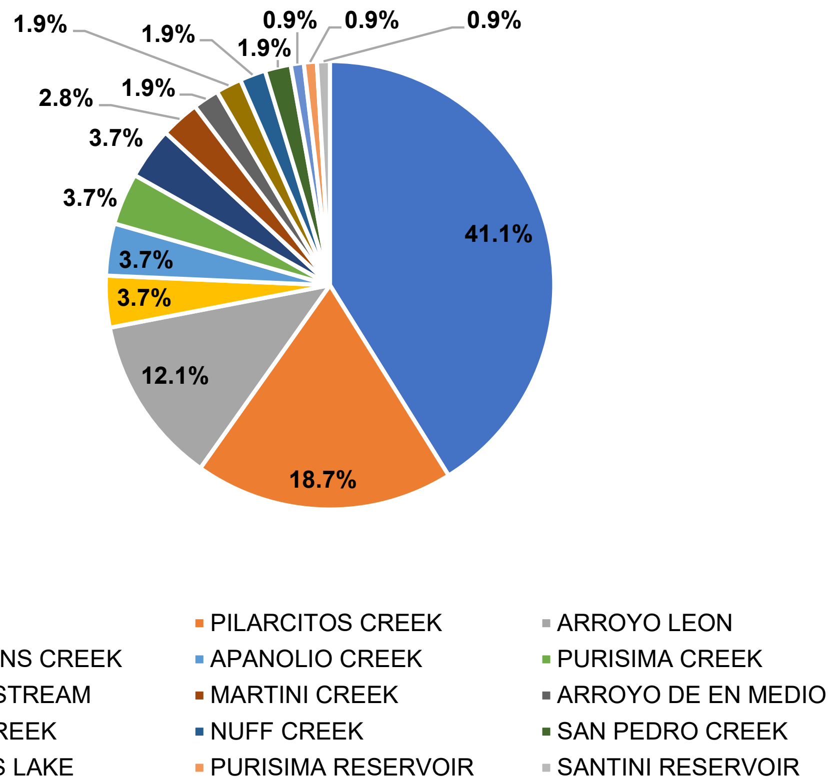



[5] Within the Project Area, water rights were researched in July 2023. It should be noted that some of the posted water rights may be duplicative. In Table 1.3, even if an Application ID is listed more than once, it is included within the table – mainly to track why an application may have changed.

[6] Statement of Diversion and Use: California Water Code §5101 requires each person or organization that uses diverted surface water or pumped groundwater from a known subterranean stream after December 31, 1965 to file with the State Water Board a Statement of Water Diversion and Use prior to February 1 of the following year (California SRWCB, 2022).

Within the Project Area, there are a number of sources which have posted water rights. These sources include unknown (or unlisted water sources), Pilarcitos Creek, Arroyo Leon, and various others. Figure 1.8 below breaks down the percentages for each of these water sources. Within the Project Area, most of the known water rights (as in not including the "unknown" water sources) are located along Pilarcitos Creek (around 19%).

**Figure 1.8. Sources of Water Rights within the Project Area**




The three largest holders of water rights within the Project Area are Peninsula Open Space Trust (POST, 18.7%), Sky Lawn Memorial Park (10.3%), and Coastside CWD (9.3%). POST has 20 water rights within the Project Area, only 1 is considered inactive. The primary beneficial use of their water rights is for stockwatering and irrigation. Sky Lawn Memorial Park has 11 water rights; however, only 3 remain active – which are all used for irrigation. Coastside CWD has 10 water rights, with 6 active licenses – which are all used for domestic purposes. For information related to the remaining water rights owners within the Project Area refer to Table 1.3.

Of the water rights that are posted within the Project Area, around 30% are either cancelled, revoked, or inactive. However, the remaining water rights (70%) are either licensed, permitted, or claimed. For the status definitions of these water rights, refer to Table 1.3.

## 1.6 Groundwater Management

The Coastside CWD was formed in 1947 and provides treated water to the City of Half Moon Bay and to the unincorporated communities of Princeton, Miramar, and El Granada. Private wells are permitted within the Coastside CWD service area; therefore, groundwater usage in the Coastside CWD service area is likely higher than the groundwater-supplies utilized by the Coastside CWD. The Half Moon Bay Terrace

Groundwater Basin is not within the boundary of a Groundwater Sustainability Agency under Sustainable Groundwater Management Act (SGMA). The Coastside CWD's distribution of potable water is regulated by the California State Water Resources Control Board (Drinking Water Division) that oversees large water systems that provide drinking water for most of the public.

Groundwater quality issues in the basin are regulated by the California State Water Resources Control Board – San Francisco Bay Region (CRWQCB-SFB). San Mateo County conducts water-related activities such as issuing well permits through the San Mateo County Health Department (Environmental Health Division), and water-quality functions such as monitoring groundwater conditions, overseeing clean-up of pollution caused by leaking underground tanks and chemical spills, and work with other agencies, such as the Environmental Protection Agency (EPA) and the Water Quality Control Boards, to make sure the clean-up process follows State and local laws. The San Mateo County Health Department also manages a Small Water Systems Program regulating these smaller water systems through inspections and other activities (San Mateo County Health Department, 2023a). Other community planning and environmental review activities are conducted through the San Mateo County Planning Department.

A figure with the location of the groundwater wells within the Project Area is shown on Figure 1.9.

## 1.7 Sources of Information

Roux obtained groundwater and surface water information from Coastside CWD, California DWR, California Department of Fish and Wildlife (CDFW), California SWRCB, CRWQCB-SFB, California Department of Toxic Substances Control (DTSC), California Department of Conservation, EPA, San Mateo County, local newspaper articles, U.S. Geological Survey (USGS), National Oceanic and Atmospheric Administration (NOAA), published articles, and Roux's own library. For a full list of references, refer to Section 6.

# 2. Surface Water Conditions

Within the Project Area, the following streams (located from north to south) discharge into the Half Moon Bay Terrace Groundwater Basin (Figure 1.2):

- Martini Creek;
- San Vicente Creek;
- Denniston Creek;
- Arroyo de en Medio;
- Frenchman's Creek;
- Pilarcitos Creek;
- Arroyo Canada Verde;
- Purisima Creek; and
- Lobitos Creek.

The surface water conditions of these streams are discussed further in the sub-sections below. For the purposes of the Proposed Recycled Water Project, Pilarcitos Creek is of greatest significance in that one of the proposed alternatives for recycled water is supplementing Pilarcitos Creek flows. Descriptions of the other creeks are provided only to provide descriptions and characteristics of other streams within the Project Area, and to better understand potential inflows into the Half Moon Bay Terrace Groundwater Basin (as discussed in Section 3.5).

## 2.1 Martini Creek

Martini Creek is an approximately two-mile-long creek with headwaters on the north side of Montara Mountain. Martini Creek outflows to the Pacific Ocean at Montara State Beach (California SWRCB, 2023e). The creek's drainage basin is composed of northern coastal scrub habitat and agricultural land. Based on weekly analysis of indicator bacteria (total coliforms, *Enterococcus*, and *Escherichia coli* [E. Coli]), Martini Creek has passed all its water quality tests in 2023 to date. This is an increase from 2021, which only 67% of the weekly analysis past the water quality tests for indicator bacteria (Swim Guide, 2023). There is an unnamed tributary that drains into Martini Creek, approximately 1.2 miles from its headwaters. Based on the documents reviewed, no USGS or NOAA gages are present along the creek.

There are three water rights associated with Martini Creek in the Project Area. These water rights were filed between 1977 and 2020 and are all associated with the Peninsula Open Space Trust for either stockwatering or irrigation. Of the three water rights, one is currently listed as being inactive (Table 1.3).

## 2.2 San Vicente Creek

The San Vicente Creek is 3.9 miles long. Its headwaters are on the western side of Montara Mountain, and it outflows to the Pacific Ocean at Fitzgerald Marine Reserve in Moss Beach, California. Additionally, San Vicente Creek flows into the Upper and Lower San Vicente Reservoirs just over a mile from its mouth (Coastside CWD, 2011).

San Vicente Creek and its reservoirs were one focus of the Denniston/San Vicente Water Supply Project that was originally proposed by Coastside CWD in 2011. A limited diversion (the "San Vicente Diversion") has existed on the San Vicente Creek since the 1900s, and a 1969 water permit (this water right, Permit ID 15882, is just outside the Project Area) allows Coastside CWD to divert up to 2 cubic feet per second (cfs) year-round (more discussion on this permit is provided in Section 2.1.3). As of 2021, the San Vicente Diversion consists of a diversion ditch and sandbag impoundment that supplies water to the Upper San Vicente Reservoir through a pipeline. The diversion is maintained by a local farmer with senior water rights who stores water in upper and lower San Vicente reservoirs (Coastside CWD, 2011).

The Denniston/San Vicente Water Supply Project would replace the seasonal diversion structure with a permanent structure and a pump station. Additionally, the project would include a 6,100-foot-long pipeline to convey San Vicente Creek water to the existing Denniston Reservoir pump station. Due to the importance of the San Vicente reservoirs in recharging groundwater levels, the project will not interfere with maintenance of the reservoirs (Coastside CWD, 2011). Based on the documents reviewed, no USGS or NOAA gages are present along the creek.

According to the California SWRCB, there are six water rights located along San Vicente Creek. The primary owner of five of the water rights is G Lea Family Farms LLC and the primary owner of one of the water rights is Coastside CWD. However, within the Project Area (Figure 1.1 and Figure 1.6) there are no water rights associated with San Vicente Creek.[7]

## 2.3 Denniston Creek

Denniston Creek is a 4.4-mile-long creek with a four-square mile watershed (Coastside CWD, 2011). Its headwaters are less than half a mile north of Montara Mountain, and it flows into the Pacific Ocean at Pillar Point Harbor. Average annual precipitation for the Denniston Creek watershed is approximately 28 inches, and the main sources of water for the creek are fog, rain, and natural springs. The headwaters of Denniston Creek are composed of erodible granitic rocks, and the creek has five unnamed tributaries fed by natural springs that flow through Miramar coarse sandy loam. Unpaved roads run along large sections of Denniston Creek, and there are a few large agricultural fields adjacent to the creek in the upper portion of the valley (TRC, 2006).

Denniston Reservoir is created by a dam on Denniston Creek, approximately 1.2 miles north of Pillar Point Harbor (Coastside CWD, 2011). The Coastside CWD operates several seasonal wells adjacent to Denniston Creek and downstream of the dam. Denniston Reservoir, which was built to supply water for agriculture in the early 1900s and is equipped with a WTP. As of 2021, the reservoir was dredged by Coastside CWD to remove approximately 500 cubic yards of soil (Coastside CWD, 2021).

The original water rights permit for the reservoir (this water right, Permit ID 15882, is just outside the Project Area), were issued by California SWRCB in 1969 and authorized Coastside CWD to divert 2 cfs from both Denniston and San Vicente Creeks on a year-round basis. The 1969 permit also included “a permanent diversion facility on San Vicente Creek consisting of a sump and pump station (a limited seasonal diversion is in place; improvements to diversion and the pump station are part of proposed project); a 6,100-foot-long 8-inch diameter pipeline from the San Vicente diversion to Denniston Reservoir pump station (part of proposed project); a pump station at the westerly end of Denniston Reservoir (in place); a WTP located northerly of this reservoir (in place and with enhanced treatment capacity approved/in place); and a treated water pipeline from the treatment plant to the existing water distribution system via the Coastside CWD’s other WTP (in place)” (Coastside CWD, 2011).

[7] A portion of San Vicente and Denniston Creeks are within the “Project Area”; however, not the whole portion of those creeks. Therefore, this is why although there are water rights along these creeks, there are no water rights within the “Project Area.”

Based on the documents reviewed, no USGS or NOAA gages are present on Denniston Creek. According to the California SWRCB, there are seven water rights located along Denniston Creek. The primary owners of the water rights include G Lea Family Farms LLC (four water rights), Peninsula Open Space Trust (two water rights), and Coastside CWD (one water right). However, within the Project Area (Figure 1.1 and Figure 1.6) there are no water rights associated with Denniston Creek.[8]

## 2.4 Arroyo de en Medio

The Arroyo de en Medio is 2.5 miles long and has headwaters approximately 1.5 miles south of Montara Mountain. The Arroyo de en Medio outflows to the Pacific Ocean at Miramar Beach in Miramar, CA. There are no tributaries to the Arroyo de en Medio (California SWRCB, 2023e; USGS, 1994; USGS, 2023h). Based on the documents reviewed, no USGS or NOAA gages are present along the creek.

There are two water rights associated with Arroyo de en Medio in the Project Area. These water rights were filed between 1956 and 2008 and are used for irrigation purposes. Of the two water rights, only one is currently listed as being active (Table 1.3).

## 2.5 Frenchman's Creek

Frenchman's Creek is an approximately four-mile-long creek located between the towns of Half Moon Bay, and Miramar, California. Its headwaters are approximately 0.25 miles northwest of Scarper Peak, and it outflows to the Pacific Ocean at Venice Beach in the town of Miramar. (California SWRCB, 2023e; USGS, 1994; USGS, 2023h). Based on the documents reviewed, no USGS or NOAA gages are present along Frenchman Creek.

There are four water rights associated with Frenchman's Creek in the Project Area. These water rights were filed between 1946 and 2016 and are used for irrigation and stockwatering purposes – all of which are still active (Table 1.3).

#### *Main Tributaries of Frenchman's Creek*

**Locks Creek**

Locks Creek is an approximately two-mile-long tributary of Frenchman Creek. Its headwaters are on the southeastern side of Montara Mountain, and it flows into Frenchman Creek approximately three miles above the mouth of Frenchman Creek (California SWRCB, 2023e; USGS, 1994; USGS, 2023c). Based on the documents reviewed, no USGS or NOAA gages are present along Locks Creek.

According to the California SWRCB, there are no water rights associated with Locks Creek in the Project Area. However, it should be noted that this tributary is located outside the Project Area.

## 2.6 Pilarcitos Creek

One of the recycled water use alternatives being considered by Coastside CWD is supplementing flow to Pilarcitos Creek. Pilarcitos Creek, the largest stream within the Project Area, is an approximately 13.5-mile-long creek with headwaters along the northeast side of North Peak Mountain, approximately 1.5 miles above Pilarcitos Lake. The creek drains westward and discharges into the Pacific Ocean between Venice Beach and Elmar Beach in the City of Half Moon Bay, California (California SWRCB, 2023e; USGS, 1994; USGS, 2023c). Elevations along the creek range from over 2,000 ft amsl to sea level. Vegetation along Pilarcitos

[8] A portion of San Vicente and Denniston Creeks are within the "Project Area"; however, not the whole portion of those creeks. Therefore, this is why although there are water rights along these creeks, there are no water rights within the "Project Area."

Creek consists primarily of shrubs and grasslands (Todd, 2003). Near the headwaters of Pilarcitos Creek is Pilarcitos Lake (also known as Pilarcitos Reservoir). Pilarcitos Lake is a reservoir maintained and operated by SFPUC.

The water quality of Lower Pilarcitos Creek is lower when compared to other coastal streams within the Project Area. For example, Pilarcitos Creek consistently shows high fecal coliform counts compared to other coastal streams. Additionally, Pilarcitos Creek historically has had high levels of total dissolved solids (TDS), total suspended solids (TSS), zinc, copper, nitrate, and orthophosphate. Potential sources of contamination include horse manure, fecal waste from seagulls, agricultural activity, and the Ox Mountain Landfill (PWA, 2008). For a list of sites of environmental concern within the Project Area, refer to Section 3.7.

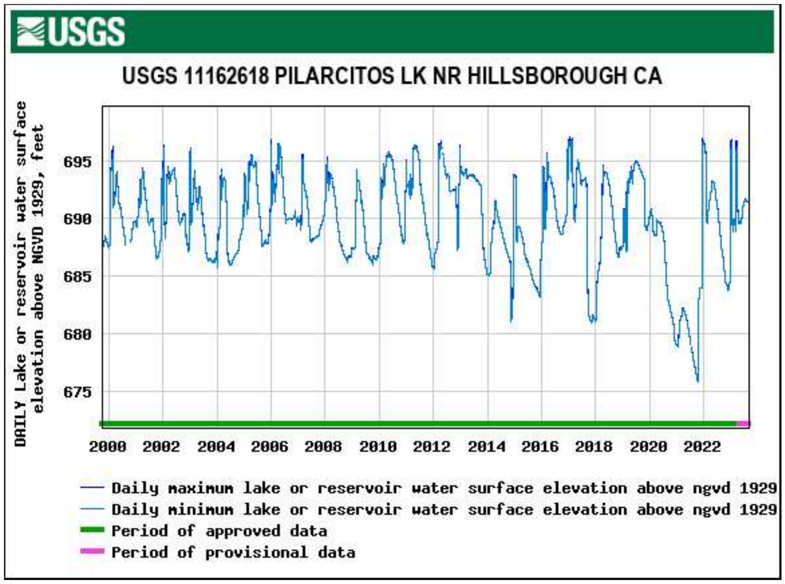
There are several main tributaries along Pilarcitos Creek: Apanolio Creek, Arroyo Leon, Corrinda Las Trancos Creek, Madonna Creek, Mills Creek, and Nuff Creek. Descriptions of these tributaries are provided below. Most of the lands around Pilarcitos Creek and its tributaries consist of agricultural land, primarily for flowers, crops, Christmas trees, and irrigated pasture. It should be noted that significant portions of the land around Upper Pilarcitos Creek and its tributaries are protected by the SFPUC. Additionally, much of the land between Pilarcitos Creek and Arroyo Leon is protected from urban development by POST. However, there are some residential lands present, especially along Highway 92 (Todd, 2003).

The USGS operates five gages along Pilarcitos Creek (starting from the headwaters, downstream to the mouth of the creek): Pilarcitos Lake (USGS, 2023c), Pilarcitos Creek below spillway (USGS, 2023d), Pilarcitos Creek above stone dam (USGS, 2023e), Pilarcitos Creek below stone dam (USGS, 2023f), and Pilarcitos Creek at Half Moon Bay (USGS, 2023g). The first four USGS gages are located in the highlands and the last gage is located in the lowlands. Pilarcitos Creek at Half Moon Bay began collecting data in 1966, Pilarcitos Creek below Stone Dam began collecting data in 1997, Pilarcitos Lake began collecting data in 1999, Pilarcitos Creek above Stone Dam began collecting data in 2022, and Pilarcitos Creek below spillway also began collecting data 2022. A summary of the data from each of these gages is provided below and included within Appendix 2.1.

**USGS 11162618, Pilarcitos Lake (USGS, 2023c)**

Measurements at the USGS gage at Pilarcitos Lake began in 1999 (Appendix 2.1). Data from this gage include daily records of the lake surface water elevation (Figure 2.1 below). Based on the data, the highest surface water measurement was recorded in February 2017 and lowest surface water measurement was recorded in September 2021.

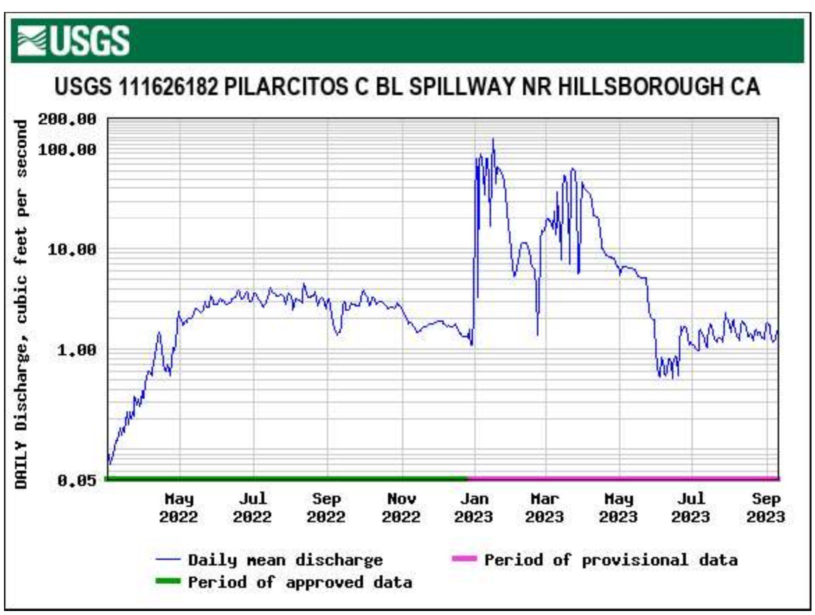
**Figure 2.1. Pilarcitos Lake Surface Water Elevation**




**USGS 111626182, Pilarcitos Creek Below Spillway (USGS, 2023d)**

Measurements from the USGS gage on Pilarcitos Creek, below the spillway, began in 2022. Data from this gage includes daily recordings of stream discharge, peak streamflow, and field measurements. Based on the data, the highest average stream discharge was recorded on January 16, 2023 at 124 cfs and the lowest average stream discharge was recorded on March 4, 2022 at 0.07 cfs (Figure 2.2). The channel at this location along the creek is described as having a soft stability, even terrane, and consisting of sand and silt-like materials (Appendix 2.1). Given the recency of installation, this data record only reflects conditions during a record wet season, and a longer data record is needed to evaluate streamflow characteristics at this location.

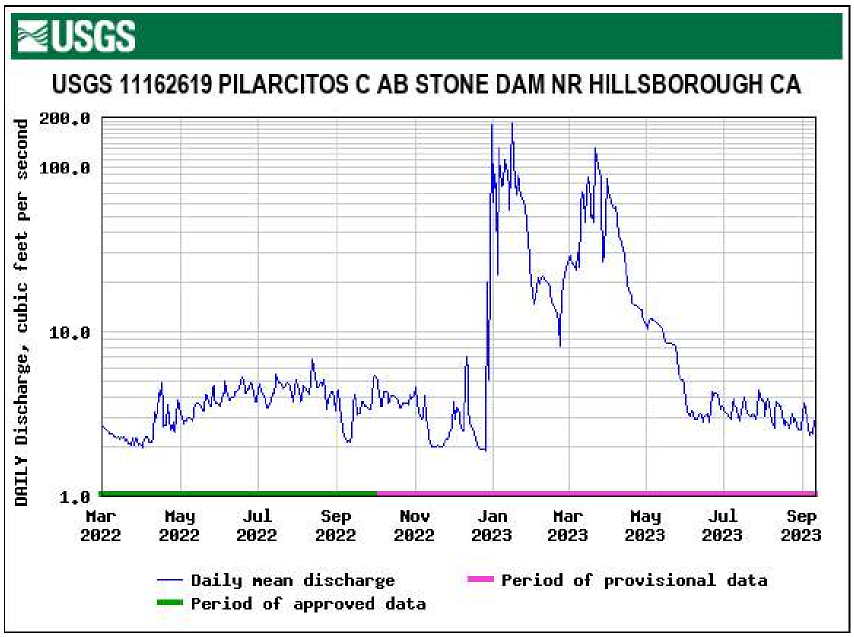
**Figure 2.2. Pilarcitos Creek Below Spillway Daily Stream Discharge**



**USGS 11162619, Pilarcitos Creek Above Stone Dam (USGS, 2023e)**

Measurements from the USGS gage on Pilarcitos Creek, above the stone dam, began in 2022. Data from this gage includes daily recordings of stream discharge, peak streamflow, and field measurements. Based on the data, the highest average stream discharge was recorded on January 1, 2023 at 186 cfs and the lowest average stream discharge was recorded on December 26, 2022 at 1.83 cfs (Figure 2.3). The channel at this location along the creek is described as having a predominately firm stability, even terrane, and consisting of gravel and sand-like materials (Appendix 2.1). Similar to the previous station, this record only presents data from a record wet season and the data record is insufficient to evaluate stream characteristics.

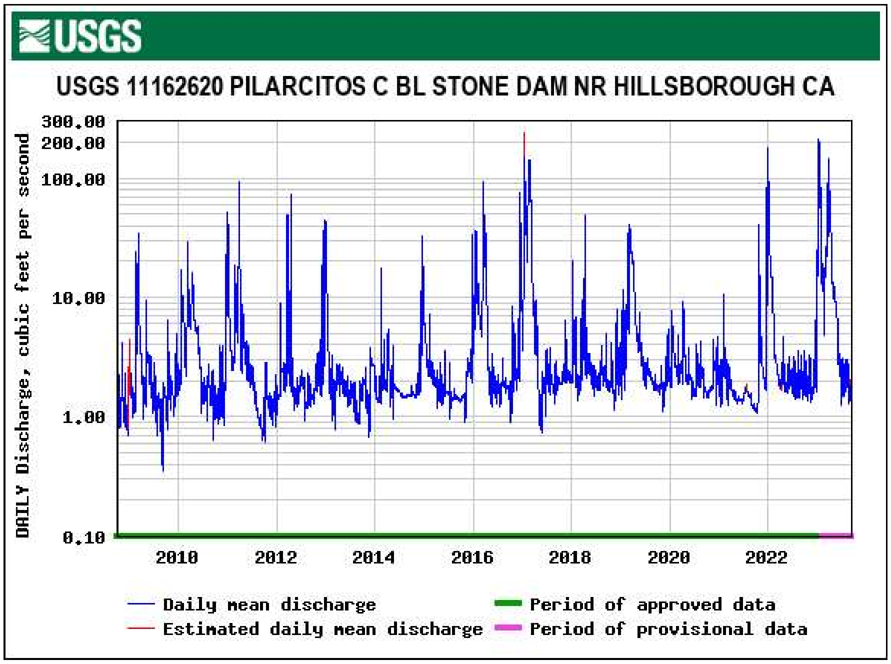
**Figure 2.3. Pilarcitos Creek Above Stone Dam Daily Stream Discharge**




**USGS 11162620, Pilarcitos Creek Below Stone Dam (USGS, 2023f)**

Measurements from the USGS gage on Pilarcitos Creek, below the stone dam, began in 1997. Data from this gage includes daily recordings of stream discharge, peak streamflow, field measurements, and water quality. Based on the data, the highest daily stream discharge was recorded on January 10, 2017 (240 cfs) and the lowest daily stream discharge was recorded on August 30, 2009 at 0.35 cfs (Figure 2.4). Throughout the dataset, the temperature ranged from 38.3˚F (December 10, 2013) to 55.3˚F (August 14 and August 15, 2020). The channel at this location along the creek is described as having a predominately firm stability, a mixture of even and uneven terrane, and consisting of gravel, cobbles, and boulders (Appendix 2.1).

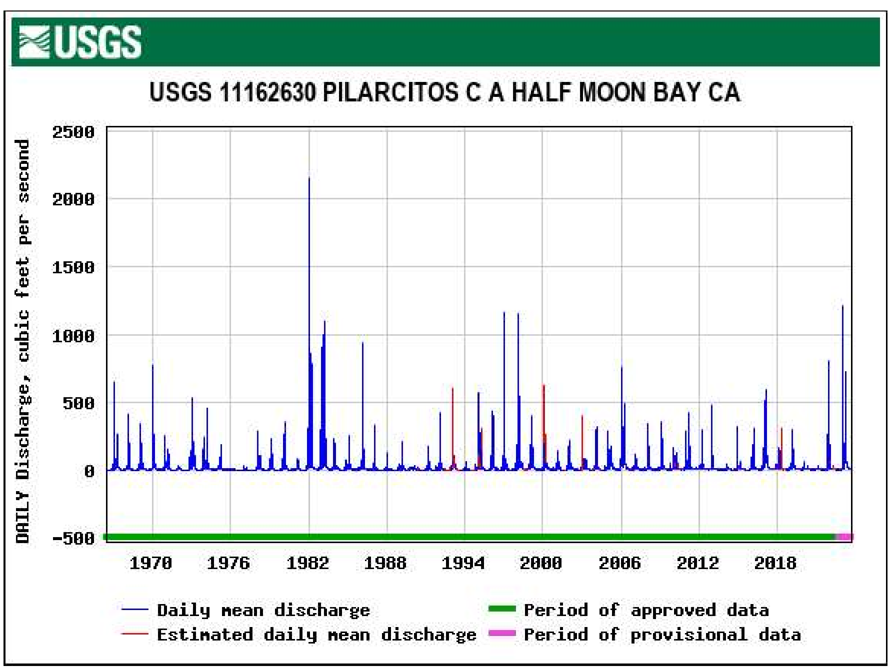
**Figure 2.4. Pilarcitos Creek Below Stone Dam Daily Stream Discharge**




**USGS 11162630, Pilarcitos Creek at Half Moon Bay (USGS, 2023g)**

Measurements from the USGS gage on Pilarcitos Creek, at Half Moon Bay, began in 1966. Data from this gage includes daily recordings of stream discharge, peak streamflow, field measurements, and water quality. Based on the data, the highest average stream discharge was recorded on January 4, 1985 at 2,150 cfs and the lowest average stream discharge was 0.00 cfs, for multiple dates (Figure 2.5). The channel at this location along the creek is described as having soft and firm stability, having predominantly even terrane, and consisting of gravel, sand, and silt-like materials (Appendix 2.1).

**Figure 2.5. Pilarcitos Creek at Half Moon Bay Daily Stream Discharge**



Based on these USGS data, the portion of Pilarcitos Creek with the highest average daily discharge is the location at Half Moon Bay. Here, the average daily discharge is generally an order of magnitude larger than the other creek gage locations. That being said, it is also the location that has some of the lowest daily discharge rates. For example, at the Pilarcitos Creek gage at Half Moon Bay, there are several dates throughout the dataset in which the daily discharge is 0.00 cfs (Appendix 2.1). Based on the information available on USGS' website, it is unclear why this location experiences such a fluctuation in stream discharge. However, it is likely the result of drought conditions and surface water usage patterns. This could also be an effect of other surface water management activities.

There are 20 water rights associated with Pilarcitos Creek in the Project Area – the highest number of water rights out of the creeks that drain into the Half Moon Bay Terrace Groundwater Basin. These water rights were filed between 1955 and 2014 and used for the following beneficial purposes: irrigation (55%), domestic (30%), fire protection (10%), and industrial (5%). Out of the 20 water rights, only 5 are listed as either revoked or inactive (Table 1.3). The implications of these water rights for the Proposed Recycled Water Project are discussed in Section 4.

***Main Tributaries of Pilarcitos Creek***

The following tributaries to Pilarcitos Creek are also important to understand relative to the Proposed Recycled Water Project. These streams are largely undeveloped and can be prone to flooding during storm events. These conditions could make discharging recycled water to Pilarcitos Creek problematic during periods of the wet season.

**<u>Apanolio Creek</u>**

Apanolio Creek (also referred to as Digges Canyon) is a 3.6-mile-long tributary to Pilarcitos Creek that drains an approximately 2.1-square mile watershed (CDFW, 2013a). Its headwaters are less than a mile southeast of Ox Hill, and it flows south through Diggs Canyon to meet Pilarcitos Creek approximately 2.5 miles from Half Moon State Beach, where the Pilarcitos outflows into the Pacific Ocean (California SWRCB, 2023e; USGS, 1994; USGS, 2023h). Elevations in the Apanolio watershed range from about 105 feet at the mouth of the creek to 1,742 feet at the headwaters. Vegetation in the watershed is primarily grassland and herbaceous forest. Ninety-nine percent (99%) of the land in the watershed is classified as undeveloped by the California CDFW, while less than 1% is classified as urban or agricultural. Additionally, 99% of the land in the Apanolio Creek watershed is privately owned (CDFW, 2013a). Based on the documents reviewed, no USGS or NOAA gages are present along Apanolio Creek.

There are 4 water rights associated with Apanolio Creek in the Project Area. These water rights were filed between 1955 and 2011 and used for the following beneficial purposes: irrigation and domestic. Out of the 4 water rights, there are currently 2 listed as inactive (Table 1.3).

**<u>Arroyo Leon</u>**

Arroyo Leon is a 6.5-mile-long tributary to Pilarcitos Creek that drains an 8.6-square mile watershed (CDFW, 2013b). Its headwaters are approximately half a mile west of King's Mountain, and it flows west through Higgins Canyon to meet Pilarcitos Creek just 1.5 miles from the Pacific Ocean. Mills Creek is a tributary of the Arroyo Leon (California SWRCB, 2023e; USGS, 1994; USGS, 2023h). Based on the documents reviewed, no USGS or NOAA gages are present along the Arroyo Leon Creek.

There are 13 water rights associated with the Arroyo Leon in the Project Area. These water rights were filed between 1977 and 2014 and used for the following beneficial purposes: irrigation (around 54%);

stockwatering (around 23%); domestic (around 15%); and other (around 7%). Out of the 13 water rights, there are currently 4 listed as either cancelled or inactive (Table 1.3).

**Corrinda Los Trancos Creek**

Corrinda Los Trancos Creek is an approximately 1.5-mile-long tributary to Pilarcitos Creek. Its headwaters are less than half a mile south of the end of Digges Canyon Road, and it joins the Pilarcitos approximately 3 miles from the mouth of the Pilarcitos (California SWRCB, 2023e; USGS, 1994; USGS, 2023h). The Corrinda Los Trancos Creek was impacted by a flood event the week of December 12, 2021. Debris from Corrinda Los Trancos clogged a culvert operated by Caltrans, causing flooding on Highway 92. On December 14, the town of Half Moon Bay reported 4.87 inches of rain in the past 72 hours, almost exceeding the average December rainfall total in the town of 5.17 inches. Flooding was also observed in Pilarcitos Creek during this rain event (Half Moon Bay Review, 2021). Based on the documents reviewed, no USGS or NOAA gages are present along the Corrinda Los Trancos Creek.

According to the California SWRCB, there are no water rights associated with Corrinda Los Trancos Creek in the Project Area.

**Madonna Creek**

Madonna Creek is an approximately 2.5-mile-long tributary of Pilarcitos Creek. Its headwaters are about a mile north of Burleigh H. Murray Ranch State Park, and Madonna Creek joins the Pilarcitos approximately 2.5 miles before the confluence of Pilarcitos Creek and the Pacific Ocean (California SWRCB, 2023e; USGS, 1994; USGS, 2023h). In 2020, the Midpeninsula Regional Open Space District detected high concentrations of lead and petroleum in soils at a junk yard at the former Madonna Creek Ranch. These chemicals, primarily from three cars and more than 30 car batteries dumped at the site, were detected 20 feet below the ground in some areas. Due to the site's proximity to Madonna Creek, Midpeninsula Regional Open Space District contracted Engineering/Remediation Resources Group Inc. to remove contaminated soil. Tests confirmed that contaminants were removed from the area (Half Moon Bay Review, 2020). Based on the documents reviewed, no USGS or NOAA gages are present along the Corrinda Los Trancos Creek.

According to the California SWRCB, there are no water rights associated with Madonna Creek in the Project Area.

**Mills Creek**

Mills Creek is an approximately four-mile-long tributary to the Arroyo Leon (which is a tributary of the Pilarcitos Creek). Its headwaters are approximately a mile to the northwest of King's Mountain, and it flows into the Arroyo Leon 1.4 miles before the confluence of the Arroyo Leon and the Pilarcitos Creek (California SWRCB, 2023e; USGS, 1994; USGS, 2023h). Based on the documents reviewed, no USGS or NOAA gages are present along Mills Creek.

According to the California SWRCB, there are no water rights associated with Mills Creek in the Project Area.

**Nuff Creek**

Nuff Creek is an approximately two-mile-long tributary of Pilarcitos Creek. Its headwaters are on the southern side of Corrinda Los Trancos Mountain, and it joins the Pilarcitos approximately 4.2 miles from the mouth of the Pilarcitos (California SWRCB, 2023e; USGS, 1994; USGS, 2023h). Based on the documents reviewed, no USGS or NOAA gages are present along Nuff Creek.

There are two water rights associated with Nuff Creek in the Project Area. These water rights were filed in 1975 and 2014 and are used for fish and wildlife preservation and enhancement as well as irrigation – both of which are still active (Table 1.3).

## 2.7 Arroyo Canada Verde

Arroyo Canada Verde (also known as Canada Verde Creek) is an approximately 2.5-mile-long creek south of the town of Half Moon Bay, California. Its headwaters are approximately 0.5 miles west of McGovern Ridge, and it flows into the Pacific Ocean at Manhattan Beach, approximately 0.2 miles south of Miramontes Point (California SWRCB, 2023e; USGS, 1994; USGS, 2023h). There are no significant tributaries along Arroyo Canda Verde, and based on the documents reviewed, no USGS or NOAA gages are present along the Arroyo Canada Verde.

According to the California SWRCB, there are no water rights associated with Arroyo Canda Verde in the Project Area.

## 2.8 Purisima Creek

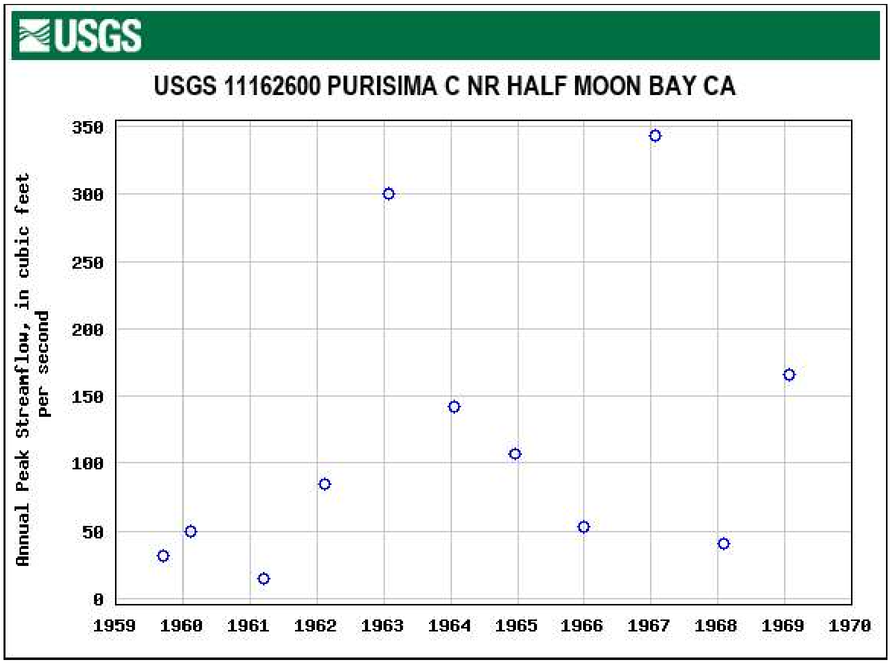
Purisima Creek is an eight-mile-long creek with headwaters on the south side of King's Mountain in San Mateo County and a drainage area of 4.83 square miles (USGS, 1994; USGS, 2023b). The creek flows a narrow, bedrock canyon before outflowing to the Pacific Ocean approximately 4.5 miles south of Half Moon Bay (USGS, 1994).

One USGS gage (Purisima C NR Half Moon Bay, USGS 11162600) was located downstream of Walker Gulch, approximately 4.1 miles from the mouth of Purisima Creek (USGS, 2023a; USGS, 2023b). The gage operated from October 1958 through October 1969 and recorded 4,021 daily stream discharge measurements. In addition to stream discharge, the gage also collected peak streamflow data (1959 through 1969; 11 data points), field measurements (2015 and 2021; 2 data points), and field water quality samples (1977 and 2015; 2 data points). The USGS does not provide an explanation for why the Purisima Creek gage went offline in 1969 (USGS, 2023b).

The mean daily discharge records (in cfs) from October 1, 1958 through October 3, 1969 are provided on Table 2.1. Based on the stream gage data exported from USGS, it appears that Purisima Creek has the highest stream discharge in the months of January (mean 7.7 cfs) and February (8.3 cfs), while the lowest stream discharge occurs in the months of August and September (both with a mean of 0.8 cfs). This is concurrent with the highest precipitation occurring in the winter months within the Project Area.

The annual peak streamflow for the gage on Purisima Creek is shown on Figure 2.6 below. Based on the data, it appears that the highest annual peak streamflow was documented in 1967 and the lowest annual peak streamflow was documented in 1961 (USGS, 2023b).

**Figure 2.6. Purisima Creek Annual Peak Streamflow**




On September 2, 2015 and September 2, 2021, the USGS collected manual field measurements of streamflow, channel width, channel velocity, channel stability, channel material, and channel evenness (see Table 2.2 below). This data shows that the Purisima Creek material changed from gravel to silt, the creek nearly doubled in width, and the channel velocity and streamflow decreased from 2015 to 2021. A large storm event may have widened the channel and transported gravel sediments from upstream of the sample point. However, the cause of this change is unclear from the available USGS data. USGS does not provide context for why these additional field measurements were collected. (USGS, 2023b).

**Table 2.2. Purisima Creek Field Measurements**

| Sample Date | Streamflow (cfs) | Channel Width (ft) | Channel Area ($ft^2$) | Channel Velocity (ft/s) | Channel Stability | Channel Material | Channel Evenness |
|---|---|---|---|---|---|---|---|
| 2015-09-02 | 0.34 | 3.50 | 0.67 | 0.51 | Firm | Gravel | Even |
| 2021-09-02 | 0.30 | 6.50 | 2.78 | 0.11 | Soft | Silt | Even |

Additionally, USGS collected water quality samples at the gage location on August 29, 1977 and September 2, 2015. The 1977 surface water sample was analyzed for general water quality parameters (temperature, specific conductance, dissolved oxygen [DO], pH), inorganic anions (chloride, nitrate and nitrite, sulfate), metals (iron, boron, silica), and alkalinity (bicarbonate, carbonate, hardness). However, fewer parameters were analyzed from the 2015 surface water sample, which included stream width, temperature, and specific conductance (USGS, 2023b). Table 2.3 provides a summary of the water quality data collected by USGS at the Purisima Creek gage.

There are four water rights associated with Purisima Creek in the Project Area. These water rights were filed between 1995 and 2011 and are used for irrigation and domestic purposes. Of the four water rights, only one is currently listed as being active (Table 1.3).

***Main Tributaries of Purisima Creek***

**Higgins Purisima Creek**

Higgins Purisima Creek is an approximately three-mile-long tributary of Purisima Creek. Higgins Purisima Creek flows into Purisima Creek at Whittemore Gulch, approximately 4.5 miles from the mouth of Purisima Creek (California SWRCB, 2023e; USGS, 1994; USGS, 2023c). It should be noted that some agencies identify this portion of the creek as part of Purisima Creek and not as a tributary to Purisima Creek .

According to the California SWRCB, there are no water rights associated with Higgins Purisima Creek in the Project Area.

## 2.9 Lobitos Creek

Lobitos Creek is an approximately 4.8-mile-long creek with headwaters on the north side of Bald Knob. The creek flows into the Pacific Ocean at Martin's Beach, six miles south of the town of Half Moon Bay, California. Lobitos Creek has no significant confluences (California SWRCB, 2023e; USGS, 1994; USGS, 2023h). Based on the documents reviewed, no USGS or NOAA gages are present along Lobitos Creek.

There are two water rights associated with Lobitos Creek in the Project Area. These water rights were filed in 1960 and 2007 and are used for irrigation and domestic purposes – both of which are still active (Table 1.3).

***Main Tributaries of Lobitos Creek***

**School House Creek**

School House Creek is 0.5-mile-long tributary of Lobitos Creek. School House Creek flows into Lobitos Creek at the junction of Lucy Lane and Verde Road in Lobitos, California, approximately 0.75 miles before Lobitos Creek meets the Pacific Ocean at Martin's Beach. The headwaters of School House Creek are southeast of the confluence with Lobitos Creek, and the creek follows Lobitos Creek Cut-Off Road (California SWRCB, 2023e; USGS, 1994; USGS, 2023h). Based on the documents reviewed, no USGS or NOAA gages are present along School House Creek.

According to the California SWRCB, there are no water rights associated with School House Creek in the Project Area.

# 3. Half Moon Bay Terrace Groundwater Basin Watershed – Conceptual Model

## 3.1 Geologic Conditions and Regional Setting

The Project Area consists of the Half Moon Bay Terrace Groundwater Basin and Pilarcitos Creek watershed (Figure 1.1). In this report, the Project Area may also be referred to as the "Half Moon Bay Terrace Groundwater Basin watershed." The Project Area is located along the Pacific Coast, in San Mateo Couty – south of the City of San Francisco. The Half Moon Bay Terrace Groundwater Basin watershed drains westward toward Half Moon Bay and the Pacific Ocean (Figure 1.2). Elevations range from approximately 2,000 feet amsl (Montara Mountain and Kings Mountain) to sea level. Vegetation in the Project Area is primarily grassland and herbaceous forest (CDFW, 2013b). Most of the land in the Project Area is classified as undeveloped by the CDFW and is privately owned (CDFW, 2013b). However, of the land that is developed, most of it is along the stream valleys or the coast (Todd, 2003).

The watersheds that surround the Project Area include, the following: San Pedro Creek, Denniston Creek, San Mateo Creek, and Purisima Creek. The location of these watersheds is shown on Figure 3.1. In addition to the Pilarcitos Creek Watershed (also known as the Arroyo Leon Watershed), the following other watersheds also drain into the Half Moon Bay Terrace Groundwater Basin: Denniston Creek and Purisima Creek.

The Project Area is marked by several unique features, including preserved records of sea level change in the marine terraces, wave-cut cliffs, evidence of folding (synclines and anticlines) and faulting, bluffs, sea stacks, sea caves, groves of ancient redwood trees, landslides, mountains, ridges, valleys, and beaches. These features display the range of topography within the Project Area.

The Project Area is within the Coast Range geomorphic province, which is substantially comprised of a thick sequence of Mesozoic and Cenozoic-aged sedimentary strata. The province is spilt into two portions, a northern and a southern portion, separated by the San Francisco Bay. The Coast Range consists of northwest-trending mountains and valleys that are subparallel to the San Andreas Fault. East of the San Andreas Fault is the Jurassic-Cretaceous Franciscan Complex and west of the San Andreas is the Cretaceous Salinian Block (CGS, 2002). The Franciscan Complex consists predominately of sandstone (graywacke) and mudstone (shale) with minor amounts of chert, limestone, greenstone, serpentinite, and mélanges. The Franciscan Complex is highly prone to landslides, due to the presence of serpentine. The Salinian Block consists of granitic rocks, which represent a piece of the old volcanic arc that was transported northward along the San Andreas Fault and placed outboard (west) of the Franciscan Complex (Anderson, 2001). Within the Coast Range geomorphic province, the coastline is uplifted, terraced, and wave-cut (CGS, 2002). These characteristics are present in the Half Moon Bay area.

To further understand the regional changes that the Proposed Recycled Water Project could have on the Project Area, a qualitative conceptual model was developed. This conceptual model consists of a description of the hydrogeologic units, geologic structure, aquifer characteristics, groundwater inflows and outflows, trends in groundwater elevation, and groundwater water quality within the Project Area.

## 3.2 Aquifer Characteristics and Hydrogeologic Units

For the purposes of this report, the aquifer characteristics (effective porosity, transmissivity, and hydraulic conductivity) are of substantial importance in evaluating the effects of the proposed recycled water alternatives, particularly those effects of using recycled water for groundwater replenishment. The effective porosity of a soil or rock is the available open space between particles available for water to flow through. It is typically expressed in terms of a percentage. Transmissivity is a measure of an aquifer's ability to transmit groundwater, while the related term "hydraulic conductivity" is equivalent to the aquifer's permeability and is equal to the transmissivity divided by the saturated thickness of the aquifer. When discussing the ability for a soil or rock to transmit water in terms of a constant then, hydraulic conductivity can be most useful as the transmissivity of an aquifer will vary with changing aquifer or groundwater level conditions. The following paragraph provides a summary of the published available aquifer characteristics within the Project Area:

> *"… the marine terrace aquifer near the proposed Lower Pilarcitos Creek wellfield has a transmissivity of about 16,000 gpd/ft [gallons per day per foot], an aquifer thickness of about 32 feet, a resulting hydraulic conductivity of approximately 500 gpd/ft$^2$ [gallons per day per square foot] and is confined. The marine terrace aquifer near the Balboa wellfield has a transmissivity of about 9,400 gpd/ft, an aquifer thickness of about 42 feet, a resulting hydraulic conductivity of about 224 gpd/ft$^2$, and a storativity of 0.0011 (confined aquifer). In regions south of the proposed Lower Pilarcitos Creek wellfield, the transmissivity is lower, ranging between 1,500 and 7,000 gpd/ft. Regional informal pumping tests and empirical analysis of the data suggest that the transmissivity may range between 1,000 and 5,500 gpd/ft for bedrock and marine terrace aquifers, respectively. In general, the informal pumping test data are consistent with formal aquifer and well testing" (Todd, 2003).*

The Project Area consists of sedimentary, igneous, and metamorphic rocks with recent alluvium and colluvium (California Department of Conservation, 2015; Figure 3.2). The Half Moon Bay Terrace Groundwater Basin Watershed is situated on a westward sloping marine terrace, composed of four main hydrogeologic units, from youngest to oldest: recent alluvium (Holocene alluvium); marine terrace deposits (Pleistocene-age); consolidated sedimentary rocks (Pliocene Purisima Formation); and igneous rocks (Cretaceous Montara Granitic rocks). A description of these hydrogeologic units is provided in the sub-sections below.

### 3.2.1 Holocene Alluvium

The Holocene alluvium consists of unconsolidated, moderately-sorted sand and gravel (California DWR, 1999; California DWR, 2014). Within the Project Area, coarse-grained alluvium is present along the stream floodplains, colluvium is present in the upper reaches of Pilarcitos Creek, beach and sand dunes are present along the coastline, artificial fill is present around urban areas, and alluvial fans are present along the coastline (California DWR, 1999; California DWR, 2014; Todd, 2003). Because these surficial materials are thin and limited in extent, they are not significant aquifers within the Project Area (Todd, 2003).

### 3.2.2 Pleistocene Marine Terrace Deposits

The Pleistocene-aged marine terrace deposits consist of poorly to moderately consolidated marine, eolian, and alluvial sand, silt, gravel, and clay. The marine terrace deposits lie unconformably on top of the Purisima Formation and are located along the coastline (California DWR, 2014). These deposits are approximately 30 to 60 feet thick and make up the main aquifer in the Half Moon Bay Terrace Groundwater Basin (Todd, 2003).

Previous investigations have been conducted on the marine terrace deposits throughout the Project Area to better understand its hydraulic properties. The investigations determined that transmissivity values range from 1,500 gpd/ft (south of the Lower Pilarcitos Creek wellfield) to 16,000 gpd/ft (near the Lower Pilarcitos

Creek wellfield), that hydraulic conductivity values range from 224 gpd/$ft^2$ (near the Balboa wellfield) to 500 gpd/$ft^2$ (near the Lower Pilarcitos Creek wellfield), and that the marine terrace aquifer's storativity is 0.0011 – indicating a confined aquifer. Fine-grained deposits at the distal portion of an alluvial fan reduce the hydraulic connection between a surface water and associated underlying aquifer materials (Reading, 1981; Walker, 1981). Therefore, within the Project Area, it is likely that the fine-grained (clay and silt) deposits (from the Holocene alluvium) created a relatively impermeable cap to the marine terrace aquifer, resulting in the confined aquifer conditions (Todd, 2003).

### 3.2.3 Pliocene Purisima Formation

The Pliocene-aged Purisima Formation consists of highly fractured, well-indurated, soft- to medium-hard, fossiliferous mudstone, siltstone, and sandstone. The formation rests nonconformably on top of the Cretaceous Montara Mountain granitic rock and is believed to be hundreds of feet thick. Within the Project Area, the Purisima Formation outcrops just west of the Half Moon Bay Airport and underlies most of the Pleistocene marine terrace deposits (California DWR, 1999; California DWR, 2014). The Purisima Formation is considered nonwater bearing; however, where groundwater is present in fractures, the water quality is usually poor, with elevated concentrations of TDS, chloride, iron, and manganese (Todd, 2003).

### 3.2.4 Cretaceous Montara Mountain Granitic Rock

The Cretaceous-aged Montara Mountain granitic rock is part of a much larger magmatic arc complex known as the Salinian Block. The Montara Mountain granitic rocks consist of highly fractured, medium to coarsely–grained crystalline rock. Within the Project Area, the granitic rock forms the mountains directly east of the coastline and underlies the younger geologic formations (California DWR, 1999; California DWR, 2014).

## 3.3 Geologic Structure

The Project Area bedrock has been heavily faulted and folded by north-northwest trending strike-slip faults (Figure 3.2). The most significant faults passing through the Project Area include the Pilarcitos Fault and the Seal Cove Fault (a splay of the San Gregorio Fault Zone [USGS, 2014]). These faults are right-lateral strike-slip faults trending northwest-southeast. Other smaller faults, likely associated with the aforementioned, make up the fault zones associated with the Pilarcitos and Seal Cove Faults. The San Andreas Fault, although outside of the Project Area, boarders the Project Area to the east. Although the lateral motion of the strike-slip faulting dominates the tectonic regime throughout the Project Area, thrust faulting resulting from the oblique geometry of the local fault zones is also present.

The compressional forces (i.e., thrust faulting) along the Pilarcitos and Seal Cove fault zones has resulted in the uplift and deformation of bedrock in the Project Area (USGS, 2014a). Most notably, right-lateral motion along the Pilarcitos and Seal Cove Faults have created a synclinal fold (a U-shaped folding of bedrock) dipping to the west-northwest, sub-perpendicular to the trend of local strike-slip faults, in rocks consisting of Miocene to Paleocene-age (5.3 to 66 million years old) marine rocks (i.e., sandstone, shale, siltstone, conglomerate, and breccia). The synclinal fold dips to the northwest away from the Santa Cruz Mountains to the east (USGS, 2014).

Faults commonly serve as barriers to groundwater movement, while in rock aquifers, the broken areas along faults may provide conduits to flow. The effects of these geologic structures on the hydraulic characteristics of the aquifers (e.g., the ability for the faults to impede groundwater movement) is unclear. At this time, we do not have the raw data for the aquifer testing reported in Todd (2003). Should those data become available, review may provide insight into this issue.

## 3.4 Regional Groundwater Inflow and Outflow

The volume of water in storage is an important aspect of the groundwater system. Changes in storage are identified in the field by changes in groundwater levels. A fundamental groundwater equation and the basis for evaluations of groundwater budgets (inflow vs. outflow estimates) is provided below:

Inflow – Outflow = Change in Storage

When outflow (groundwater discharge both directly in-basin or through underflow to surrounding basins) exceeds inflow (groundwater recharge in basin plus contributions from surrounding basins), there is a negative change in groundwater in storage and groundwater levels can be expected to decline. When inflow exceeds outflow, the reverse is true. When the system is in equilibrium, water levels will generally remain relatively constant despite short-term fluctuations. Where they occur, long-term groundwater level declines are a clear indication that outflow has been exceeding inflow for an extended period. It should also be noted that in many areas, the recovery of groundwater levels following groundwater being removed from storage can take much longer than the period it took to decline, depending on the volume removed from storage, groundwater recharge, precipitation trends, and the geology of the basin.

Many factors affect the ability of water to reach the groundwater system as recharge (e.g., inflow), including the character of the rainfall events, surface soil characteristics, and evaporation rate. Frequently it is simpler, and more accurate, in a basin with relatively stable groundwater levels to calculate outflows and then assume that the total outflows are equal to the total inflows (groundwater recharge in the Project Area being the largest contributor).

With respect to the Proposed Recycled Water Project, each alternative will result in their own specific effects on the groundwater budget. Numerical groundwater models are ideal tools for evaluating these changes as they can evaluate the interdependency of these aspects of the aquifer system(s). They also provide a means for evaluating the internal consistency of the assumptions in the conceptual model.

### 3.4.1 Inflow Components

The primary inflows to the Project Area include rainfall recharge, deep percolation from irrigation water, subsurface inflow, stream recharge, and leakage from pipelines. See Table 3.1 for the average inflow values estimated by others for the Project Area. In the sub-sections below, only the inflows with significant contributions to regional groundwater are discussed in detail.

#### *Rainfall Recharge*

This is the portion of precipitation that falls on the land surface and percolates directly to recharge. As previously mentioned, the average annual precipitation at the Half Moon Bay Terrace station (period of record from 1939 through 2016) is 26.2 inches, with more than half of that precipitation falling during November through February. A portion of that precipitation will percolate to the aquifer system as recharge.

#### *Percolation from Irrigation Water*

Within the Project Area, irrigation is used primarily for agricultural and landscaping purposes. A portion of the water that is applied for irrigation percolates down through the soil and into the groundwater basin. Note, if the water applied for irrigation comes from a source outside the Project Area, then it represents inflow. However, if the irrigation source is from local groundwater, it is not considered an inflow, but rather a return flow of groundwater back into the basin.

As previously discussed, within the Half Moon Bay Terrace Groundwater Basin, most of the land (over 40%) is used for agricultural purposes. Therefore, the amount of inflow due to percolation from irrigation water is significant.

#### *Subsurface Inflow*

Due to the bedrock units of the Santa Cruz Mountains surrounding the Project Area, underflow from surrounding groundwater basins is likely to be minimal.

#### *Stream Recharge*

This is the recharge that percolates to groundwater from streams. Within the Project Area, the following streams (from north to south) discharge into the Half Moon Bay Terrace Groundwater Basin (Figure 1.2; Figure 3.1):

- Martini Creek;
- San Vicente Creek;
- Denniston Creek;
- Arroyo de en Medio;
- Frenchman's Creek;
- Pilarcitos Creek;
- Arroyo Canada Verde;
- Purisima Creek; and
- Lobitos Creek.

The surface water conditions of these creeks were previously discussed in Section 2.

#### *Leakage from Pipelines*

Coastside CWD completed a water supply evaluation that discussed leakage from pipes, which represents an inadvertent inflow of imported water to the Half Moon Terrace Groundwater Basin. According to Coastside CWD, unmetered water includes authorized uses such as pipeline flushing and firefighting. It also includes unauthorized uses, such as meter inaccuracy and pipeline leaks (Coastside CWD, 2002; Todd, 2003).

### 3.4.2 Outflow Components

The primary outflows from the Project Area include subsurface outflow to the Pacific Ocean, groundwater pumping, and hydrophyte and phreatophyte water consumption. See Table 3.2 for the average outflow values estimated by others for the Project Area. In the sub-sections below, only the outflows with significant contributions to regional groundwater are discussed in detail.

#### *Subsurface Outflow to the Ocean*

Within the Project Area, the marine terrace aquifer is relatively thin (30 to 50 feet thick) and slopes from east to west, extending under the Pacific Ocean. Similarly, groundwater levels decline from east to west, indicating groundwater flows towards the ocean and out of the groundwater basin (Todd, 2003).

### *Groundwater Pumping*

Groundwater is pumped for agricultural irrigation, landscape irrigation, and domestic use. Of the groundwater pumped, some is returned to the Project Area via percolation (as discussed above); however, some is consumed leading to an outflow of the regional groundwater basin. Ocean Colony Partners operates four wells at the north end of Balboa Boulevard near Kelly Avenue. The water is pumped to irrigate 210 acres of the Half Moon Bay Golf Links (Todd, 2003).

### *Hydrophyte and Phreatophyte Water Consumption*

Along the creeks (Section 2.1) within the Project Area, there is riparian vegetation – which includes hydrophytes and phreatophytes. Hydrophytes are plants that require the presence of surface water. Phreatophytes are deep-rooted plants that obtain a significant portion of their water requirements from groundwater (like the blue gum eucalyptus, which are prevalent along Pilarcitos Creek [PWA, 2008]). Hydrophytes and phreatophytes transpire more water than other plants and often require more water than rainfall can provide.

## 3.5 Groundwater Elevation Trends

Within the Project Area, there are a number of groundwater wells (Figure 1.9), consisting of domestic, irrigation, industrial, monitoring, municipal, and water supply wells (GAMA, 2023a; GAMA, 2023b). Where available, information related to water elevation (or depth to water) was extracted and compiled to understand groundwater trends within the Project Area – as displayed in Table 3.3 and Appendix 3.1. Additionally, if available, Well Completion Reports (WCRs)[9] were tabulated and downloaded for selected groundwater monitoring wells (Appendix 3.2). Not only are the downloaded WCRs within Appendix 3.2, but also a Google Earth KMZ of the wells in the Project Area with links to their corresponding WCRs is provided as well. Groundwater elevation data was obtained from the California DWR (California DWR, 2023b), including their California Statewide Groundwater Elevation Monitoring (CASGEM) program (CASGEM, 2023).

Based on records from the California DWR, the current groundwater trends within the Project Area, specifically the Half Moon Bay Terrace Groundwater Basin, are stable (Appendix 3.1; California DWR, 2014). The current, seasonal, and long-term groundwater trends show that the groundwater elevations within the Project Area display either “no trend” (that groundwater levels have neither increased nor decreased) or an increasing trend (that groundwater levels have increased somewhere between 5 to 25 feet; California DWR, 2023c). Rising groundwater levels may be in part a result of the end of a period of prolonged drought conditions. Although stable, depths in groundwater do fluctuate throughout the year, with the depth to groundwater generally the greatest in the summer and shallowest in the winter (California DWR, 2014).

Given the limited thickness of the marine terrace deposits, and stable groundwater levels, a limited volume of storage appears to be available for recycled water if used for groundwater replenishment. Particularly during periods of groundwater highs (e.g. during winter), there may be limitations to the volume of groundwater that can be physically recharged absent a wide-spread recharge design/network instead of a specific groundwater recharge facility with limited surface area.

The following hydrographs below (which are also located in Appendix 3.3), show a couple examples of the observed groundwater elevations within the Project Area.

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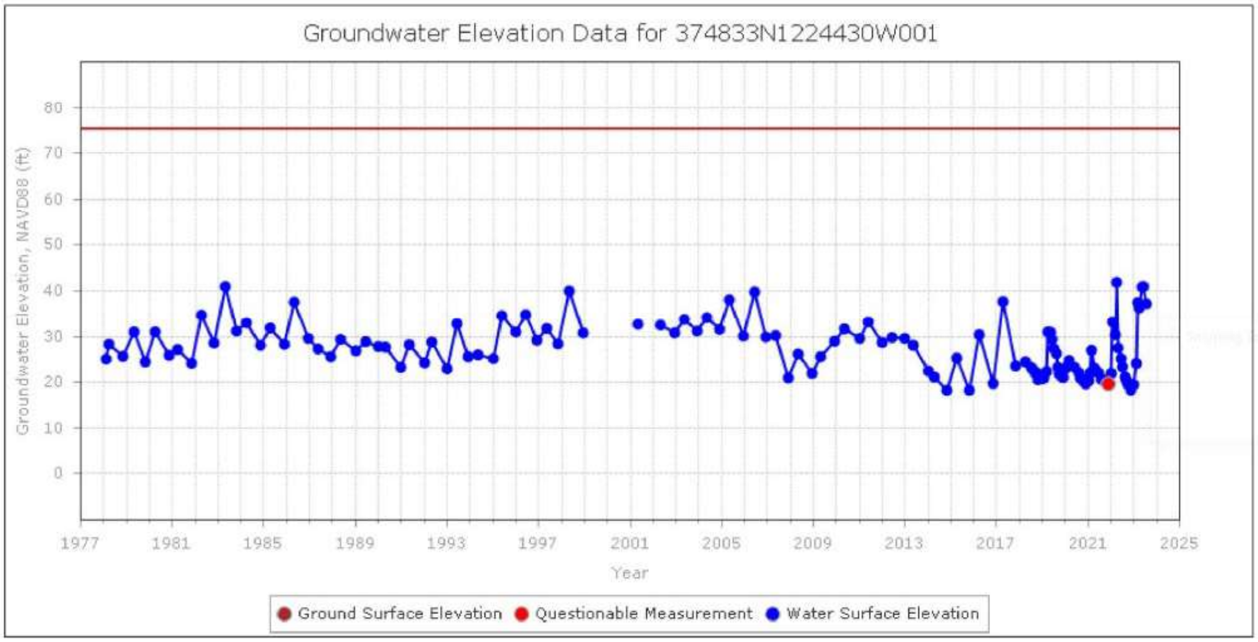
[9] It should be noted that the California DWR is currently working on a Well Completion Report Map Application; however, it is not finalized as the date of this report (California DWR, 2023d).

**CASGEM Well ID 7004**

CASGEM Well ID 7004 (also referred to as well 374833N1224430W001) is located near Half Moon Bay, California, along Frenchman's Creek Road (see Figure 3.3 below). According to the hydrograph for this well (see Figure 3.4 below), since the late-1970s the groundwater elevations in the well have fluctuated somewhere between 20 and 40 feet amsl. Between the late 1970s and early 2000s, the groundwater elevations had less variation than what is currently observed. Although present day groundwater elevations are approximately 20 feet higher than they were in the late 1970s, they appear to be trending slightly downward (California DWR, 2023c).

**Figure 3.3. CASGEM Well ID 7004 Location**

**Figure 3.4. CASGEM Well ID 7004 Hydrograph**

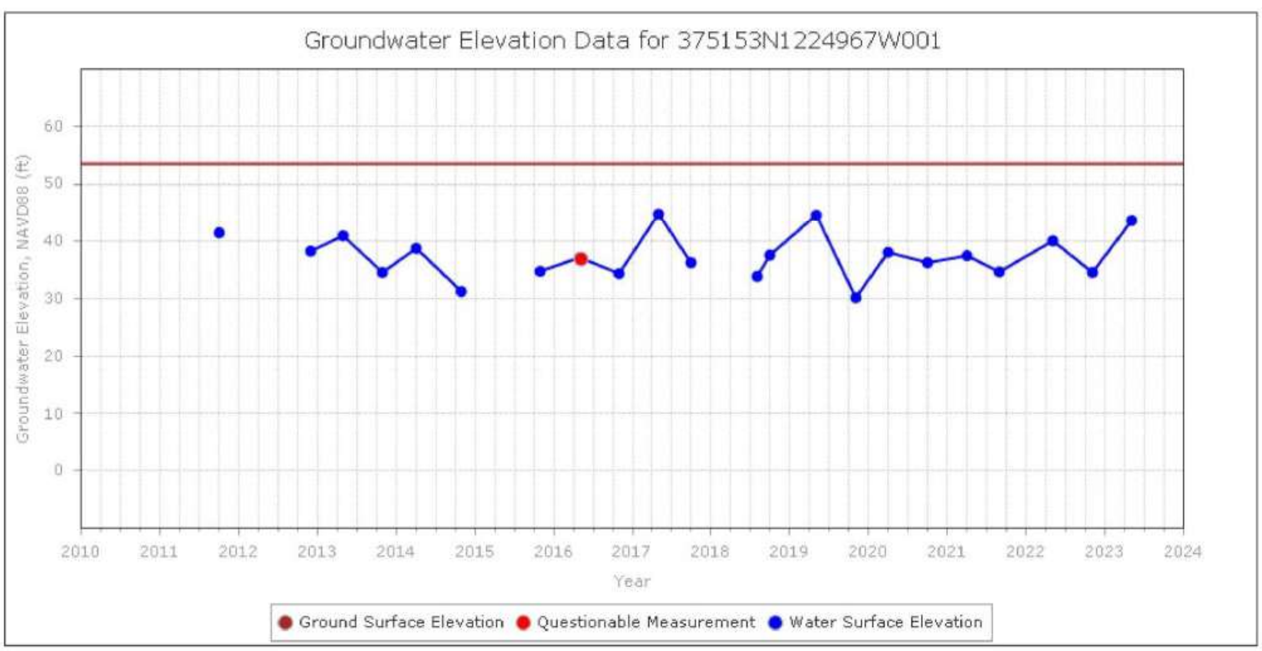



**CASGEM Well ID 48471**

CASGEM Well ID 48471 (also referred to as well 375153N1224967W001) is located in Moss Beach, California, adjacent to the airport (see Figure 3.5 below). According to the hydrograph for this well (see Figure 3.6 below), since the 2010s the groundwater elevations in the well have fluctuated somewhere between 30 and 45 feet amsl. However, the current groundwater elevations are comparable to the first recorded groundwater elevations in the early 2010s (California DWR, 2023c).

**Figure 3.5. CASGEM Well ID 48471 Location**


**Figure 3.6. CASGEM Well ID 48471 Hydrograph**



For additional hydrographs within the Project Area, refer to Appendix 3.3.

## 3.6 Regional Groundwater Water Quality

The regional groundwater quality surrounding the Project Area has been affected by various human activities, including but not limited to, agriculture (crops and pastureland), gas stations, airports, military facilities, landfills, and private residences. Additionally, natural bedrock may also be impacting the regional groundwater (Todd, 2003).

In previous investigations, groundwater quality was documented as a concern within the Project Area. This is because high concentrations of TDS, iron, and manganese were documented within groundwater wells (California DWR, 2014; Todd, 2003). The TDS concentrations ranged from 300 milligrams per liter (mg/L) to over 700 mg/L, which exceeds the secondary drinking water standard of 500 mg/L. Additionally, concentrations of iron and manganese exceeded their respective drinking water standards. The excessive iron and manganese may originate from the underlying Purisima Formation, which is characterized regionally with high iron and manganese. However, the excessive iron and manganese may also reflect inadequate test well development and removal of suspended sediment (Todd, 2003). The distribution of TDS, iron, and manganese in groundwater within the Project Area is tabulated in Table 3.4 and provided in Appendix 3.4.

Additional details regarding regional groundwater water quality conditions, which include environmental cleanup sites within the Project Area and their potential risk to the underlying aquifer, are discussed in the sub-sections below.

### 3.6.1 Environmental Cleanup Sites

Within the Project Area, there are 79 environmental cleanup sites listed on the SWRCB's Geotracker website and DTSC's Envirostor website (Table 3.5).[10] These environmental cleanup sites consist of leaking underground storage tank (LUST) sites, cleanup program sites, military cleanup sites, school investigations, and voluntary cleanups. Of the 79 environmental cleanup sites, 60 (over 75%) are related to LUST sites. Of the 79 environmental cleanup sites, 78 have received either a “Completed – Case Closed” or “No Further Action” from SWRCB and/or DTSC. The remaining open case (a LUST cleanup site) is for a private residence in Moss Beach (Envirostor, 2023; GeoTracker, 2023a).

According to the SWRCB, the private residence is a home located on Stetson Street in Moss Beach, California. The nearest surface water is the Pacific Ocean, located approximately 1,000 feet west of the site. Additionally, a portion of the Fitzgerald State Marine Reserve, which the California RWQCB designated as an area of special biological significance, is directly west of the subject site (GeoTracker, 2023b).

In 2002, a 500-gallon heating oil underground storage tank (UST) was removed from the Moss Beach private residence and “significant contamination” was observed in soil beneath the former UST. In 2003, an onsite environmental investigation was conducted, which detected total petroleum hydrocarbons (TPHs) in soil and groundwater at and beneath the site. In 2005, the footprint of the former UST was over-excavated, and 60-tons of TPH-impacted soil was removed from site. In 2008, groundwater monitoring wells were installed at the Moss Beach private residence and quarterly groundwater monitoring began (GeoTracker, 2023b).

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[10] Note some of the environmental cleanup sites are duplicative as they are listed in multiple database (i.e., in both GeoTracker and Envirostor).

Even though the site is still listed as "open" and "active," the last groundwater monitoring report uploaded to GeoTracker was in 2016 (GeoTracker, 2023b). In the 2016 groundwater monitoring report, free product was observed in groundwater at the Moss Beach private residence (TEC Environmental, 2016). Given that no further documents were uploaded to GeoTracker, the status of the cleanup at this site is unknown. For more information related to the Moss Beach private residence environmental cleanup site refer to Appendix 3.5.

### 3.6.1 Aquifer Risk

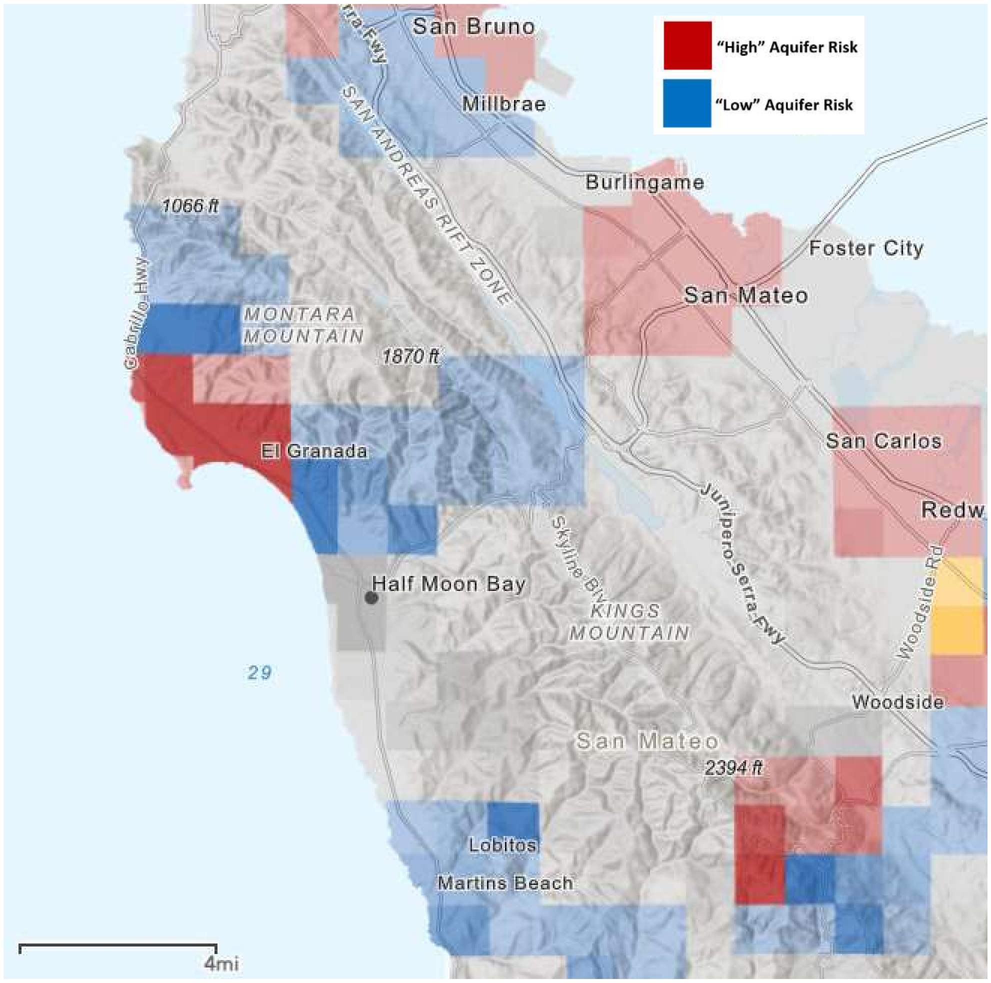
Under SWRCB's Groundwater Ambient Monitoring and Assessment Program (GAMA) there is a feature called the "Aquifer Risk Map." This is an interactive tool designed to identify areas where domestic wells (serving less than five connections) and state small water systems (serving between 5 and 15 connections) may be at a relatively higher risk of accessing groundwater that does not meet primary drinking water standards.[11] The Aquifer Risk Map displays "Sections" with unique identification numbers (called a "Section Number" in this report) and ranks the water quality risk as "high," "medium," or "low." Associated with a Section Number is also information related to the contaminants of concern (COC; chemicals above or near their respective primary or secondary MCL) and number of domestic wells within that section (GAMA, 2023c).

Within the Project Area, there are approximately 80 Sections on the Aquifer Risk Map. Of these Sections, 17 are listed as having a "high" aquifer risk because at least one COC is observed in groundwater above its respective MCL. Additionally, other COCs were observed in groundwater close to their respective MCLs. In the Sections with "high" aquifer risk, 15 have domestic groundwater wells present. See Table 3.6 for a full listing of the Aquifer Risk Map Sections within the Project Area.

Figure 3.7, shown below, displays a zoomed-out output from the Aquifer Risk Map near the Project Area. The areas in red are associated with Sections that have a "high" aquifer risk, the areas in blue are associated with Sections that have a "low" aquifer risk, and the areas in gray have no data available (GAMA, 2023c). Based on the output, most of the Sections flagged as having "high" water quality risks are located along the Pacific Ocean, between the towns of Montara and Miramar. For a more detailed version of the Aquifer Risk Map within the Project Area, refer to Appendix 3.6.

[11] The Aquifer Risk Map was developed to fulfill requirements included in Senate Bill 200 (Monning, statues of 2019) and is a component of California's Safe and Affordable Funding for Equity and Resilience (SAFER) program. The primary purpose of this map interface is to inform Water Boards staff in support of the SAFER annual Fund Expenditure Plan.

**Figure 3.7. Aquifer Risk Map Output for the Project Area**




Based on the Aquifer Risk Map, the groundwater COCs within the Project Area include the following: 1,2,3-trichloroprone (1,2,3-TCP),[12] aluminum, barium, fluoride, nitrate as nitrogen ($NO_3N$), and lead (GAMA, 2023a; GAMA, 2023c). The groundwater analytical results for these COCs are displayed in Table 3.7 and Appendix 3.7. Sources of 1,2,3-TCP include industrial areas (like the airport) and landscaping/agricultural areas. Sources of nitrate could include leakage from septic tanks as well as pesticide application. As for aluminum, barium, fluoride, and lead, these COCs are likely from the natural bedrock within the Project Area. However, there are also exceedances of aluminum, barium, and lead around the Ox Mountain Landfill (discussed further below).[13] The presence of aluminum in the groundwater monitoring wells is unusual. Generally, dissolved aluminum is not present in groundwater unless very acidic (pH < 4) or alkaline (pH > 10) conditions are present. Therefore, the aluminum present in the groundwater monitoring wells throughout the Project Area likely exists in the suspended sediment load (Todd, 2003).

Although the Aquifer Risk Map identified the area along the coast, between the towns of Montara and Miramar, as having a "high" risk for groundwater contamination, the distribution for some of the COCs (aluminum, barium, and lead) identifies another potential source: the Ox Mountain Landfill (also known as

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[12] 1,2,3-TCP is a man-made hydrocarbon, used as a degreasing and/or cleaning agent. Additionally, 1,2,3-TCP has been found to be an impurity resulting from the production and use of soil fumigants (EPA, 2017).

[13] Note, the Ox Mountain Landfill was not located within either SWRCB's website (GeoTracker) or DTSC's website (Envirostor).

the Corinda Los Trancos Landfill). The Ox Mountain Landfill is located at 12310 San Mateo Road in Half Moon Bay, California – along Corinda Los Trancos Creek and in between Nuff Creek and Apanolio Creek, three tributaries that feed into Pilarcitos Creek. This area was likely not flagged by the Aquifer Risk Map, since groundwater wells surrounding the landfill are probably not used for domestic purposes (GAMA, 2023a). The landfill has been used as a solid waste disposal site since 1976 and currently serves as the major disposal site for San Mateo County. The major water quality concern with any landfill is the potential for migration of leachate (Todd, 2003). However, it appears that the landfill has a program in place to reduce the migration of leachate offsite. For additional information about the Ox Mountain Landfill, refer to Appendix 3.8 - which includes responses to public records requests and online queries.

Based on the alternatives being considered, recycled water alternatives such as groundwater replenishment and supplemental flow to Pilarcitos Creek would be in areas of low risk.

# 4. Findings

## 4.1 Recycled Water Use and Hydrogeologic Conditions

### 4.1.1 Groundwater Replenishment Option

Roux evaluated the groundwater replenishment option assuming a recharge facility immediately west of the Half Moon Bay High School (Figure 4.1). The location was provided by WWE. This is an area with “Low Aquifer Risk” as defined in Section 3.7.1. While it is recognized that recharge operations could occur elsewhere, this was assumed the most likely place where a replenishment option could be realized. The key issues that would affect the physical feasibility of this option include the presence or absence of groundwater wells within a 60-day water movement radius from the site based on California state requirements, and to consider the scale and extent of groundwater mounding as a result of percolation or injection of the recycled water in a defined footprint.

Roux used the USEPA seepage calculator (USEPA, 2023) to estimate seepage velocity. The resulting seepage velocity could then be used to estimate an approximation of the 60-day travel distance, based on advection and sorption. Although other factors, for example dispersion, could affect velocity, the lack of hydraulic data in the specific area of the proposed recharge facility, and the associated uncertainty, results in this approximation providing a reasonable, environmentally conservative estimation for the purposes of this report.

Seepage velocity is a function of hydraulic conductivity, the groundwater gradient, and the effective porosity of the soils or rock present. As described earlier, assumptions were made based on results of aquifer testing conducted in the test wells described in Todd (2003) using a range of transmissivities derived from the test wells in the Lower Pilarcitos Wellfield (713 gpd/ft$^2$, 523 gpd/ft$^2$, and 302 gpd/ft$^2$ for high, average, and low values), an assumed hydraulic gradient based on the cross-sections prepared by Todd of 0.01, and a range of effective porosity values of 0.1 to 0.4 (10 to 40 percent). Based on these results, the calculated seepage velocities ranged from 1 ft/day to 9.5 ft/day with a most likely value of 4.75 ft/day (assuming average hydraulic conductivity and 0.2 effective porosity). The resulting 60-day travel distances ranged from 60 feet to 570 feet with a most likely distance of 285 feet. There are no wells within that radius for the proposed recharge location.

Following that review, Roux used the USGS groundwater mounding analysis spreadsheet based on Carleton (2010) that uses the Hantush equation (1967) for estimating mounding beneath an infiltration basin, to evaluate the effect of conducting recharge of recycled water at the location presented in Figure 4.1. Infiltration was assumed at an average recharge of 500,000 GPD and after one year of operation (see Figure 4.2 below). The results indicated that the formation would not be able to accept those volumes of recharge as the predicted groundwater mound was approximately 25 feet, and possibly above ground surface. An average recharge of 125,000 GPD for one year produced results that were more reasonable with mounding of approximately 9 feet (see Figure 4.3 below), and likely 8 feet under the high school facilities. In either case, in the absence of test wells and on-site groundwater data at the proposed location, it was calculated that mounding above the depth to groundwater would occur if recycled water were percolated or injected into groundwater at the proposed location. It is unknown whether mounding of this scale would affect existing underground (or above-ground) infrastructure. It would follow that if the locations of groundwater recharge were more dispersed (e.g. injection wells dispersed widely across the basin), the aquifer system would be more likely to accept the groundwater recharge without excessive mounding. This would also lead to substantially more infrastructure to move the recycled water to widely dispersed locations.

With all of these estimations, the absence of site-specific hydraulic information makes these analyses conceptual in nature, and actual parameter values could vary widely. However, despite these uncertainties, the conditions that lead to a slow seepage velocity and the lack of effect on downgradient wells in the 60-day period, also lead to excessive mounding. If hydraulic conditions are such that the mounding presented would be less than shown, those conditions would likely also indicate conditions producing a higher seepage velocity, and the greater likelihood of affecting downgradient wells in the 60-day period.

While an expensive, site-specific geotechnical and hydrologic field investigation and associated modeling would refine these analyses and provide greater confidence in this alternative as a feasible option for recharging groundwater using recycled water, the relationships between seepage velocity and mounding lead to this alternative unlikely to be a feasible option.

**Figure 4.2 - Mounding 500,000 GPD (y-axis equals mounding in feet, x-axis equals distance from recharge zone)**

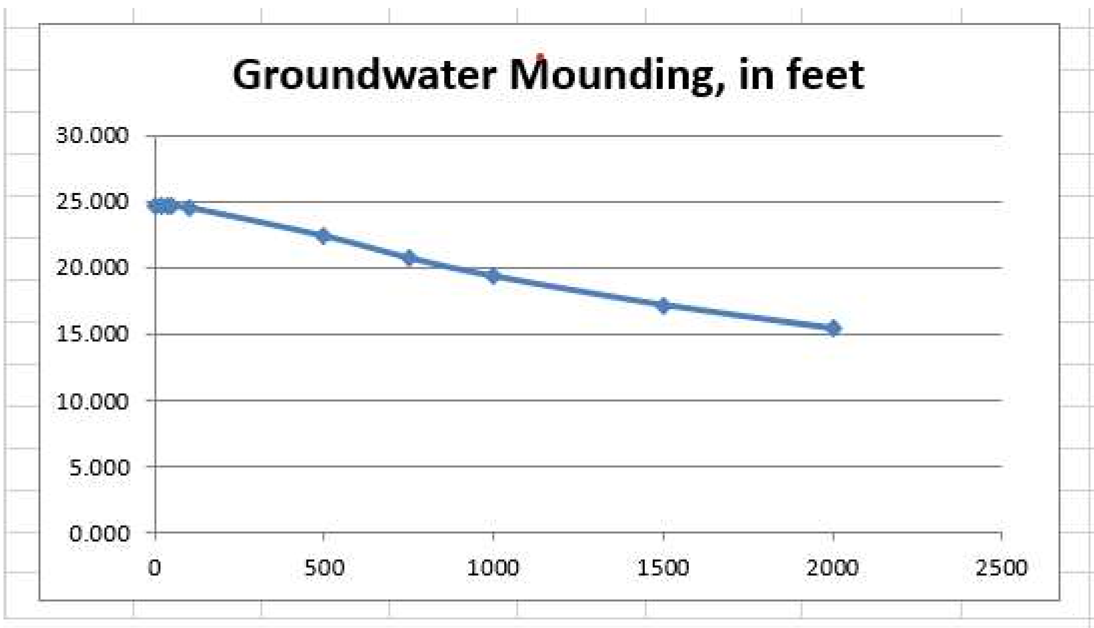
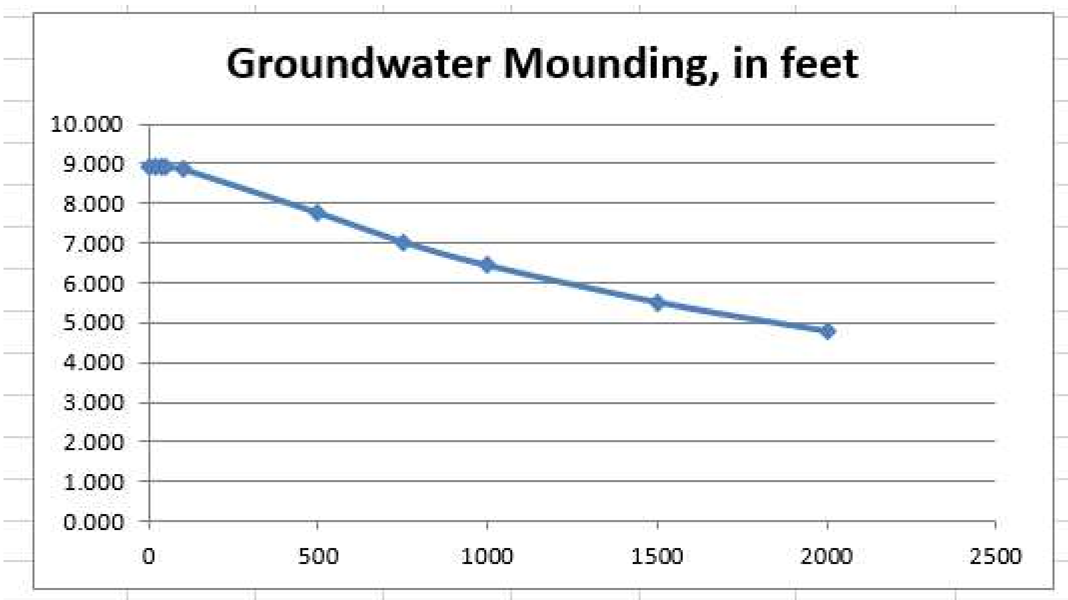


**Figure 4.3 - Mounding 125,000 GPD (y-axis equals mounding in feet, x-axis equals distance from recharge zone)**




The injection of recycled water into groundwater is considered an indirect potable reuse of recycled water and would be regulated by the State Water Board and the installation of injection wells in the Project Area is under the oversight of the San Mateo Environmental Health Department. Well permits would be required for all drilling activities including aquifer test wells and final groundwater injection wells. Additionally, State Water Board approval of a groundwater injection system would be required.

### 4.1.2 Surface Water Augmentation Option

As previously discussed in Section 1.5, there are over 100 water rights filed within the Project Area (Table 1.3). For the Proposed Recycled Water Project, if Coastside CWD chooses the Surface Water Augmentation Option, there will need to be consideration as to how it will affect existing surface water rights. For example, along Pilarcitos Creek there are six licensed and/or claimed water rights for domestic purposes. Most of these locations are in the upper reaches of the stream - between Pilarcitos Lake and Highway 92 (Figure 1.6). If Coastside CWD were to augment Pilarcitos Creek with recycled water, the quality of the recycled water cannot impair an individual's source of domestic water.

Additionally, the same can be said about irrigation water. Along Pilarcitos Creek there are seven licensed and/or claimed water rights for irrigation purposes. Most of these rights are along the reach of the creek that runs parallel to Highway 92 (Figure 1.6). The users of these irrigation water rights divert water from Pilarcitos Creek for various agricultural purposes, like crops, flowers, Christmas trees, and some irrigated pasture (Todd, 2003). Although California allows the use of recycled municipal wastewater for agriculture (EPA, 2023), if Coastside CWD were to augment Pilarcitos Creek with recycled water, the quality of the recycled water cannot impair an individual's source of irrigation water. For example, if the recycled water has salinity levels above a crop's "salinity threshold"[14] it could negatively impact the yield of a crop (Grattan, 2003).

Also, there are water reuse specifications when using recycled water for agricultural purposes – which contains water quality and sampling requirements based on crop type (EPA, 2023). Table 4.1 summarizes these reuse specifications, which includes:

- Food crops where the recycled water has come into contact with the edible portion of the plant, daily Total Coliform sampling is required;
- Food crops where the recycled water has come into contact with the edible portion of the plant, continuous sampling of turbidity is required; and
- Ornamental nursery stock, where irrigation does not occur 14-days prior to harvesting, sampling of dissolved oxygen, nitrogen, and phosphorous is required (although sampling frequency is not stated).

Although the Surface Water Augmentation Option is not necessarily direct discharge of recycled water to agricultural lands, the water reuse specifications should be considered to ensure that water right holders are not negatively affected by the proposed recycled water project. Due to the discharge of recycled water to a water body of the United States and the anticipated hydrologic and biological impacts of increased flow to Pilarcitos Creek, an NPDES and Lake and Streambed Alteration (LSA) permit will likely be required to implement such a reuse scenario. A General Permit for the discharge of recycled water to Waters of the State does not exist and as a result, an Individual NPDES Permit would be required. Individual Permits are evaluated on a case-by-case basis and may require rigorous technical assessment to confirm discharged water would not exceed project specific effluent limits.

Other considerations to deliberate regarding the Surface Water Augmentation Option, is how discharge of recycled water may (1) alter the stream's characteristics (such as stream discharge, peak streamflow, stream channel width and depth) and (2) impact animal and plant species within the riparian area. For example, will surface water augmentation cause flooding and/or bank erosion if the addition of recycled water accidentally increased stream discharge beyond what the stream channel can naturally manage? Also, will the addition of recycled water accidentally impact federally-listed threated species like the steelhead trout (PWA, 2008)? Due to the likelihood of stream bank and channel alteration resulting from an increased flow of water to Pilarcitos Creek, a LSA permit would be required prior to project implementation. In addition to the standard ecological and hydrologic investigation activities required for an LSA permit, CEQA analysis of the project's impacts may be required. A CEQA analysis can result in a rigorous inquiry into a wide range of impacts including impacts to biological resources, water quality, etc.

The Pilarcitos Integrated Watershed Management Plan provides a summary of the existing conditions along Pilarcitos Creek, as well as the other main creeks within the watershed basin (PWA, 2008). This report should be referred to if the Surface Water Augmentation Option is further considered along Pilarcitos Creek.

### 4.1.3 Wetlands Enhancement Option

Wetland enhancement is not a common use of recycled water; however, examples of this type of reuse have been identified in Pacifica, California, north of the Project Area. Wetland enhancement is the enhancement of existing wetlands that increase a particular function of a wetland while wetland restoration is used to refer to the return of a wetland to a former condition. All wetland enhancement projects are coordinated with the guidance of the CDFW Wetland Conservation Program (CDFW, 2023). As all wetlands are unique, there is

[14] Salinity threshold: the maximum amount of salt a crop can tolerate in the rootzone without reduction in yield.

no established regulatory structure for the enhancement of wetlands; however, the permitting requirements discussed in the following section are likely to apply to any wetland enhancement project.

## 4.2 Recycled Water Use and Permitting Requirements

This section details the permits that will likely be required to implement the proposed reuse options. This section begins with a general summary of the different permits associated with recycled water reuse and then details the specific permit requirements that should be anticipated for each reuse scenario. For additional information regarding permits, refer to Appendix 4.1.

**National Pollution Discharge Elimination System (NPDES) Permit**

The NPDES is a federal program authorized under the Clean Water Act of 1977 (EPA, 2010). The State of California has been delegated by the federal government to implement the NPDES program through the State Water Resources Control Board (State Water Board) and the nine Water Quality Control Boards (Regional Water Boards) of California. In California, NPDES permits are also referred to as waste discharge requirements (WDRs) regulating discharged wastewater from municipal and industrial facilities. The San Francisco Regional Water Quality Control Board (SFRWQCB) is the agency branch that issues NPDES permits in the San Francisco Bay Basin including Half Moon Bay. NPDES permit requirements may apply to the stream augmentation and wetland enhancement recycled water reuse options evaluated in this analysis (EPA, 2010).

For effluent discharged to waters of the United States, NPDES permits are required. There are two types of NPDES permits; Individual Permits and General Permits that are issued by the SFRWQCB to allow discharge of wastewater to the waters of the United States within the San Francisco Bay Area (EPA, 2010). Both permit types share many similar components (the general outline of each permit type includes effluent limitations, monitoring and reporting requirements, special conditions, and standard conditions), however, the process of permit issuance varies between Individual and General Permits.

An Individual Permit is issued to a specific facility and is based on specific information the from the permit application and associated sources (i.e., previous permit requirements, discharge monitoring reports, technology and water quality standards, total maximum daily loads, ambient water quality data, and special studies). Following submittal of a permit application, the major steps in the permit development process include: (1) establishing the technology-based effluent limitations; (2) derivation of effluent limitations protective of state water quality standards; (3) anti-backsliding analysis; (4) application of final effluent limitations; (5) development of monitoring and reporting requirements; (6) development of special conditions; (7) incorporation of standard conditions; (8) preparation and publication of fact sheet for review by the public; (9) public comment and response period; (10) Environmental Protection Agency review or Clean Water Act certification; (11) final permit issuance. Upon Individual Permit issuance, the permit is valid for a specific period not to exceed 5 years. Reapplication every five years, at a minimum, is required (EPA, 2010).

A general permit is a pre-established permit permitting the release of a certain type of discharge from common facilities (EPA, 2010). General Permits are issued to permit multiple facilities with similar functions and discharges under the same permit. A facility seeking to discharge effluent regulated under an existing general Permit may apply to be included within the umbrella of that specific general permit. A facility permitted under a general permit can avoid the rigorous permitting process of the individual permit if it can prove that its discharge qualifies under an already established General Permit. The steps to develop a General Permit are similar to the steps detailed above for the Individual Permit, with the addition of an initial study to confirm the following:

- A large number of facilities will be covered by the General Permit;
- The facilities have similar production processes or activities;
- The facilities generate similar pollutants; and,
- Whether uniform water quality-based effluent limitations will appropriately implement water quality standards.

Once the permitting authority has confirmed the above criteria and completed the permitting process as outlined above for the Individual Permit process, the final permit will establish the requirements for the specific information that must be submitted by a facility that wishes to be covered under the General Permit. For a new facility to apply for discharge under an existing General Permit, the facility would only be required to demonstrate compliance with the requirements of the General Permit to be included under the applicable General Permit. The catalogue of NPDES General Permits falls under a list of Program Areas. These program areas include various agricultural, municipal, industrial, and stormwater discharge categories (EPA, 2010).

**Lake and Streambed Alteration Permit**

The CDFW, under California Code of Regulations (CCR), Fish and Game Code (FGC) Section 1602, manages the LSA Program to protect lakes and streams from potential adverse impacts related to human alterations of water bodies throughout California (CDFW, 2023b). The CDFW requires application for a LSA permit for the following lake and streambed alteration activities:

- Diversion or obstruction of natural flow of any river, stream, or lake;
- Any modification of the bed, channel, or bank of any river, stream, or lake;
- The use of material from any river, stream, or lake; and,
- The deposition or disposal of materials into any river, stream, or lake.

The LSA Program requirements may apply to the following water reuse options evaluated in this analysis:

- Stream augmentation; and,
- Wetland enhancement/restoration.

The LSA Program defines “any river, stream, or lake” as those that are both perennial and episodic in flow. Although CCR FGC 1602 does not speak specifically to the discharge of recycled water to streamflow, the alteration of the streambank at the point of discharge is often observed in the form of erosion and/or armoring of the streambank, construction along the creek for the discharge infrastructure would be required, and the recycled water entering Pilarcitos Creek could be considered disposal of materials. Through the FGC 1602 process, if the proposed project could adversely affect a fish and wildlife resource, appropriate avoidance, minimization, and mitigation would be required. A key concept to tease out in this would be if the proposed discharge could cause hydromodification (alteration of streambed or stream bank as a result of increased flow) that results in a stream alteration.

Notification of any LSA project requires notification through the CDFW Environmental Permit Information Management System (EPIMS). This includes an LSA application and fee in excess of $14,000 (CDFW, 2023c). At the time of project notification, a selection of an LSA Agreement type will be required. Due to the proposed permanent augmentation to Pilarcitos Creek, a long-term Standard Agreement would be the most suitable agreement type for this proposed recycled water use scenario. This agreement is a type of permit and will include the necessary measures, as determined by CDFW, to protect existing fish and wildlife resources within the stream proposed for augmentation. These measures may include installation, repair, or maintenance of water diversions, culverts, stream crossings, or any other modification of a lake or streams bed, bank, or channel including extraction or deposition of material (i.e., sand or gravel) from/into the stream proposed for augmentation. At the time of application submittal, detailed project design specifications must be submitted, and the project must be prepared to begin in order to qualify for the Standard Agreement.

Additionally, FGC 5650 limits the discharge of any material considered harmful to biological resources into waters of the State of California. Although FGC 5650 does not specify water quality standards, it would prevent the discharge of recycled water impacted with chlorine, organic matter, sediment, or other contaminants that can be harmful to aquatic life (CDFW, 2023b).

**California Environmental Quality Act (CEQA) Considerations**

Prior to issuance of a LSA Permit, the CDFW is required to comply with all CEQA requirements. CEQA compliance may include any of the following (CDFW, 2023b):

- Negative Declaration: a written statement that an Environmental Impact Review (EIR) is not required because a project will not have a significant adverse impact on the environment.
- Mitigated Negative Declaration (MND): a document that describes a project and its potential environmental impacts and explains how the project has been revised or mitigated to avoid or reduce those impacts to a less than significant level.
- Environmental Impact Review (EIR): an environmental analysis containing information on potential effects, measures to mitigate those effects, and an analysis of alternatives to a proposed project. CEQA requirements may apply to all of the recycled water reuse options evaluated in this analysis.

If an MND or EIR declaration is determined appropriate for the proposed stream augmentation scenario, a specific environmental analysis of the proposed project may be required. A filing fee of approximately $4,000.00 is charged by CDFW to cover the cost of participating in the CEQA review process (CDFW, 2023d).

**California Endangered Species Act (CESA) Considerations**

An additional consideration of an LSA Permit may include an assessment of endangered or listed species that may be impacted by a stream augmentation project (CDFW, 2023b). A biological assessment of biological resources of Pilarcitos Creek may be required to confirm the presence or absence of endangered and/or listed species prior to the discharge of recycled water. If endangered and/or listed species are identified, an Incidental Take Permit may be required by CDFW prior to implementation of a stream augmentation project.

CESA and incidental take permit requirements may apply to the stream augmentation and wetland enhancement recycled water reuse options evaluated in this analysis.

**Well Construction Permits**

Subsurface drilling permits in San Mateo County are issued by the San Mateo County Health, Land Use, Septic System, and Water Wells Program (SMCH). The SMCH issues well drilling permits for the installation of new wells (SMCH, 2019). A complete PE 4666 Well Drilling Permit application is submitted to the SMCH for review and approval. The application includes site information, well owner information, property owner information, and drilling contractor information. The fee for a well drilling permit for the 2023/2024 fiscal year is $1,992 per well (SMCH, 2023b).

SMCH permit requirements would only apply to the injection of recycled water under a groundwater replenishment water reuse scenario, or production wells designed to capture replenished groundwater for other uses.

## 4.3 Data Gaps and Recommendations

There are several data gaps that were identified during the course of this report. These data gaps include:

- The absence of geotechnical or hydrogeologic data in the groundwater replenishment basin area;
- Limited aquifer test data and absence of raw data for previous aquifer tests;
- Limited information relating to effects of faulting on groundwater movement;
- Limited information for much of the basin outside of the Half Moon Bay Terrace Groundwater Basin watershed; and
- Lack of information relating to the number of identified wells that are no longer in use or have been abandoned and where they are located.

In order to address some of the more key issues listed above, Roux is providing three general recommendations, that while enhancing the Proposed Recycled Water Project analysis, would also provide valuable information and/or tools for water resource management.

The first recommendation is related to the condition whereby private wells (not belonging to Coastside CWD) are allowed within the Coastside CWD service area. Given instances such as in the groundwater replenishment option where distances to domestic wells is a key parameter, the knowledge of which wells are no longer active or have been abandoned could provide substantially more flexibility for decision-making around topics for which there are concerns about domestic wells. Roux is providing in this report information related to existing wells, such as well logs, for wells within the Coastside CWD service area and beyond (Appendix 3.2). We recommend that a well-canvassing effort be conducted to identify which of those wells are operational and which can be deemed to be unusable or no longer existing to rule out future decisions that may be based on obsolete consideration.

Roux also recommends the construction of a numerical groundwater flow model. That would provide Coastside CWD with a tool that could then be used to quantitatively evaluate effects of various groundwater management (and some surface water management) scenarios that may arise. As described earlier, numerical groundwater flow modeling not only provides a tool for evaluating groundwater flow and water budget conditions, but also is the only method to evaluate the internal consistency of the assumptions built into the understanding of the groundwater basin. This is an important quality assurance/quality control step for decision-making. A model would enhance the confidence in construction of new wells or well-fields designed in a manner that reduces well interference and could be used to optimize groundwater use alternatives. Further, a model could be used to evaluate groundwater-surface water interactions under different groundwater usage scenarios.

The last recommendation is to conduct site-specific hydraulic testing (aquifer testing). The construction of a numerical model would substantially benefit from additional hydraulic testing under controlled pumping and recovery conditions. Thus, evaluating the hydraulic characteristics of aquifer materials in a more widespread area of the Half Moon Bay Terrace Groundwater Basin Watershed.

# 5. Signatures of Participating Professionals

Respectfully submitted,

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# Recycled Water Feasibility Study

COASTSIDE COUNTY WATER DISTRICT

REGULAR MEETING OF THE BOARD OF DIRECTORS

SEPTEMBER 10, 2024

# Background

- Since the late 1990's , the District has participated in numerous studies with other Coastside agencies to pursue recycled water on the coast  (including with Sewer Authority Mid-Coast and its member agencies)
- Given emerging technologies, climate change, and the changing  regulatory environment, as the water retailer, the District decided to take a fresh look at recycled water on the Coastside.
- In Summer 2023, District contracted with Waterworks Engineers, LLC. ("Waterworks") to conduct a feasibility study

# Scope

- Goal of study:  to assess the hydrogeology of the region; the technical, regulatory, and permitting requirements and  the economic feasibility to derive and evaluate potential alternatives for water reuse
- Focus was to review a range of alternatives including:
  - Non-potable reuse
  - Indirect potable reuse
  - Direct potable reuse
  - Projects with environmental benefits
- Primary component: Hydrogeologic report ( prepared by Roux Associates, Inc.) to determine if using recycled water for groundwater replenishment or environmental benefit are feasible options

# Scope

Study focused on recycled water uses within the District's jurisdictional boundaries. Options considered:

| Non-Potable Reuse | Indirect Potable Reuse | Direct Potable Reuse | Environmental Benefit |
|---|---|---|---|
| Fill Station(s) | Groundwater Replenishment | Direct Potable Reuse at Nunes WTP | Pilarcitos Creek Augmentation or Other Creek Augmentation |
| Landscape Irrigation | Reservoir Augmentation | | Wetland Enhancement |
| Agricultural Irrigation | | | |
| Skylawn Irrigation | | | |
| Ocean Colony Golf Course Irrigation | | | |

# Key Findings

- Hydrogeological conditions (assessed by ROUX) show limited feasibility of use of recycled water for indirect potable reuse and groundwater replenishment.
  - Given low porosity of soils in the HMB Terrace Groundwater Basin, the slow "seepage velocity" from percolating or injecting recycled water would result in groundwater "mounding"
  - Limitations given private wells in the service area
- Surface water augmentation is difficult due to water rights on local creeks/cannot impair quality of a rightsholder's source of irrigation water

| Alternative | Feasible | Reasoning |
| --- | --- | --- |
| Fill Station(s) | No | Little demand for recycled water within service area. |
| Landscape and Agricultural Irrigation | No | Little demand for recycled water within service area. |
| Skylawn Memorial Park Irrigation | No | Park not within service area, so would not be able to deliver recycled water. |
| Ocean Colony Golf Course and Landscape Irrigation | No | Ocean Colony has other water supplies that are more cost effective than recycled water and therefore, does not have a demand for recycled water. |
| Pilarcitos Creek Augmentation or Other Creek Augmentation | No | Does not offset groundwater use or provide additional water resources from indirect or direct potable reuse. |
| Wetland Enhancement | No | Does not offset groundwater use or provide additional water resources from indirect or direct potable reuse. |
| Groundwater Replenishment | No | 1. There are private wells in the service area that limits where water may be replenished.<br>2. A limited amount of water that can be replenished at one location due to mounding |
| Reservoir Augmentation | No | There is no known partner who has a reservoir available for augmentation. |
| Direct Potable Reuse at Nunes WTP | Further study needed | Next steps are to find potential funding sources and continue technical studies. |

# Waterworks Criteria – Ranking of Options

- Cost Criteria: 20-year life cycle costs (including capital outlay plus annual O&M costs
- Non-cost Criteria:
  - Environmental and social impacts/benefits
  - Ease of implementation and regulatory compliance
  - Engineering, construction and operations
  - Climate resiliency

Table 15. Life Cycle Costs

| Alternative | | Capital Cost (a) | Annual O&M Cost | 20 Year Net Present Worth (b) | Delivered Water in 20 Years (MG) | Net Present Worth/ MG | Rank |
|---|---|---|---|---|---|---|---|
| **Non-Potable Reuse** | Fill Station(s) | $3.50 M | $0.10 M | $5.07 M | 183 | $28,000 | 4 |
| | Landscape and Agricultural Irrigation | $27.2 M | $1.07 M | $44.0 M | 600 | $73,000 | 6 |
| | Skylawn Memorial Park Irrigation | $29.4 M | $1.16 M | $47.6 M | 1,000 | $48,000 | 5 |
| | Ocean Colony Golf Course and Landscape Irrigation | $22.0 M | $1.20 M | $40.9 M | 1,830 | $22,000 | 1 |
| **Indirect Potable Reuse** | Groundwater Replenishment | $38.8 M | $3.53 M | $94.2 M | 913 | $103,000 | 7 |
| | Reservoir Augmentation | $65.7 M | $4.85 M | $142 M | 6,570 | $22,000 | 1 |
| **Direct Potable Reuse** | Direct Potable Reuse at Nunes WTP | $63.0 M | $6.19 M | $160 M | 6,570 | $24,000 | 3 |

*The District's current cost of raw water from SFPUC is $7,000/MG*

Table 14. Summary of Non-Cost Criteria

| Alternative | Criteria / Sub-criteria | Delivered Water in 20 Years (Million Gallons) (a) | Total Non-Cost Criteria Score | Rank by Non-Cost Score | (Total score) x (delivered water per 20 years)/ (10,000) (b) | Weighted Rank by Produced Water |
|---|---|---|---|---|---|---|
| Non-Potable Reuse | Fill Station(s) | 183 | 30 | 1 | 0.5 | 8 |
| | Landscape Irrigation | 600 | 26 | 2 | 1.6 | 6 |
| | Agricultural Irrigation | 600 | 26 | 2 | 1.6 | 6 |
| | Skylawn Memorial Park Irrigation | 1,000 | 21 | 5 | 2.0 | 4 |
| | Ocean Colony Golf Course and Landscape Irrigation | 1,830 | 25 | 4 | 4.6 | 3 |
| Indirect Potable Reuse | Groundwater Replenishment | 913 | 18 | 7 | 1.6 | 5 |
| | Reservoir Augmentation | 6,570 | 15 | 10 | 9.9 | 2 |
| Direct Potable Reuse | Direct Potable Reuse at Nunes WTP | 6,570 | 19 | 6 | 12.5 | 1 |
| Environmental Benefit | Pilarcitos Creek Augmentation or Other Creek Augmentation | 0 | 18 | 7 | 0.0 | 9 |
| | Wetland Enhancement | 0 | 18 | 7 | 0.0 | 9 |

# Conclusions

- Of the alternatives evaluated, Waterworks concluded that direct potable reuse is the most promising . . .
  - Has potential to diversify the District's water supply portfolio
  - New regulations
    - In December 2023, State Water Resources Control Board approved regulations for direct potable reuse
    - Direct potable reuse is in pilot stages in a few large agencies, but will become viable for smaller agencies in the future

*The District with SAM (Sewer Authority Mid-Coast) and other local stakeholders should consider direct potable reuse in long term planning of drinking water and wastewater facilities . . .*

# Final Thoughts

- Waterworks: “to be feasible, proposed recycled water projects need partners that want to collaborate with the District and a reason to pursue the project such as a policy or economic reason . . .”
- To make recycled water a reality on the Coastside will require collaboration with local stakeholders (SAM and member agencies and other Coastside agencies) <u>and</u> broader stakeholders such as SFPUC, BAWSCA, County of San Mateo, State and Federal agencies to find funding and support for recycled water project on the Coastside.