

National Park Service



**Sausalito-Marín City
Sanitary District**



SMCSD / Fort Baker Recycled Water Feasibility Study

January 2004

DRAFT

RMC
Raines, Melton & Carella, Inc.
Consulting Engineers/Project Managers

SMCSD/ Fort Baker Recycled Water Feasibility Study Draft Report

January 30, 2004

Prepared by:



Table of Contents

1. Introduction	1
2. Background	1
2.1 Fort Baker	1
2.1.1 Water System	1
2.2 Sausalito-Marín City Sanitary District	3
3. Recycled Water Supply and Demand	4
3.1 Wastewater Supply	4
3.1.1 Current Wastewater Flow	4
3.1.2 Future Wastewater Flow	4
3.2 Quality Requirements	7
3.2.1 Department of Health Services Requirements	7
3.2.2 Irrigation Requirements	7
3.3 Recycled Water Demand	9
4. Recycled Water Facility Alternatives	15
4.1 Option 1: SMCSD Recycled Water Production Facility	15
4.1.1 Microfiltration	15
4.1.2 Reverse Osmosis	15
4.1.3 Ultraviolet Disinfection	16
4.1.4 Siting	16
4.2 Option 2: Fort Baker Satellite Treatment Plant	18
4.2.1 Satellite Membrane Biological Reactor Package Plant	18
4.2.2 Siting	19
5. Most Feasible Option	21
5.1 Treatment Site	21
5.2 Treatment Process	23
5.2.1 Influent Pumping	23
5.2.2 Fine Screening	23
5.2.3 Odor Control	24
5.3 Building Requirements	24
5.4 Solids Handling	26
5.4.1 Option 1: Pump Solids to SMCSD	26
5.4.2 Option 2: Truck Solids to SMCSD	27
5.4.3 Option 3: On Site Solids Treatment	28
5.5 Recycled Water Storage Reservoir	30
5.6 Distribution System Pump Station	30
5.7 Recycled Water System Operation	31
5.7.1 Residual Disinfection	32
5.7.2 Recycled Water Demand Management	32
5.7.3 Staffing	32
5.8 Regulatory Requirements	32
5.9 Estimated Cost	33
6. Recommendations and Next Steps	37
6.1 Additional Studies/Information	37
6.2 Funding	37
References	38

Appendices

Appendix A: Marin Headlands Wastewater Sampling Results
Appendix B: Microfiltration Membrane Information
Appendix C: Reverse Osmosis Information
Appendix D: Ultraviolet Disinfection Information
Appendix E: Most Feasible Option Treatment and Cost Information
Appendix F: SMCSD Recycled Water Treatment Capital and O&M Cost Estimates
Appendix G: Initial Treatment Plant Building Massing Diagrams
Appendix H: Solids Handling Options Cost Estimates
Appendix I: Water Reuse Permit for the Presidio Trust Recycled Water Facility
Appendix J: Potential Funding Sources for Local Pubic Agencies

List of Tables

Table 3-1: Current Dry Weather Wastewater Flow	4
Table 3-2: Fort Baker Projected Average Dry Weather Wastewater Flows	5
Table 3-3: Recent Sampling	8
Table 3-4: Estimated Future Recycled Water Demand at Fort Baker	13
Table 4-1: Microfiltration Equipment Footprint.....	15
Table 4-2: Reverse Osmosis Equipment Footprint	15
Table 5-1: Options Summary.....	21
Table 5-2: Recycled Water Equipment Footprints.....	24
Table 5-3: Summary of Solids Handling Options	26
Table 5-4: Pump Station Design Criteria.....	30
Table 5-5: Presidio Trust of San Francisco Self-Monitoring Program.....	33
Table 5-6: Satellite Treatment Plant Capital Cost Estimate	34
Table 5-7: Storage and Distribution Capital Cost Estimate	35
Table 5-8: Satellite Treatment Plant Annual O&M Cost Estimate	36
Table 5-9: Total Annual Cost Estimate Summary	36

List of Figures

Figure 2-1: Project Site Map	2
Figure 3-1: Estimated Future Wastewater Flow	6
Figure 3-2: SMCSD Influent Chloride Concentration and Tide Level (11/11/2001 – 11/12/2001) ...	9
Figure 3-3: Recycled Water Users at Fort Baker	10
Figure 3-4: Potential Recycled Water Users.....	12
Figure 3-5: Estimated Recycled Water Demands and Future Wastewater Flow at Fort Baker	14
Figure 4-1: Existing SMCSD Wastewater Treatment Plant Layout	17
Figure 4-2: Microfiltration/Reverse Osmosis Footprint Required	18
Figure 4-3: ZenoGem® Process Schematic	19
Figure 4-4: Buildings Examined at Fort Baker.....	20
Figure 5-1: Most Feasible Option Site.....	22
Figure 5-2: Recycled Water Treatment Process Schematic	23
Figure 5-3: Recycled Water Treatment Plant Layout.....	25
Figure 5-4: On-Site Solids Handling Layout.....	29
Figure 5-5: Recycled Water Operation Schematic	31

Executive Summary

Fort Baker is a former military facility located in the Marin Headlands, which is part of the Golden Gate National Recreation Area. The National Park Service is currently in the process of implementing a reuse plan for Fort Baker. An essential part of the Reuse Plan is to make Fort Baker a model sustainable National Park facility. The purpose of this report is to outline the most feasible option for providing recycled water at Fort Baker as part of the National Park Service's sustainable approach. Recycled water use at Fort Baker would reduce potable water demand and would reduce treated wastewater discharges to San Francisco Bay.

Recycled water is produced from wastewater. The use and production of recycled water is regulated by the San Francisco Bay Regional Water Quality Control Board (RWQCB) and the California Department of Health Services (DHS). Currently, all wastewater generated from the Marin Headlands, which includes Fort Baker, Fort Cronkhite, and Fort Barry, flows through Fort Baker where it is pumped to the Sausalito-Marín City Sanitary District (SMCSD) for treatment. The current amount of wastewater generated at Fort Baker is expected to increase after the Reuse Plan has been implemented. The amount of recycled water that can be produced is limited by the amount of wastewater that is available. The total future wastewater average dry weather flow from the Marin Headlands is expected to be 54,600 gallons per day, including 27,900 gallons per day from Fort Baker.

Recycled water demands at Fort Baker and surrounding areas were evaluated as part of this study. Due the facilities available, cost and the proximity of demands, demands outside of Fort Baker were not carried forward to the most feasible option development. The estimated future recycled water demands at Fort Baker are shown in Table ES-1.

Table ES-1: Potential Recycled Water Demands at Fort Baker

Potential Recycled Water Users	Total Area (Acres)	Irrigated Area (Acres)	Demands	
			Average Month Daily (GPD)	Peak Month Daily (GPD)
<u>Fort Baker Irrigation</u>				
Parade Grounds	14.0	13.5	39,200	54,900
Water Front Meadow	8.5	4.3	12,300	17,200
Other Landscape Restoration	3.9	3.9	11,300	15,800
Coast Guard Headquarters	0.9	0.8	2,300	3,200
Subtotal	27.3	22.5	65,100	91,100
<u>Proposed Conference Center</u>				
Toilet Flushing	-	-	3,600	3,600
Commercial Laundry	-	-	2,500	3,300
Subtotal	0	0	6,100	6,900
Fort Baker Total	27.3	22.5	71,200	98,000

The irrigation demands shown in Table ES-1 would be seasonal and would occur from March through October. The non-irrigation demands from the proposed conference center would remain approximately constant throughout the year. Since there is more recycled water demand than wastewater flow during dry weather, not all recycled demands can be met, if only wastewater from the Marin Headlands is used.

Two main alternatives were considered as part of this study; 1) upgrade the existing SMCSD wastewater treatment plant or 2) construct a new satellite treatment plant at Fort Baker. A summary of the alternatives that were evaluated is presented in Table ES-2.

Table ES-2: Alternatives Summary (Treatment Only)

Option	Treatment Process	Sites	Maximum Recycled Water Production	Estimated Treatment Capital Cost*	Estimated Treatment Annual O&M Cost*
Option 1: SMCSD Treatment Plant Upgrade					
Modify Existing Layout	MF/RO	Current SMCSD process would need to be modified	0.2 MGD	\$6,070,000	\$62,300/year
Option 2: Fort Baker Satellite Plant					
Use Existing Building	MBR	No buildings available with adequate space	0.06 MGD	Not Calculated	Not Calculated
Most Feasible Option New Building	MBR	Construct new building on previously developed site; could require an Environmental Assessment	0.06 MGD	\$4,360,000	\$59,200/year

Note:

- Capital cost includes treatment plant building and site modifications

- Capital cost includes construction mark-up, implementation costs, and a 35% planning level contingency

*Liquid treatment only, estimate does not include solids handling, distribution or storage

There are two main issues that would make using the SMCSD treatment plant difficult.

1. Upgrading the existing SMCSD treatment plant to produce recycled water suitable for the demands shown in Tables ES-1, would require advanced treatment processes (i.e. microfiltration/reverse osmosis). Advanced treatment would be needed to reduce the concentration of total dissolved solids in the SMCSD wastewater, since high concentrations of total dissolved solids (greater than 450 milligrams per liter) can be toxic to some sensitive plant species. High total dissolved solids concentrations are a result of bay water intrusion into low lying areas of the SMCSD collection system tributary.
2. There is little available space at the existing SMCSD treatment. Adding advanced treatment would most likely require modifying the existing treatment processes to make room for the additional equipment.

Due to the issues associated with upgrading the SMCSD treatment plant and based on the information currently available, constructing a new satellite recycled water facility at Fort Baker was selected as the most feasible option.

The satellite recycled water facility at Fort Baker would provide primary, secondary and tertiary wastewater treatment and produce 0.06 million gallons per day of recycled water that satisfies the RWQCB and DHS requirements. Since there would not be enough recycled water available to meet all of the recycled water demands during peak summer months, the National Park Service would need to consider alternatives such as supplementing with potable water or limiting the amount of irrigation during this period.

The treatment plant would be housed in a new building located on the existing building pad east of the Bay Area Discovery Museum. The approximate dimensions of the new treatment plant building would be 90 feet long by 30 feet wide by 21 feet high. The design of the future recycled water plant would be in compliance with the Fort Baker Compatibility Study in order to achieve a compatible fit with the historic district in which it is located. An 110,000 gallon underground storage tank would also be required.

The preliminary estimate of the capital cost for the most feasible option including treatment, storage and distribution is \$5.45 million. The estimated annual operation and maintenance cost for the facility is \$131,000.

1. Introduction

The purpose of this report is to outline conceptual alternatives and a most feasible option for recycled water use at Fort Baker. The National Parks Service's (NPS) goal is to utilize recycled water as part of a sustainable approach for Fort Baker.

The use of recycled water at Fort Baker would provide a number of benefits including: a) reduced demand for potable water at Fort Baker consistent with the park's Marin Municipal Water District's (MMWD) water allotments, b) divert sanitary sewer discharges from the Golden Gate National Recreation Area (GGNRA) from being processed through the Sausalito-Marín City Sanitary District (SMCSD) treatment plant, thereby reducing wastewater discharges into San Francisco Bay, c) enhance partnership between NPS, SMCSD, MMWD and neighboring communities and d) provide an important sustainability demonstration project at the Park consistent with the goals of NPS, the Fort Baker Final Environmental Impact Statement (FEIS) and Reuse Plan (Fort Baker Plan).

2. Background

The Marin Headlands, which includes Fort Baker, Fort Cronkhite, and Fort Barry, is part of the GGNRA operated by the National Park Service. The NPS is currently implementing a reuse plan for Fort Baker as described in the Fort Baker Final Environmental Impact Statement and Reuse Plan. An essential part of the Reuse Plan is to make Fort Baker a model sustainable National Park facility. As such, the NPS has determined that a reclaimed water program, including treatment and distribution facilities, is a sustainable approach to meeting non-potable water demands such as irrigation, toilet flushing, etc.

Sausalito-Marín City Sanitary District is one of the potential sources of wastewater for the Fort Baker recycled water project. Another option is to treat the Fort Baker wastewater on-site using a satellite treatment plant capable of producing recycled water. A map of the project area is shown in Figure 2-1.

2.1 Fort Baker

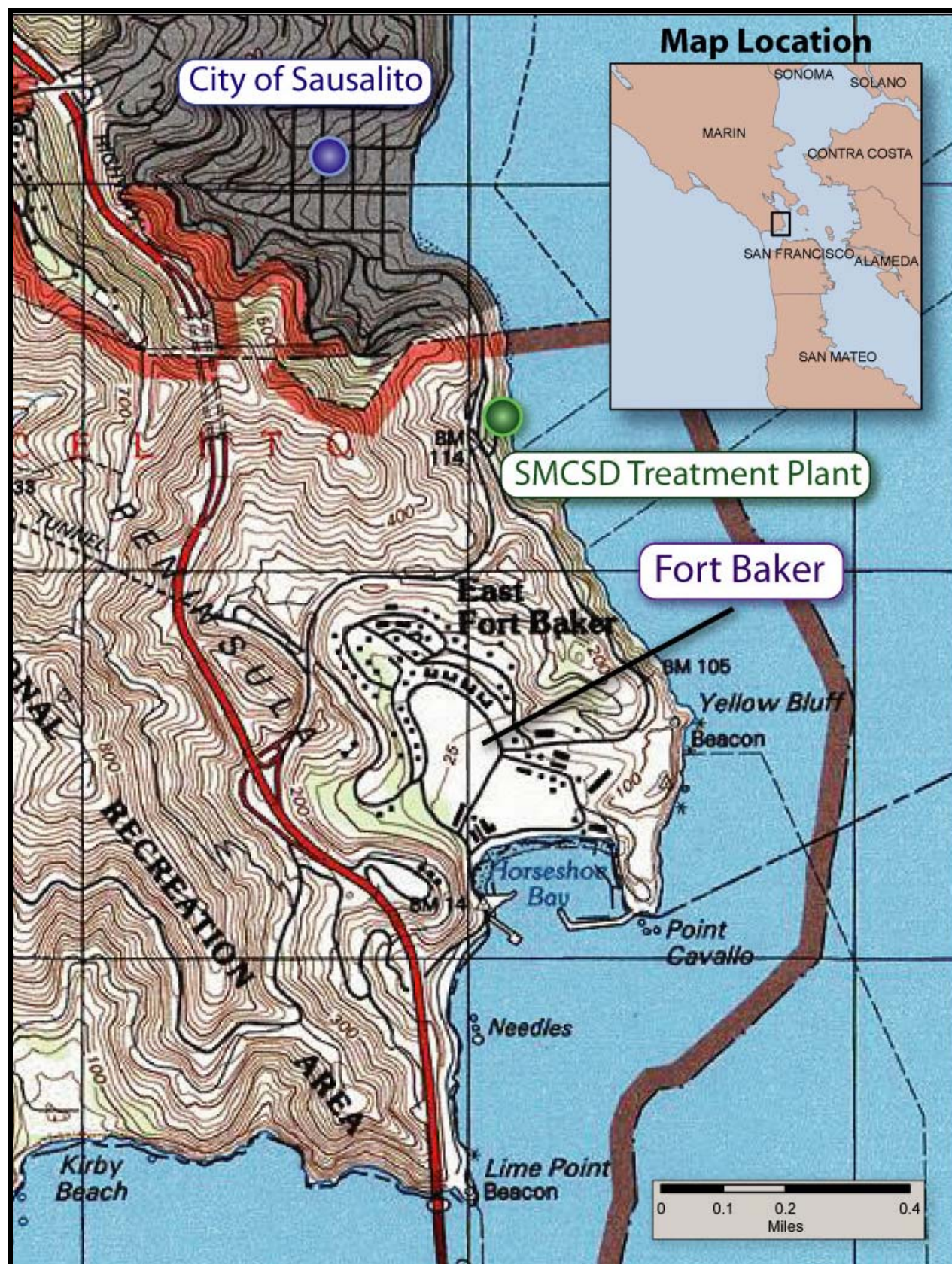
The Fort Baker Plan calls for establishing a Retreat and Conference Center in the core cantonment, retention and expansion of the Bay Area Discovery Museum, rehabilitation of the historic parade ground, the restoration of habitat areas, and the enhancement of waterfront recreation opportunities near Horseshoe Cove. The projected increase in Park visitors under the Fort Baker Plan would increase water demand and wastewater flows above current usage. Marin Municipal Water District provides water service through a common service line to Fort Baker, Fort Barry, and Fort Cronkhite. Wastewater from Fort Baker and the rest of the Marin Headlands is currently sent to SMCSD for treatment.

The NPS has performed a significant amount of work to identify deficiencies in the current utility system at Fort Baker. The majority of the utility infrastructure investigation was done by Psomas and Associates.

2.1.1 Water System

The existing water system is adequately sized to accommodate the potable water demands of the Fort Baker Plan; however some parts of the system may need to be upgraded to meet fire fighting requirements and some capacity constraints (Psomas and Associates, March 2001b). There is an abandoned non-potable distribution system at Fort Baker; however previous studies have recommended that this system not be used due to its current poor condition.

Figure 2-1: Project Site Map



2.2 Sausalito-Marín City Sanitary District

The Sausalito-Marín City Sanitary District wastewater treatment plant is designed to treat 1.8 million gallons per day (MGD) average dry weather flow (ADWF), which is collected from the City of Sausalito, Marin City, Tamalpais Valley, Muir Woods and the Marin Headlands (which includes Fort Baker). The current ADWF treated by the SMCSD plant is 1.6 MGD. The plant is located on NPS property approximately 2,200 feet along East Road from the core cantonment of Fort Baker. The SMCSD treatment process consists of primary sedimentation, followed by a fixed film reactor, secondary sedimentation, sand filtration, and disinfection. The fixed film reactor oxidizes organic material in the wastewater as it trickles through loosely packed media with attached bacteria that use the organic material to produce energy. Treated wastewater from the SMCSD treatment plant is discharged to San Francisco Bay. The SMCSD wastewater treatment system is designed to meet secondary treatment standards for Bay discharge.

As described in Section 3.2, there are additional filtration and disinfection processes required by the State of California Department of Health Services that would need to be added in order to produce recycled water at SMCSD. There are two additional issues that would complicate recycled water production from SMCSD. The first issue is chlorides. A significant amount of high chloride concentration saltwater from the Bay, infiltrates into the SMCSD collection system tributary, which results in elevated chloride concentrations at the SMCSD plant. The resulting high concentration of chlorides and other dissolved solids make it unsuitable for irrigation purposes. Chlorides and other dissolved solids are not removed by a normal filter process used for recycled water production. Reduction of chlorides would require a more advanced treatment process such as reverse osmosis.

The second complicating issue at SMCSD is the constraints of the site. The SMCSD plant is located on a small beach area on the Bay front and there is no room within the existing footprint for expansion. Construction of recycled water facilities at SMCSD would likely require expansion and construction of facilities on the adjacent beach.

3. Recycled Water Supply and Demand

Recycled water is produced from wastewater and is typically used for irrigation. It is therefore important to identify the amount of wastewater available for use and the potential amount of demand there may be for recycled water.

3.1 Wastewater Supply

Currently wastewater generated at Fort Baker is combined with other wastewater flows from the rest of the Marin Headlands and sent to the SMCSD treatment plant. In the 1997 *East Fort Baker Sewer System Study Addendum*, Psomas and Associates estimated that Fort Baker contributed 38% of the total Marin Headlands wastewater flow.

3.1.1 Current Wastewater Flow

Based on SMCSD data from January 1999 through August 2003, from April through November the total wastewater flow from the Marin Headlands ranges between 40,000 gallons per day to 69,000 gallons per day. Based on the 38% estimate, the current Fort Baker wastewater flow ranges from 15,200 gallons per day to 26,200 gallons per day over the same period. Current average dry weather wastewater flows are presented in Table 3-1.

Table 3-1: Current Dry Weather Wastewater Flow

Wastewater Source	ADWF (Gallons per day)
SMCSD	1,600,000
Fort Baker Only	16,400
Fort Barry & Fort Cronkhite	26,700
Total Marin Headlands	43,100

3.1.2 Future Wastewater Flow

After the Fort Baker Plan has been fully implemented the amount of wastewater flow will be different than the current flow. As part of the Fort Baker Final Environmental Impact Statement, an estimate of future wastewater flows was prepared. Since the preparation of the FEIS, other analyses, and further design have allowed for refinements in the projected wastewater demands to be made. The resulting estimated wastewater flow is shown in Table 3-2.

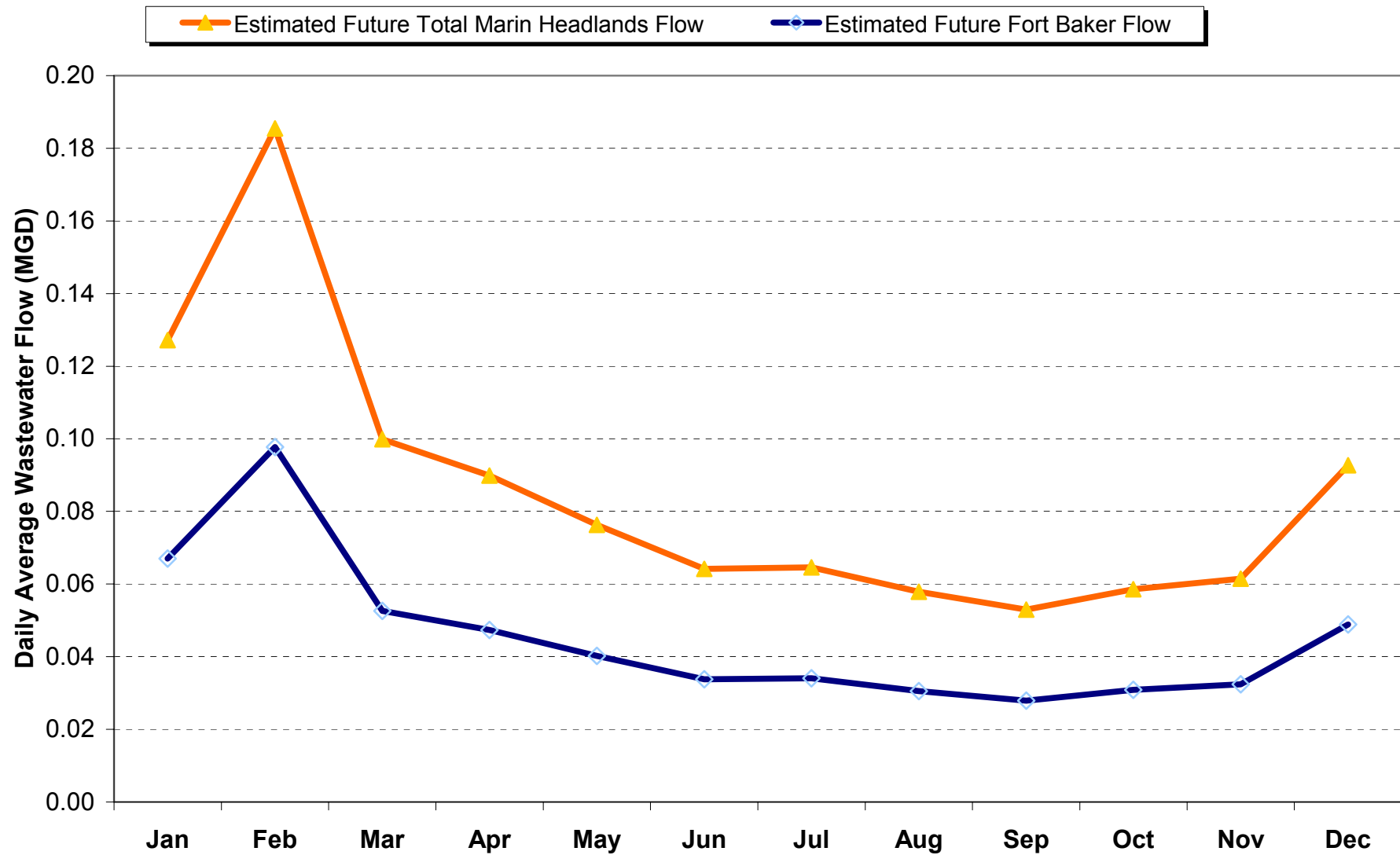
Table 3-2: Fort Baker Projected Average Dry Weather Wastewater Flows

Type of Use	Gallons per Day (gpd)
Retreat and Conference Center	
Guest Lodging	7,880
Staff and Other Lodging	880
Meeting rooms	2,800
Dining rooms	990
Employees	840
Bay Area Discovery Museum	
Exhibit/ Offices	4,460
U.S. Coast Guard	
Offices/ Storage	750
Water Front Activities	1,000
Vista Point	7,600
NPS Operations	700
Total	27,900

Table adapted from the NPS *Fort Baker Plan Final Environmental Impact Statement*, October 1999 and updated based upon refined design calculations provided by the NPS in August 2003.

The ADWF from other areas in the Marin Headlands is currently 26,700 gpd. Assuming this flow does not increase, the projected wastewater flow for Fort Baker and Marin Headlands as a whole would be 27,900 gpd and 54,600 gpd, respectively.

The wastewater flow varies by season with peaks occurring in wet weather due to infiltration/inflow. The seasonal variation of the future wastewater flow is illustrated in Figure 3-1.

Figure 3-1: Estimated Future Wastewater Flow

3.2 Quality Requirements

The wastewater used for recycled water production needs to be treated to meet the requirements of the California Department of Health Services (DHS) and if necessary, it needs to be treated to prevent damage to plants that are irrigated.

3.2.1 Department of Health Services Requirements

The San Francisco Bay Regional Water Quality Control Board (RWQCB) and the California Department of Health Services regulate the use and production of recycled water. The NPS would need to obtain approval from the RWQCB before recycled water is used at Fort Baker. The RWQCB will review the plan for recycled water use to ensure that groundwater and ecological resources would not be impacted. For the proposed uses under the Fort Baker plan, all recycled water would need to meet the Title 22 Disinfected Tertiary recycled water requirements listed in the California Code of Regulations for “unrestricted” use. The requirements for Title 22 Disinfected Tertiary recycled water are as follows:

1. Wastewater must be “oxidized” (i.e. treated to secondary standards).
2. Filtered wastewater must be disinfected by either:
 - Filtration followed by chlorination with a CT value of not less than 450 milligram-minutes/ liter; or
 - A disinfection process combined with filtration that has been demonstrated to proved 99.999% removal or inactivation of plaque-forming units of F-specific bacteriophage MS2, or polio virus in wastewater.
3. Total coliform concentrations must not exceed:
 - 7-day median concentration of 2.2 most probable number (MPN) per 100 milliliters;
 - Not more than one sample greater than 23 MPN per 100 milliliters in any 30-day period; and
 - No sample shall exceed a 240 MPN per 100 millimeters.

As described in the SMCSD National Pollution Discharge Elimination System (NPDES) wastewater discharge permit (Order No. 00-060), SMCSD is currently required to meet the following total coliform limits.

1. The moving median for five consecutive samples shall not exceed 240 MPN/ 100 ml; and
2. No single sample shall exceed 10,000 MPN/ 100 ml

Although, the SMCSD treatment plant effluent currently achieves these limits, it does not satisfy the Title 22 disinfection requirements. In addition, the sand filters used in the SMCSD treatment process do not meet the “filtered wastewater” requirement for Title 22 recycled water.

3.2.2 Irrigation Requirements

The Title 22 recycled water quality requirements were developed for the protection of human health. Title 22 does not address other water quality requirements of the recycled water use such as irrigation requirements for plant health. Irrigation is one of the primary uses for recycled water and the water needs to be of sufficient quality so that it does not harm the plants that are irrigated. For example, elevated chloride concentrations can be toxic to plants. This is often a concern in the San Francisco Bay Area because of saltwater intrusion into sanitary sewer collection systems located along the Bay front. In addition, the quality of the recycled water should also be checked to ensure that it does not cause problems with the distribution system (e.g. clogging, corrosion, etc.). During the feasibility study staff from SMCSD collected additional samples of the SMCSD effluent and combined Marin Headlands wastewater to assist in the recycled water quality evaluation. The analytical results from the sampling are included in Appendix A.

Chloride measurements of the SMCSD raw influent wastewater were taken on November 11, 2001. The daily variation in chloride levels is shown in Figure 3-2. San Francisco Bay tide levels are also shown in Figure 3-2. During the sampling period, chloride levels ranged from 880 mg/L to 2,849 mg/L. Typically, chloride concentrations of greater than 150 mg/L pose a problem for irrigation. Elevated influent chloride levels at the SMCSD treatment plant are caused by saltwater infiltration and are influenced by tide levels. Although

improvements are planned for the collection system tributary to the SMCSD treatment plant, it is unlikely that influent chloride levels would be reduced to the point where SMCSD treated wastewater could be used for recycled water without additional treatment (e.g. reverse osmosis).

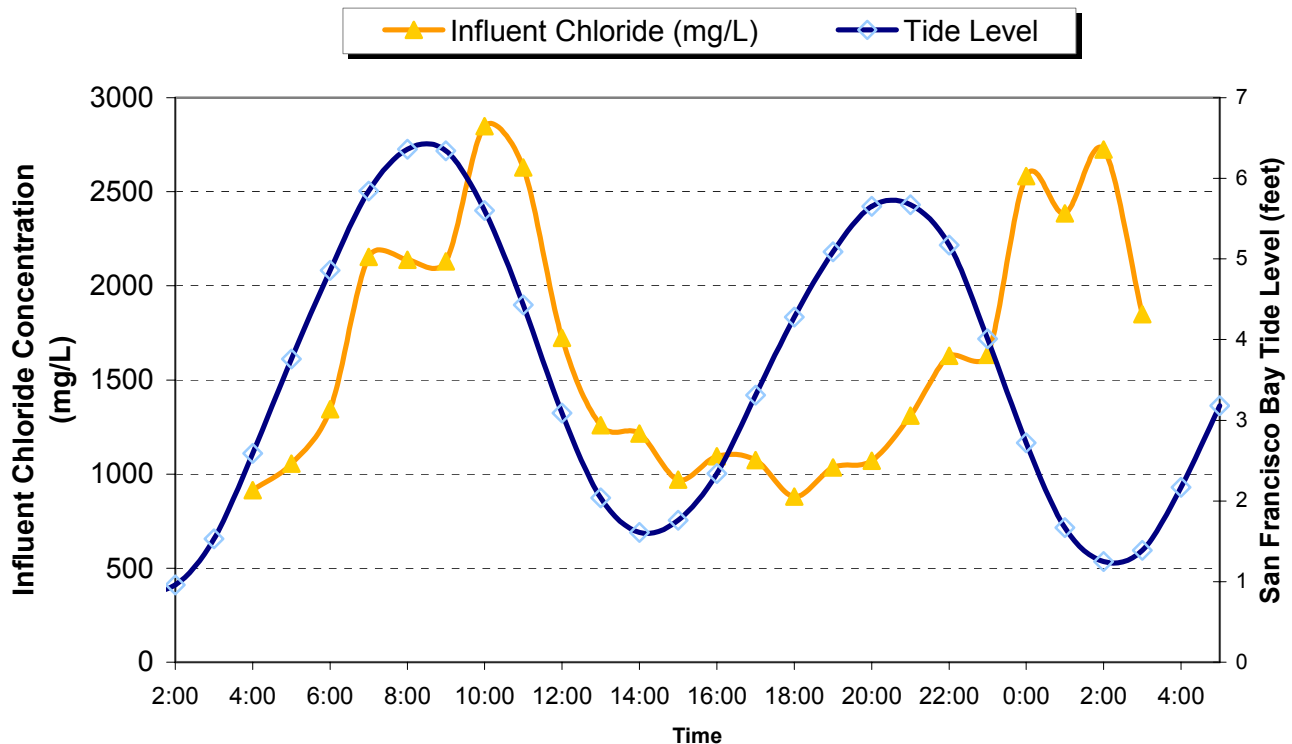
Raw wastewater grab samples from Fort Baker (which is the combined wastewater flow from the Marin Headlands) were analyzed for chlorides and TDS. The results are shown in Table 3-3 along with the result from SMCSD raw influent sampling.

Table 3-3: Recent Sampling

Sample	Chlorides (mg/L)	TDS (mg/L)
SMCSD Raw Influent (24 hour average)		
11/11/2001	1652	-
Fort Baker (Grab)		
2/26/2002	52.0	342
2/27/2002	62.3	256
2/28/2002	78.7	-

Since the collection system for Fort Baker is above sea level, it is not subject to Bay water infiltration. Based on these initial measurements, the Fort Baker wastewater would not require any additional treatment beyond the guidelines established by the DHS and RWQCB for the production and use of recycled water.

Figure 3-2: SMCSD Influent Chloride Concentration and Tide Level (11/11/2001 – 11/12/2001)



3.3 Recycled Water Demand

Potential uses for recycled water include landscape irrigation, toilet flushing, and commercial laundry. Demand for recycled water will be dependent on the amount of land that is irrigated and the extent to which recycled water use is incorporated into the design of the proposed Fort Baker Retreat and Conference Center. Potential recycled water demand sites are shown in Figure 3-4.

The most significant demand for recycled water is expected to be for irrigation. It is estimated that typical turf grass would require approximately 26-inches per unit area of water from March to October every year. Potential irrigated areas and other recycled water demands near Fort Baker are presented in Figure 3-4.

Other sites, which could be supplied with recycled water as part of the Fort Baker project include, the Marine Mammal Center and Native Plant Nursery. The Marine Mammal Center and the Native Plant Nursery are located in Fort Cronkhite, which is approximately 3 to 4 miles away from Fort Baker. Assuming a construction cost \$100 per linear foot it would cost approximately \$1.9 million to install a pipeline to the eastern areas of the Marin Headlands. Recycled water service to this area from Fort Baker would also require pumping and is most likely cost prohibitive at this time.

Recycled water could be supplied to the southern portion of the City of Sausalito. This would require further discussion with the City of Sausalito regarding their interest in using recycled and the amount of area that would be irrigated. The NPS and SMCSD encourage the use of recycled water (as is consistent with NPS compliance requirements) by the NPS, its Park Partners and local communities served by the SMCSD treatment plant. Furthermore, the economic and engineering feasibility of the project may be greatly enhanced by local, State and Federal partnership on this Project. However, based on the initial discussions with the City of Sausalito, it was determined that providing recycled water to the City of Sausalito was not feasible at this time due to lack of viable demands in proximity to the SMCSD treatment plant, and to the need to add a reverse osmosis process to reduce chlorides from the SMCSD wastewater.

It may be possible to supply the Vista Point visitor area with recycled water. It is estimated that the Vista Point area would require approximately 4 acre-feet per year (3,740 gallons per day) of recycled water. Providing this area with recycled water would require future negotiations between the NPS and Caltrans. The relative location of these potential recycled water demands are shown on Figure 3-4. However, since demands outside of Fort Baker are either undefined at this point or remote enough to be cost prohibitive, this study focuses only on demands from within the Fort Baker site.

Potential recycled water demands for Fort Baker are shown in Table 3-4, which includes demand estimates for irrigation on the Fort Baker site, as well as other potential dual plumbing demands (e.g. toilet flushing and laundry) from the proposed Fort Baker Retreat and Conference Center. The areas listed under "Fort Baker Irrigation" include currently irrigated areas as well as future irrigated areas (Parade Grounds, Water Front Meadow and Other Landscaping) that are included as part of the Fort Baker Plan. The irrigated areas at Fort Baker, except for the Other Landscaping areas, are shown in Figure 3-3.

Figure 3-3: Recycled Water Users at Fort Baker



The non-potable water demand has significant seasonal variation with peak demand occurring during the summer irrigation season. Figure 3-5 illustrates the seasonal variation in demand with a peak month/peak day demand of 144,300 gpd. To meet this demand fully with recycled water, a recycled water facility would have a design capacity of 144,300 gallons per day with a storage volume of approximately 100,000 gallons to meet the peak hour demands of 240 gallons per minute. Although most of the non-potable water requirements occur during the summer months, non-potable demand from toilet flushing and laundry use would occur year round with a demand of between 6,000 to 7,000 gpd during the non-irrigation season.

Figure 3-5 also shows the projected wastewater flow from the Marin Headlands which is estimated at 54,600 gpd. This discrepancy between non-potable demand and available recycled water supply from the Marin Headlands leads to two basic alternatives for recycled water production which are discussed in Section 4. One alternative is to locate the recycled water facility at SMCSD where there is adequate supply available to fully serve the total non-potable demand. The second alternative is to locate a recycled water facility at Fort Baker and serve a portion of the non-potable demand with the available Marin Headlands wastewater flow.

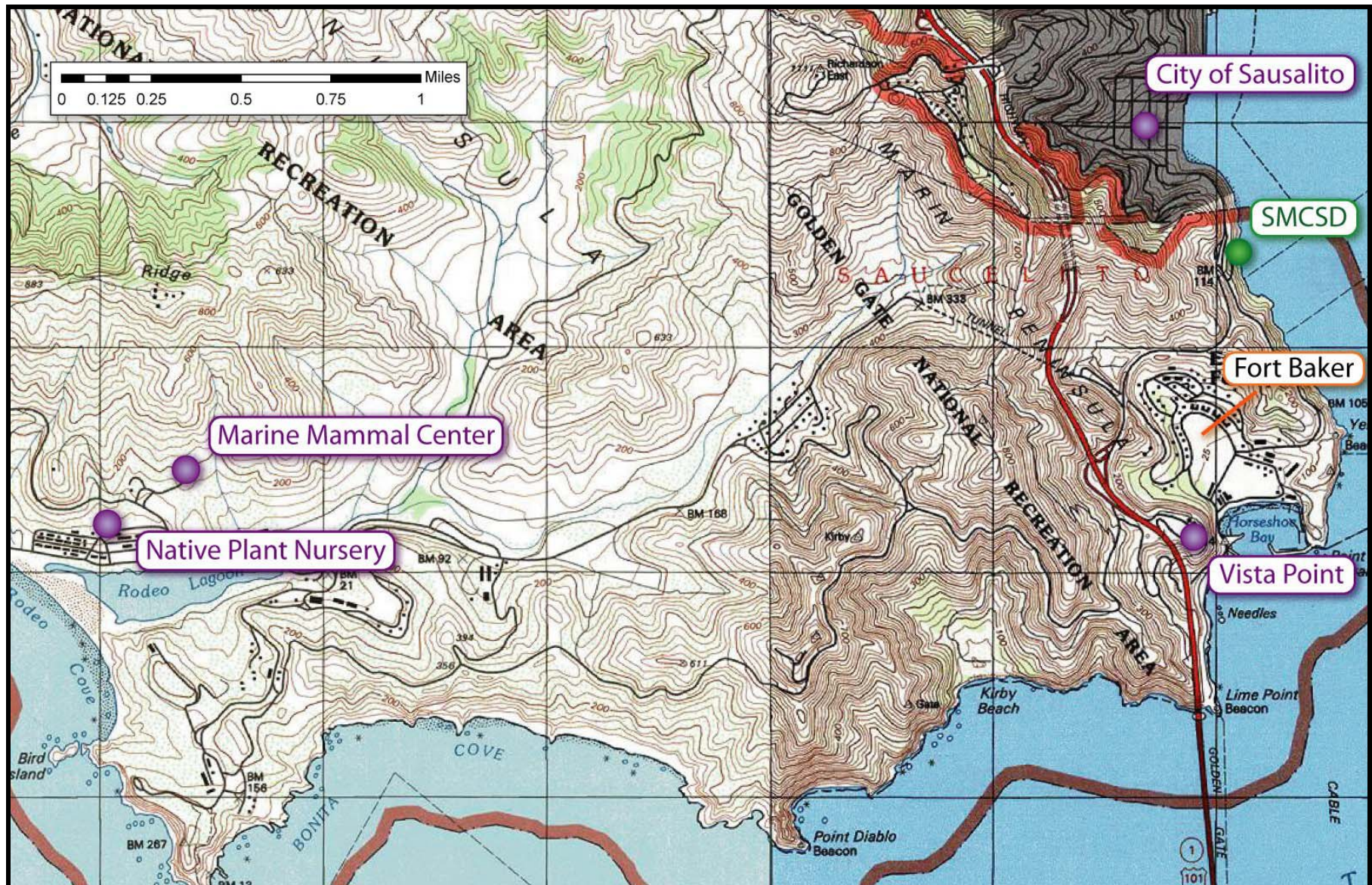
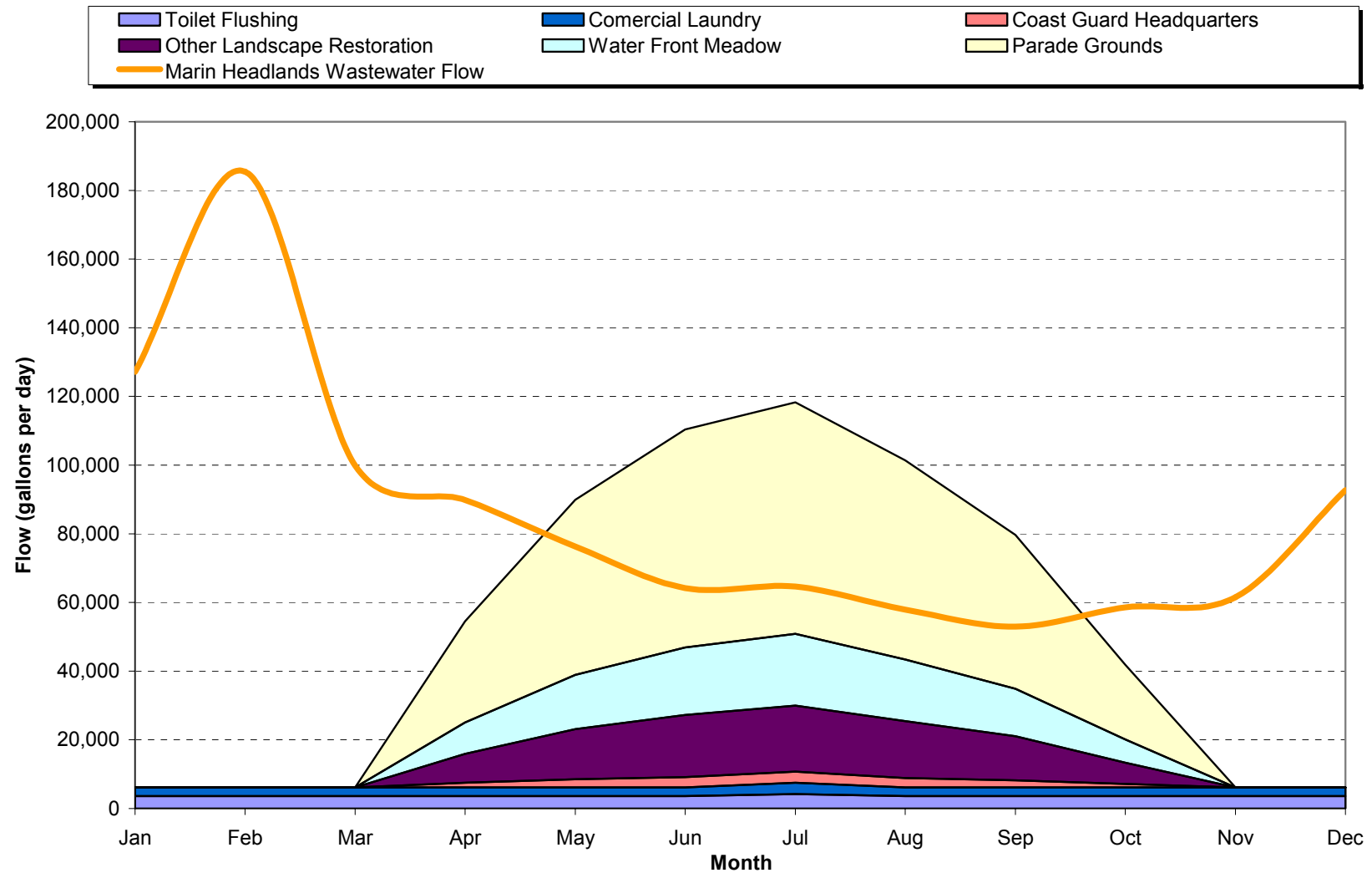
Figure 3-4: Potential Recycled Water Users

Table 3-4: Estimated Future Recycled Water Demand at Fort Baker

Potential Recycled Water Users	Total Area (Acres)	Irrigated Area (Acres)	Demands				
			Average Annual (AFY)	Average Month Daily (gpd)	Peak Month Daily (gpd)	Peak Month Peak Day (gpd)	Peak Month Peak Day Peak Hour (gpm)
Factor			1	1.5	1.4	1.5	2.4
Fort Baker Irrigation							
Parade Grounds	14.0	13.5	29.3	54,800	82,300	197,400	137.1
Water Front Meadow	8.5	4.3	9.2	17,300	25,900	62,100	43.1
Other Landscape Restoration	3.9	3.9	8.5	15,800	23,800	57,000	39.6
Coast Guard Headquarters	0.9	0.8	1.7	3,200	4,900	11,700	8.1
Proposed Fort Baker Plan							
Toilet Flushing	-	-	4.0	3,600	4,200	4,200	7.0
Commercial Laundry	-	-	2.7	2,500	3,300	3,300	5.4
Fort Baker Total	27.3	22.5	55.4	71,200	98,700	144,300	240.4

Assumptions:

- Irrigation only required for 8 months of the year (March through October)
- Average seasonal water demand for Turf Grass is estimated to be 26 inches times the unit area
- Toilet Flushing based on 15 gal/day per person, 75% average capacity, 120 Employees and 20 year round residents
- Commercial Laundry based on 14 gal/day per person and 75% average capacity
- Average Month Daily demand factor of 1.5 is based on the 8-month irrigation season
- Peak Month Daily demand factor of 1.4 is based on the 1999-2000 water meter data for the Marin Headlands
- Peak Month, Peak Day (PMPD) demand is estimated using the PMAD demand and a Peaking Factor of 1.5 consistent with other bay area recycled water projects (e.g. Presidio recycled water project)
- Peak Month, Peak Hour demand is calculated using the PMPD demand and a Peak Factor of 2.4, which represents a ten-hour night irrigation period (9 p.m. to 7 a.m.).

Figure 3-5: Estimated Recycled Water Demands and Future Wastewater Flow at Fort Baker

*Note: Does not include demand from Vista Point

4. Recycled Water Facility Alternatives

Several options were initially evaluated as part of the recycled water feasibility study. Based on a preliminary evaluation, two options were further developed and are presented in this section. The most feasible option for Fort Baker is discussed in Section 5.

4.1 Option 1: SMCSD Recycled Water Production Facility

The SMCSD treatment plant is a secondary treatment plant and needs additional filtration and disinfection processes to meet the Department of Health Services requirements for recycled water use. In addition, the high concentrations of chlorides and total dissolved solids in the SMCSD final effluent would be toxic to plants if the water were used for irrigation. To produce Title 22 recycled water that is suitable for irrigation, the SMCSD treatment plant would need to be upgraded to include tertiary and advanced treatment processes. Secondary effluent from the SMCSD plant would be treated using two membrane processes (microfiltration and reverse osmosis) followed by disinfection.

4.1.1 Microfiltration

The semi-permeable membranes used for the reverse osmosis (RO) process are easily clogged if the water being treated contains a high concentration of suspended solids. The use of microfiltration prior to RO will help reduce RO membrane fouling and reduce the frequency at which cleaning is required. Microfiltration is a low-pressure membrane process for removing suspended particles with a diameter greater than 0.05-10 microns.

The dimensions for the microfiltration process equipment are shown in Table 4-2. More detailed information on the microfiltration membrane process is included in Appendix B.

Table 4-1: Microfiltration Equipment Footprint

Equipment	Width (feet)	Length (feet)
Process Tank	8.1	15
Process Equipment Skid	8.1	20

4.1.2 Reverse Osmosis

To reduce the concentration of TDS typically found in the SMCSD final effluent, treatment by reverse osmosis is required. Reverse osmosis works by forcing water through a semi-permeable membrane, which screens out dissolved solids.

As a byproduct, the RO process will produce a brine solution, which would contain a high concentration of TDS. The brine waste would need to be taken off-site for disposal or, if allowed by the RWQCB, blended back into the SMCSD effluent and discharged to the Bay. The estimated footprint requirement for a skid mounted RO unit of producing 200,000 gpd of recycled water is shown in Table 4-2. More detailed information on the RO process is included in Appendix C.

Table 4-2: Reverse Osmosis Equipment Footprint

Equipment	Width (feet)	Length (feet)
RO Skid	6	23
Cleaning Equipment Skid	7	7
Chemical Injection Skid	2	4

4.1.3 Ultraviolet Disinfection

Treated water from the RO process would need to be disinfected prior to use to satisfy the Department of Health Services requirements for recycled water use. RO provides some removal of viruses, however disinfection is still required. Disinfection options include ultraviolet (UV) disinfection and chlorination. Due to the relatively large amount of space required for chlorine disinfection, UV disinfection is better suited this application. More detailed information on the UV process is included in Appendix D.

At high enough intensities, ultraviolet light can prevent pathogens in wastewater from reproducing. UV disinfection does not provide residual disinfection, therefore a small dose of chlorine is recommended prior to distribution and/or storage.

Where ultraviolet disinfection is used for disinfection after reverse osmosis, the DHS requires a minimum UV dose of 50 mJ/cm² and a permeate transmittance of at least 90% or greater at a wavelength of 254 nm (NWRI and AWWARF Dec. 2000).

4.1.4 Siting

As shown in Figure 4-1, the SMCSD treatment plant is built on a platform on the waterfront. There is little or no room at the SMCSD treatment plant site for the addition of new treatment processes. Options for siting a recycled water facility are: 1) modify the existing treatment plant, 2) expansion onto the adjacent beach or 3) building a remote facility near the existing SMCSD treatment plant.

Other sites were considered during the evaluation, including a site along Fort Baker Road near SMCSD and expansion of the SMCSD footprint onto an adjacent beach south of the plant. These sites were not considered for further evaluation due to potential environmental impacts that could result from the development of those sites. Therefore only modifying the existing treatment plant was evaluated as part of this study.

A 0.2 MGD MF/RO treatment process would require a footprint of approximately 30 feet by 50 feet (see Figure 4-2). The equipment included in the footprint are the microfiltration tank and equipment, reverse osmosis process and cleaning skids, and the UV disinfection process. Space for a recycled water pump station and storage tank would also be required at or near the treatment plant. Potential locations at the SMCSD treatment plant for construction of the MF/RO equipment are the sand filter area and on top of the primary clarifier (requires construct of a cover over the primary clarifiers), which were shown in Figure 4-1.

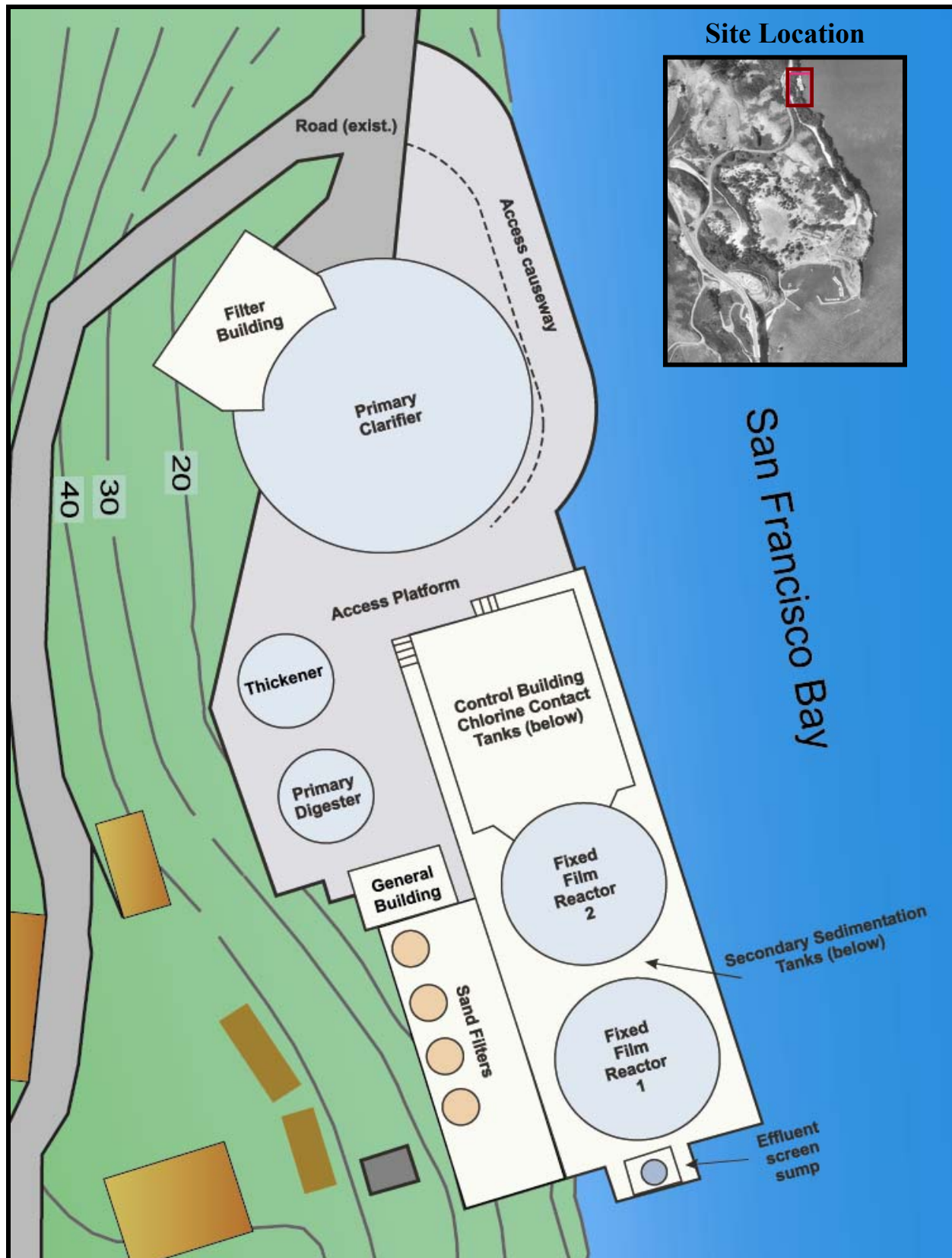
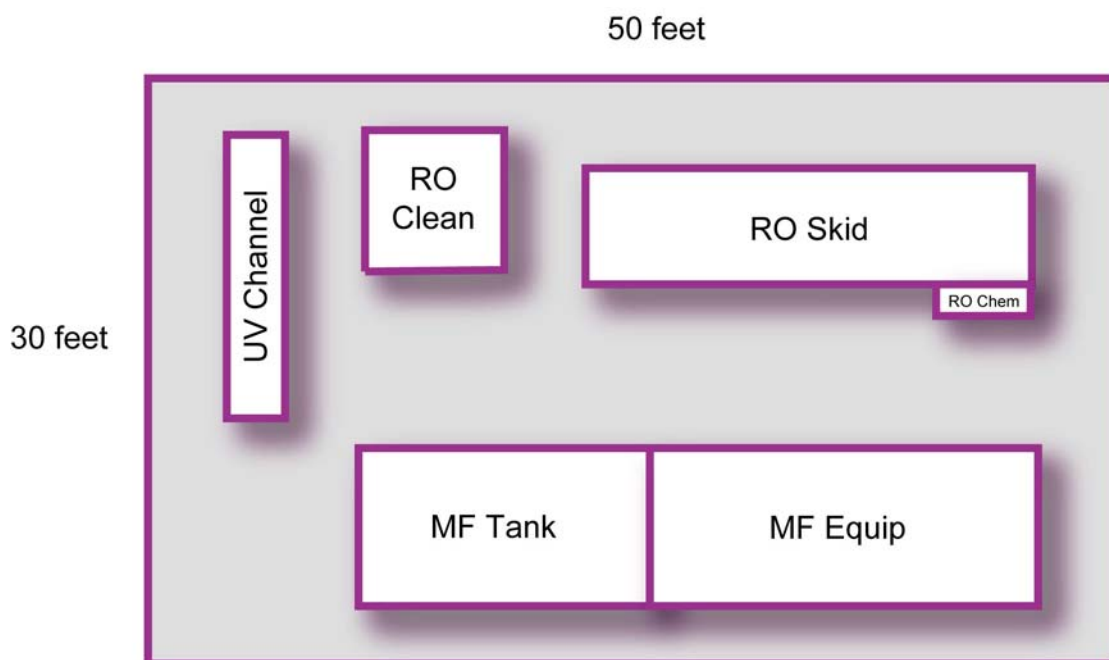
Figure 4-1: Existing SMCSD Wastewater Treatment Plant Layout

Figure 4-2: Microfiltration/Reverse Osmosis Footprint Required

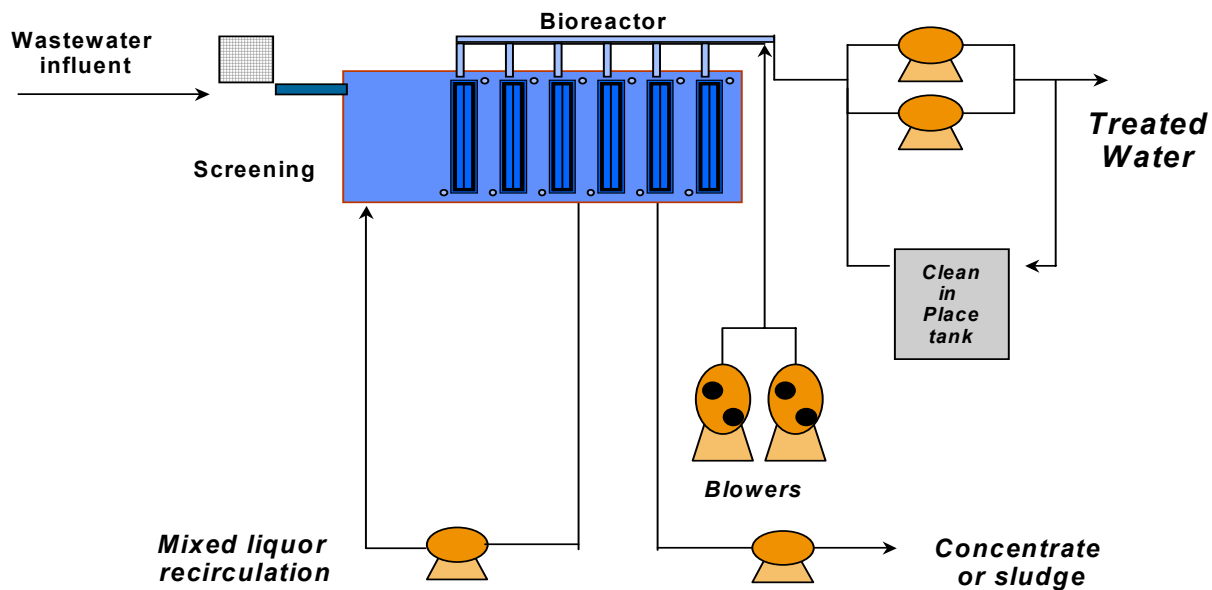
4.2 *Option 2: Fort Baker Satellite Treatment Plant*

The second option is to treat the Marin Headlands wastewater on-site at Fort Baker to produce recycled water. The benefit of this option is that the Marin Headlands wastewater has a low concentration of TDS and therefore would not require RO for TDS removal. However, the Fort Baker satellite plant would need to provide secondary treatment in addition to tertiary treatment.

The amount of recycled water that could be produced is dependent on the amount of wastewater available from the Marin Headlands. During dry weather months the total Marin Headlands wastewater flow is projected to be 54,600 gallons per day. The estimated peak month peak day recycled water demand for the Fort Baker Plan is 144,300 gallons per day. During the dry weather months there would not be sufficient wastewater flow from the Marin Headlands to allow a satellite treatment plant to meet the total recycled water demand, shown in Figure 3-4. The shortfall in irrigation demand would need to be provided by an alternative water supply such as potable water or alternative irrigation policies. For example, the estimated demand is based on typical water requirements to “keep the grass green”. Instead, the NPS could choose to not irrigate some landscape areas or could irrigate them for only a portion of the year.

4.2.1 *Satellite Membrane Biological Reactor Package Plant*

The recommended treatment system is a membrane biological reactor (MBR) integrated with an ultrafiltration membrane system. This treatment system typically is offered as a complete package from a manufacturer and has the advantage of providing both secondary and tertiary treatment in a small footprint. An MBR system sized for the Fort Baker flow would be approximately 8 feet wide, 44 feet long and 10 feet high. However, additional vertical clearance of 10 to 11 feet would be required to accommodate removal of the membranes. The bioreactor membranes would need periodic cleaning, which requires removing them from the tank. A schematic of the ZenoGem® process is shown in Figure 4-3.

Figure 4-3: ZenoGem® Process Schematic

Sludge generated from the package plant would need to be pumped to SMCSD, trucked to SMCSD, or treated on-site and hauled away for disposal. Ultraviolet disinfection of the treated wastewater is included as part of the package plant, however a small amount of sodium hypochlorite would be needed for membrane cleaning and residual disinfection of the recycled water distribution system. More detailed information on the package wastewater plant is included in Appendix E.

4.2.2 Siting

To allow for adequate operation and maintenance, a building at least 30 feet wide by 90 feet long and 21 feet tall is required. Existing buildings 671, 633 and 655 were evaluated for their potential to house the recycled water treatment facility. Their locations are shown in Figure 4-4. Building 691 was also initially examined, however the NPS has stated that it is unavailable for use. Based on the package plant dimension, none of the buildings available have a footprint large enough to house the satellite treatment plant. An alternative to the retrofit of an existing building is the construction of a new building to house the satellite plant. However the construction of a new building may require an environmental assessment and addendum to the Fort Baker FEIS.

Figure 4-4: Buildings Examined at Fort Baker

5. Most Feasible Option

Table 5-1 summarizes the two potential recycled water options discussed in Section 4. Based on the current information and facilities available, the NPS determined that the most feasible option, at the time of this study, is a satellite package plant located in a new building on the old maintenance building pad (formerly Building 570) east of the Bay Area Discovery Museum. Due to the amount of wastewater available at Fort Baker, the most feasible option would have a capacity of approximately 0.06 MGD.

Table 5-1: Options Summary

Option	Treatment Process	Sites	Maximum Recycled Water Production	Estimated Treatment Capital Cost*	Estimated Treatment Annual O&M Cost*
Option 1: SMCSD					
Modify Existing Layout	MF/RO	Current SMCSD process would need to be modified	0.2 MGD	\$6,070,000	\$62,300/year
Option 2: Fort Baker Satellite Plant					
Use Existing Building	MBR	No buildings available with adequate space	0.06 MGD	Not Calculated	Not Calculated
Most Feasible Option New Building	MBR	Construct new building on previously developed site; could require an Environmental Assessment	0.06 MGD	\$4,360,000	\$59,200/year

Note:

- Capital cost includes treatment plant building and site modifications

- Capital cost includes construction mark-up, implementation costs, and a 35% planning level contingency

*Liquid treatment only, estimate does not include regulatory compliance, solids handling, distribution or storage

A more detailed capital and operation and maintenance cost estimate for the SMCSD treatment option is included as Appendix F. Detailed cost estimates for the most feasible option (Option 2) are presented in Section 5.9.

5.1 Treatment Site

The site for the most feasible option is the abandoned building pad located east of the Bay Area Discovery Museum. The previously disturbed site was formerly the site of a maintenance building. The site is approximately 60 feet wide and 300 feet long. Most of the site is flat and is located at an elevation of 34 feet. An aerial photo graph of the most feasible option site is shown in Figure 5-1

Figure 5-1: Most Feasible Option Site

It is anticipated that a portion of the site may be used for some other purpose as part of the Fort Baker Plan. Therefore it is assumed that the recycled water treatment facility would need to be located within a 160 foot by 60 foot area on the east side of the site, which is illustrated by the rectangle shown in Figure 5-1.

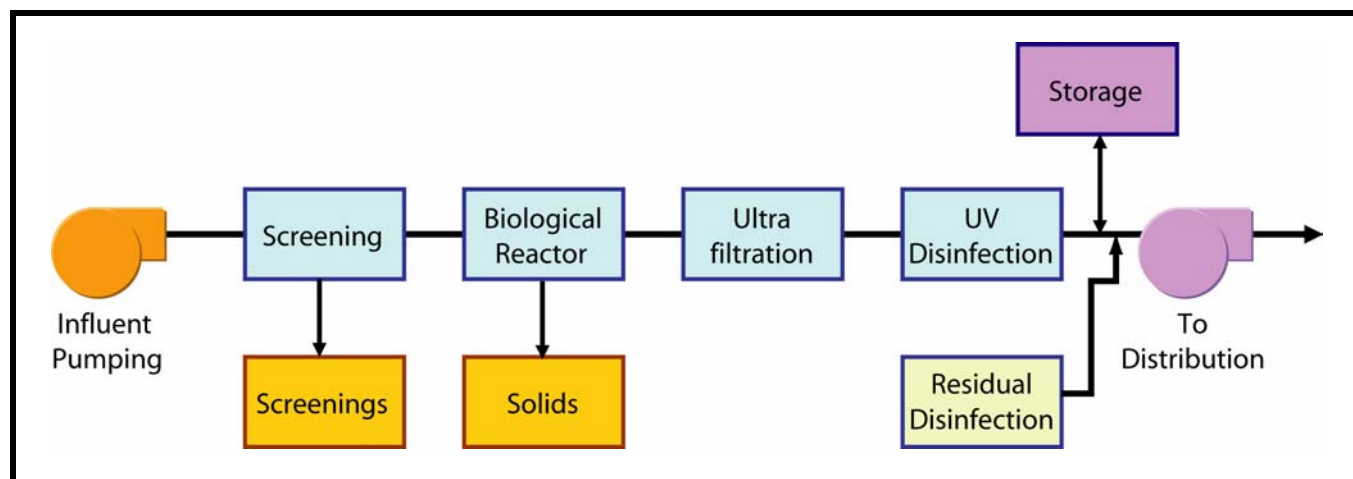
There are several factors that need to be considered as part of the recycled water treatment plant building design. Future plans for the San Francisco Bay Trail contains a route that would pass through the proposed site. The exact location, orientation and size of the recycled water treatment plant should be discussed with the Bay Trail designers. For the purposes of this study it was assumed the maximum width of the treatment plant building should be 30 feet, which would leave approximately 30 feet for the Bay Trail.

The treatment plant building also needs to be designed and constructed so that it is compatible with the Fort Baker Plan. The design of the future reclaimed water plant would be in compliance with the Fort Baker Compatibility Study in order to achieve a compatible fit with the historic district in which it is located.

5.2 Treatment Process

As discussed in Section 4.2, the satellite treatment package plant would be a membrane bioreactor with ultraviolet disinfection. Wastewater from Fort Baker and the rest of the Marin Headlands would be pumped to the recycled water treatment plant, screened, treated by the biological reactor, filtered through ultrafiltration membranes, disinfected by ultraviolet light and then either stored or distributed. A schematic of the recycled water treatment process is shown in Figure 5-2. The general operation of the membrane biological reactor was discussed in Section 4.2.1.

Figure 5-2: Recycled Water Treatment Process Schematic



5.2.1 Influent Pumping

Raw wastewater would be supplied to the recycled treatment plant from the existing wastewater pump station (Pump Station 5-1) in Fort Baker that sends wastewater to SMCSD for treatment via the existing 8-inch diameter force main. Since pumping to the most feasible option site would require less pumping energy than pumping to SMCSD, a throttling and isolation valve would be required as part of the connection to recycled water treatment plant. In addition, an isolation valve would also be required on the existing force main down stream of the connection to recycled water treatment facility.

5.2.2 Fine Screening

A fine screen is required ahead of the MBR package plant in order to remove large material, trash and string material that could clog or damage the membranes. The package plant manufacturer requires that a screen with an opening not greater than 2.0 millimeters must be used in front of the process.

A rotary screen is proposed for this application. Wastewater from the influent pump station would flow directly into the fine screen. The fine screen would be enclosed to reduce odors. The rotary screen would be mounted on top of the MBR process skid and would feed directly into the MBR. Material that is greater than the screen opening would be captured by the screen and funneled into a covered dumpster. Periodically, the dumpster would need to be emptied and the contents (screenings) hauled away for disposal. The screenings dumpster would need to be emptied and the contents hauled away once per week to limit the amount of odor generated from the screenings. Chemicals could be added to the screenings to minimize odor impacts.

Based on typical wastewater treatment plant, at 0.06 MGD it is estimated that the fine screen would generate approximately 1.8 ft³/day of screened material. A one-cubic yard dumpster would provide approximately 2-weeks of screenings storage.

Some landfill disposal sites may have specific requirements that the screenings would have to meet before they would be accepted (e.g. water content). Additional requirements may result in the need for additional equipment such as a compacter and/or washer. Screenings disposal restrictions should be evaluated prior to design.

5.2.3 Odor Control

To minimize nuisance odors, odor control equipment would need to be installed as part of the treatment plant building. All air within the treatment plant building would pass through an odor control unit prior to being discharged outside of the building. All the treatment process within the building would also be covered. Air from within the covered treatment process would be scrubbed prior to being emitted from the treatment building. Based on the preliminary treatment layout, an odor control unit with a capacity of at least 900 cubic feet per minute (cfm) of air would be required.

For the purposes of the most feasible option development, it was assumed that a granular media odor control unit would be used. A package skid mounted odor control unit could be utilized for this application. The odor control unit media would need to be monitored on a periodic basis for effectiveness and replaced as necessary. A soil bed filter odor control unit is another potential option that should be evaluated as part of the preliminary design process.

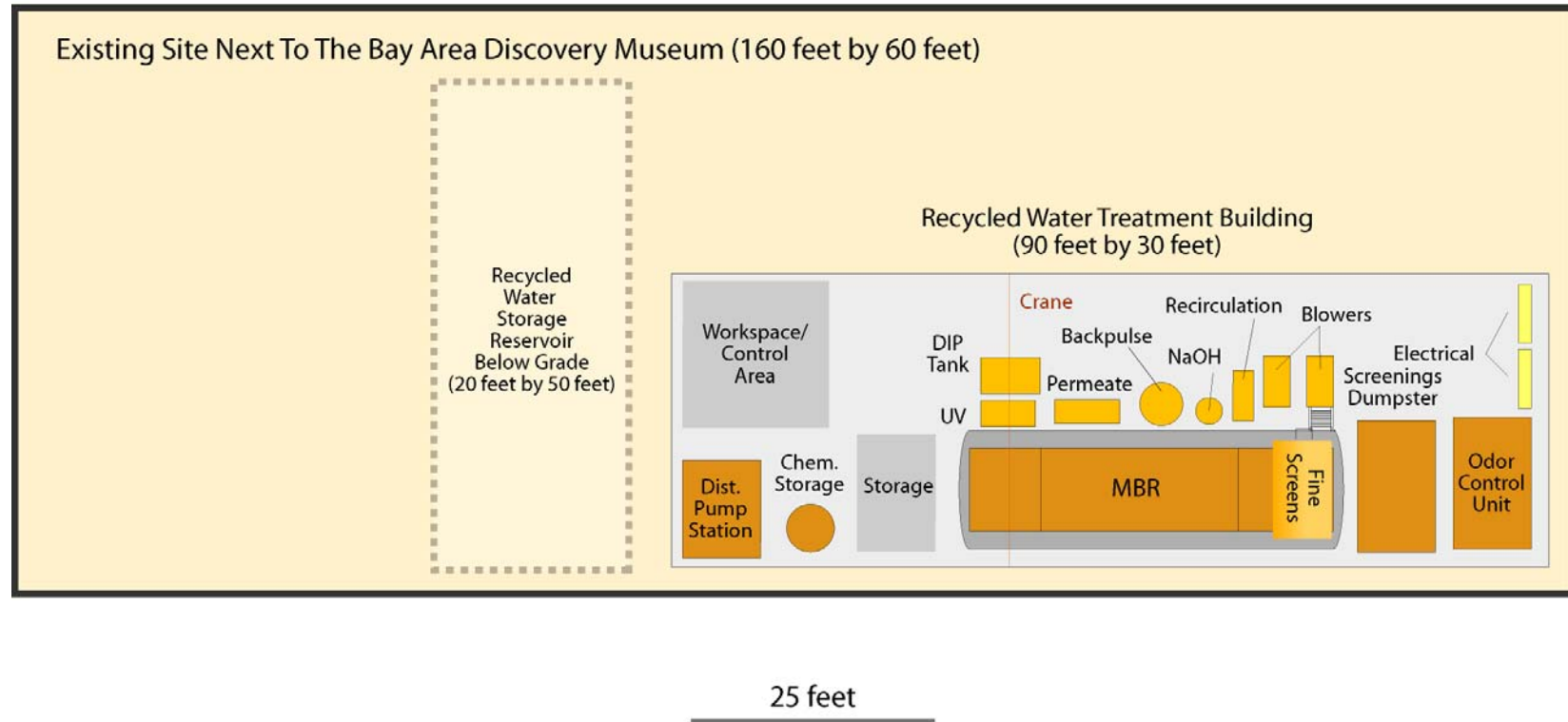
5.3 Building Requirements

The recycled water treatment plant building must be sized large enough to house all of the required treatment components and ancillary equipment. In addition to the treatment process skid, space would also be required for the additional equipment listed in Table 5-2.

Table 5-2: Recycled Water Equipment Footprints

Equipment	Footprint	Notes
Treatment Process Skid	40' x 12'	Requires a vertical height clearance of 21 feet
Misc. Process Equipment	36' x 8'	Required for MBR operation and/or cleaning
Fine Screen	6' x 8'	Rotary drum screen located on top of process skid
Screenings Dumpsters	4' x 2'	Need door access for removal
Odor Control Unit	6' x 10.5'	
Chemical Storage Area	5' x 5'	
Workspace/Control Area	15' x 15'	
Material, Tools and Equipment Storage Area	12' x 8'	
Recycled Water Pump Station	8' x 10'	Would be located inside the treatment plant building

A layout for the recycled water treatment plant (without on-site solids handling) is shown in Figure 5-4.

Figure 5-3: Recycled Water Treatment Plant Layout

The length of the treatment plan could probably be reduced if the recycled water pump station were constructed inside of the recycled water storage tank. An initial set of massing diagrams for the most feasible option treatment plant building were prepared (using an assumed building size of 30 feet by 80 feet and a height of 21 feet) by the NPS and are included as Appendix G.

5.4 Solids Handling

As a byproduct of the wastewater treatment process, biological solids are produced. The MBR manufacturer estimated that the treatment plant would produce approximately 550 gpd of solids at a concentration of 1.5%. The solids would accumulate inside the MBR tank. Solids could be wasted from the MBR tank daily or up to once every two weeks. If solids were removed once every two weeks the volume of waste solids needing handling would be approximately 7,700 gallons.

There are three alternatives for handling biosolids produced at a Fort Baker package plant: 1) pump the biosolids to SMCSD for treatment, 2) truck the biosolids to SMCSD for treatment or 3) treat the biosolids at the recycled water treatment plant site.

A summary of the solids handling alternatives is presented in Table 5-3. A discussion of each of the solids handling options is provided in Sections 5.4.1 through 5.4.3. For the purposes of the development of the most feasible option, it was assumed that Option 2, wherein solids are trucked to SMCSD, would be used. The NPS may want to further examine other solids handling options prior to design of the recycled water facility. More detailed solids handling cost estimates for each option are included in Appendix H.

Table 5-3: Summary of Solids Handling Options

Option		Estimated Capital Cost	Estimated O&M Cost	Frequency of Truck Loads	Comments
Option 1: Pump Solids to SMCSD	Use Existing Pump Station and Force Main	\$40,000	\$7,000*	None Required	Requires flushing, which reduces recycled water production by ~715 gpd. May cause problems with SMCSD treatment process.
	New Solids Pump Station and Force Main	\$229,900	\$5,000*	None Required	New force main along East Road, solids added directly to SMCSD's solids handling facility
Option 2: Truck Solids to SMCSD (option used for developing cost estimates in Section 5.9)		\$50,000	\$5,000*	Once every two weeks	Need to schedule hauling to minimize impacts to neighbors
Option 3: On Site Solids Treatment		\$1,040,000	\$24,100	Once per month	Requires large capital investment including a larger treatment plant building and chemical deliveries

Note: Estimated capital cost includes construction mark-up, implementation cost and a 35% planning contingency

*Does not include cost of treatment by SMCSD

5.4.1 Option 1: Pump Solids to SMCSD

In most situations, solids from satellite package plants are returned to the sewer system where they are combined with raw wastewater and carried to main wastewater treatment plant for treatment. Option 1 would involve pumping waste solids from the Fort Baker recycled water facility to SMCSD for treatment. There are two potential methods from pumping the waste solids to SMCSD: 1) utilize the existing wastewater pump station and force main to SMCSD, or 2) construct a new dedicated solids pump station and force main to SMCSD. For either method, the NPS would need to negotiate an agreement with SMCSD for treatment of the waste solids.

Use Existing Pump Station and Force Main

Operation of the recycled water treatment plant and Pump Station 5-I would need to be coordinated in order to pump waste solids to SMCSD. Once every two weeks, the wastewater flow to the recycled water treatment plant would be turned off and re-routed to SMCSD. Mixed liquor would then be drained from the MBR tank through a drain that would be connected to the wet well for Pump Station 5-I. The waste solids from the treatment plant would combine with the raw wastewater from Fort Baker and the rest of the Marin Headlands. The combined wastewater would then be pumped through the existing sewer force main to SMCSD. The MBR would continue to drain until the required amount of solids are removed from the tank. After the solids are drained, Pump Station 5-1 would continue to pump raw wastewater to SMCSD until approximately 10,000 gallons are pumped, which should be sufficient for flushing the force main. The amount of raw wastewater required to pump solids the SMCSD treatment plant for flushing was estimated to be approximately 10,000 gallons, which is equivalent to the volume of the existing sewer force main from Fort Baker to SMCSD. After the sewer force main is flushed, raw wastewater would be re-directed back to recycled water facility and normal operation would resume.

If solids from the Fort Baker recycled water treatment plant are pumped to SMCSD using the existing force main, they would be combined with the influent wastewater to the SMCSD plant. The additional solids loading in the SMCSD raw influent could create treatment problems for SMCSD, due to the fact that it would enter the plant at a higher concentration and maybe difficult to remove after it has been mixed with the SMCSD liquid process.

Utilization of the existing pump station and force main would be the easiest solids handling option to implement, however it would also be the most inefficient method of solids handling since the solids would be re-treated at the SMCSD plant and over 10,000 gallons of potential recycled water would be lost every two weeks.

The estimated capital cost of using the existing pump station and force main for solids handling is \$40,000. Annual operating costs would be approximately \$7,000 per year which includes power and labor, but does not include solids treatment costs for SMCSD.

New Solids Pump Station and Force Main

A new solids pumping station could be constructed, inside of the recycled water treatment plant building, along with a new force main to SMCSD that would parallel the existing sewer force main. The sole purpose of the pump station would be to transport waste solids to SMCSD for treatment. The pump station could be set to run constantly or for a short period each day to send the required 550 gallons per day to SMCSD. The advantage of this method of pumping solids to SMCSD is that the recycled water treatment plant would not have to be shut down and waste solids could be pumped directly into SMCSD's exiting solids handling facility instead of being mixed with the raw wastewater influent. The disadvantage of this method is that it would require the construction of an additional pump station and a new force main along East Road.

The estimated capital cost of a new pump station and force main for solids handling is \$229,900. Annual operating costs would be approximately \$5,000 per year which includes power and labor, but does not include solids treatment costs for SMCSD.

5.4.2 Option 2: Truck Solids to SMCSD

Instead of pumping solids to SMCSD, solids could be trucked to SMCSD where they would be unloaded directly to SMCSD's solids handling system. A small solids unloading station would need to be constructed at SMCSD that would allow the solids from Fort Baker to be unloaded directly into the SMCSD solids handling system. The package membrane bioreactor allows for flexible operation, which would allow for solids to be wasted once every two weeks. Approximately 7,700 gallons of mixed liquor would need to be hauled to SMCSD. The NPS should schedule the transport of solids to SMCSD during times when hauling would least impact traffic and recycled water treatment plant neighbors.

The estimated capital cost of trucking solids to SMCSD is \$50,000. Annual operating costs would be approximately \$5,000 per year which includes hauling and labor, but does not include solids treatment costs for SMCSD. Under Option 2, the NPS would need to negotiate an agreement with SMCSD for the treatment of waste solids generated from the recycled water treatment plant.

5.4.3 Option 3: On Site Solids Treatment

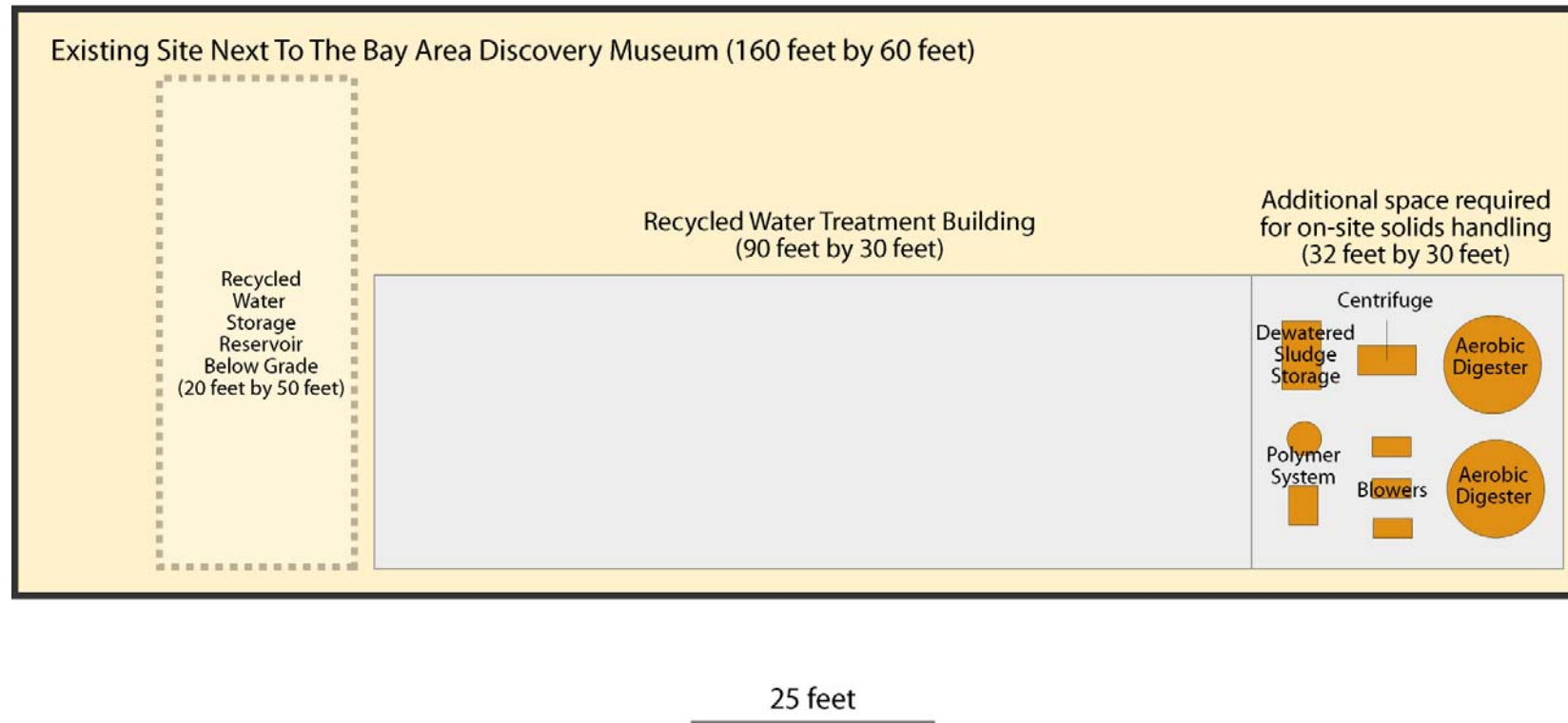
Another option for solids handling is to treat the solids on-site at the satellite treatment plant. Allowable sludge stabilization and disposal practices are specified in the Code of Federal Regulations, Section 40, Part 503. These are commonly referred to as the "503 regulations". The 503 regulations have differing requirements depending on the final disposal of the sludge with Class A being more stringent than Class B. For the solids generated at Fort Baker it is proposed that Class B requirements be met, which is equivalent to the treatment that would be provided at the SMCSD in the first two solids treatment options.

To meet Class B requirements, the solids must first be stabilized to reduce the organic material contained in the sludge and prepare it for disposal or beneficial reuse. The sludge stabilization method proposed for the satellite plant is aerobic digestion in which the solids are aerated for approximately 15 days until the volatile solids content is reduced.

After stabilization, the liquid content of the sludge is over 95%. A dewatering step is needed to increase the solids content of the sludge from approximately 5% to at least 20% so that it can be trucked to a landfill. Dewatering would occur in a centrifuge which separates the solids from the liquid portion of the sludge.

Figure 5-4 shows a layout for the solids handling process along with the required space for the main recycled water treatment plant building. The solids handling facilities include two aerobic digestion tanks, blowers, diffusers, a centrifuge, dewatered sludge storage, and polymer storage and pumps to augment the dewatering process. The additional footprint required for an on-site solids processing facility is approximately 30 by 32 feet or an additional 960 square feet. The facility would require truck access for delivery of chemicals and for loading the dewatered sludge for disposal.

The estimated capital cost of an on-site solids handling facility is \$1,040,000. Annual operating costs for the solids processing facility would be approximately \$24,100 per year which includes power, chemicals, and labor.

Figure 5-4: On-Site Solids Handling Layout

5.5 Recycled Water Storage Reservoir

Peak recycled water demand generally occurs at night since this is when irrigation typically is done. However, the bulk of the wastewater is generated during the day. A recycled water storage tank is therefore needed to store recycled water during the day so it can be used during the night. The larger the storage reservoir the more flexibility the recycled water system would have for meeting recycled water demands. To provide flexibility, the recycled water reservoir should be sized to provide 2 days of storage at peak month average day flow. The volume required would therefore be 110,000 gallons. If the size of the reservoir is a concern, a smaller reservoir could be constructed, but it would provide less operational flexibility. The minimum required storage volume is 1 day at peak month average day flow (55,000 gallons).

Due to potential visual impacts and site constraints, if the reservoir is located at the proposed treatment plant site, it should be constructed underground. As shown on Figure 5-3. The reservoir would be approximately 20 by 50 feet and 15 feet deep, and would be located adjacent to the treatment plant building.

Another storage option would be to utilize the three existing abandoned storage tanks located on the side of the hill near Vista Point. The three storage tanks have a combined capacity 160,000 gallon. Since the largest of the storage tanks has a capacity of 100,000 gallons (20 feet in diameter by 15 feet tall), only it would be needed to store recycled water. The bottom elevation of the tanks is estimated to be 115 feet above sea level. Some of the areas in the Capehart Housing area are over 120 feet in elevation and therefore reuse of the existing storage tanks would still require pumping to convey the water from the storage tank to the distribution system at adequate pressure. The condition of the tanks and their structural and seismic integrity for storing water are not known at this time. In addition, potential environmental impacts from the construction of a pipeline to the existing storage tanks would need to be evaluated. A list of suggested studies, for further exploring the potential use of the existing storage tanks, is presented in Section 6.1.

5.6 Distribution System Pump Station

Assuming the storage reservoir is located adjacent to the treatment plant building, a pump station would be required to supply recycled water from the reservoir to the users at adequate pressure. The pump station would be located inside of the treatment plant building and would consist of one duty pumps plus one standby pump.

The recycled water pump station was sized based on assumptions provided by the NPS, which are shown in Table 5-4.

Table 5-4: Pump Station Design Criteria

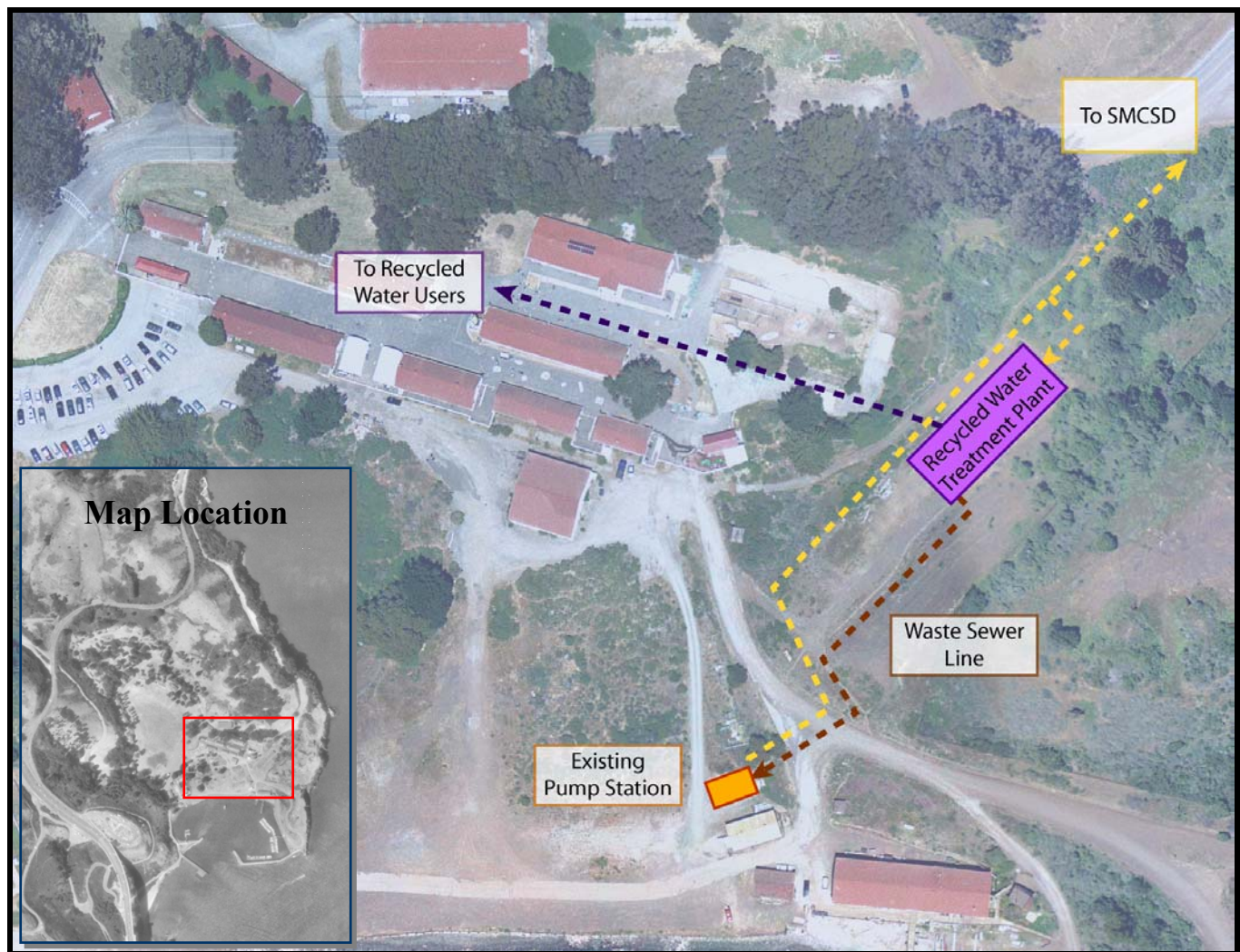
Design Criteria	Assumption
Highest Service Elevation	120.0 feet (Capehart Housing)
Pump Suction Elevation	19.0 feet (Bottom of Recycled Water Reservoir)
Recycled Water Delivery Pressure	40 psi (Capehart Housing)
Maximum Flow Rate	400 gpm
System Headloss	15 psi
Pumps	1 duty plus 1 stand-by
Pump Station Hydraulic Grade Line	160 feet
Pump Size	25 HP
Pump Station Configuration	Wet Pit, Vertical Turbine

The pump station, consisting of pumps, valves, piping and instrumentation and controls, would be located inside of the treatment plant building in order to reduce noise. To save treatment plant space, the pump station could also be constructed inside of the recycled water storage tank, which would also provide noise protection.

5.7 Recycled Water System Operation

The recycled water treatment facility would be integrated into the existing sewer system. The configuration of the recycled water treatment facility and the existing sewer system is shown in Figure 5-5. Wastewater would be collected for treatment via a connection to the 8-inch diameter force main from Pump Station 5-I to SMCSD. A sewer return line from the recycled water treatment plant to Pump Station 5-I, would also need to be constructed for use in the event the treatment process or storage reservoir needs to be drained. The inclusion of a back-up power generator is not included as part to the recycled water facility since recycled water is not a critical utility (i.e. can be out of service for short periods of time without major impacts) and wastewater treatment redundancy is provided by Pump Station 5-I which would direct flows to the SMCSD treatment plant. However, the treatment plant should have an emergency plan that would contain provisions for shutting down the plant in the event of a power outage or other emergency.

Figure 5-5: Recycled Water Operation Schematic



The recycled water treatment plant would have two distinct modes of operation which would coincide with the irrigation season (March through October) and the non-irrigation season (November through February). During the irrigation season the recycled water treatment would operate at or near its capacity in order to meet the irrigation demands at Fort Baker. During the non-irrigation season the only demands for recycled water would be

the commercial laundry and toilet flushing, which would range from approximately 6,100 gpd to 7,500 gallons (10.2% and 12.5% of the treatment plant capacity, respectively). The remaining wastewater flow from the Marin Headlands would be pumped to SMCSD for treatment. The package MBR could be operated at these low flows, but it would probably require increased supervision for the treatment plant operator.

The alternative to operating the recycled water treatment plant at low flows during the non-irrigation season would be to shut down the recycled water facility and use potable water for to meet the commercial laundry and toilet flushing demands. If the recycled water treatment plant will be shut down during the non-irrigation season, the MBR tanks would need to be filled with clean water to keep the membranes from drying out and becoming brittle. In addition, the MBR would require a few weeks of start up time to form a population of microorganism, in the MBR, which are needed for biological treatment.

5.7.1 Residual Disinfection

In order to prevent bacterial growth within the distribution system and recycled water storage tank, a small amount of sodium hypochlorite would be added. Sodium hypochlorite would be metered into the treatment plant effluent prior to entering the recycled water storage tank or being distributed.

5.7.2 Recycled Water Demand Management

Due to the fact that the most feasible option would not provide enough recycled water to satisfy all of the recycled water demands listed in Table 3-4 during the peak summer months, the NPS will need to manage the demand for recycled water.

One option for meeting the peak summer demand would be to supplement the recycled water system with potable water. When potable water is needed, the supply to the potable water supply would be turned on and potable water would be added to the recycled water storage tank for distribution.

The peak demand for recycled water could be also reduced by limiting irrigation of the parade grounds. The NPS could allow the parade ground to receive less or no water during periods when recycled water demand exceeds the recycled water supply.

5.7.3 Staffing

The recycled water treatment plant would need to be run by a certified Class III (tertiary treatment less than 1.0 MGD) wastewater treatment operator. The Presidio Trust is currently in the process of designing and approving a recycled water facility (satellite membrane bioreactor) similar to the most feasible option discussed in this report. The RWQCB has recently approved a recycled water permit (Order R2-2004-0001) for the Presidio Trust's recycled water facility that outlines the regulatory requirements that the recycled water facility must satisfy. The Presidio Trust's permit was approved by the RWQCB in January 2004. The recycled water permit for the Presidio Trust Recycled Water Facility does not require full time staffing at the treatment plant, however the permit does require that a certified operator be on-call at all times. A copy of the Presidio Trust recycled water permit is included in Appendix I. In addition to being on-call, the certified operator must visit the recycled water facility no less than three times per week. The recycled water facility would need to be equipped with automatic monitoring and alarms that would notify the on-call operator in the event a problem occurs.

It is anticipated that a recycled water facility built at Fort Baker would need to meet similar staffing requirements. Due to minimal amount of staffing required for these types of satellite facilities, it may be cost effective for the NPS to contract with SMCSD to operate and maintain the recycled water facility or to have the same operator staff both the Presidio Trust and Fort Baker recycled water facilities.

5.8 Regulatory Requirements

As stated in Section 3.2, the NPS would need to obtain approval from the RWQCB in order to operate produce and distribute recycled water.

The construction of a new treatment plant building at Fort Baker will likely require an environmental assessment since the building was not included in the Environmental Impact Statement prepared for the Fort Baker plan. The environmental assessment would need to be completed prior to the submission of a Report of Waste Discharge to

the RWQCB for approval. An Engineering Report for the Production, Distribution and Use of Recycled would also need to be prepared and submitted to the RWQCB and to DHS with the Report of Waste Discharge.

If the recycled water facility is approved, the RWQCB would require that routine monitoring and reporting be performed at the recycled water treatment facility. The proposed monitoring and sampling requirements listed in the recycled water permit for the Presidio Trust recycled water facility are shown in Table 5-5. A copy of the permit is included in Appendix I. The required samples would need to be collected and sent to an analytical laboratory for testing. As an alternative, the NPS could negotiate with SMCSD to have some of the testing and/or sampling performed by SMCSD's staff.

Table 5-5: Presidio Trust of San Francisco Self-Monitoring Program

Parameter	Influent	Effluent	Treatment Plant/ Recycled Water Users
Flow Rate (MGD)	Continuous		
BOD ₅ (mg/L)	Weekly		
Total Suspended Solids (mg/L)	Weekly		
Total Inorganic Nitrogen (mg/l)	Weekly		
Total Coliform (MPN/100ml)		Twice per Week	
Turbidity (NTU)		Continuous	
Dissolved Oxygen (mg/L)		Daily	
Standard Observations			Twice per Week (only when irrigating with recycled water)

Source: Adapted from the tentative order for the Presidio Trust Recycled Water Facility

Standard observations are visual inspections of the irrigation system and irrigated areas to ensure that there is no surface runoff, ponding, odor or malfunctioning equipment. The results from the self monitoring program need to be compiled and submitted to RWQCB on a monthly basis.

In addition to the self monitoring requirements, the Presidio Trust is also required to implement a program to ensure that the treatment system is properly maintained and operated. An annual report must be submitted to the RWQCB on annual basis that documents the status of the program.

5.9 *Estimated Cost*

The cost estimates presented in this section were developed based on vendor quotations and previous project estimates. The American Association of Cost Engineers defines this as an Order of Magnitude estimate and expects that an estimate of this type is accurate within plus 50 percent or minus 30 percent. The estimated capital cost estimate for a package plant to treat 0.06 MGD is \$4.36 million. A detailed treatment capital cost estimate is shown in Table 5-6. For the capital cost estimate shown in Table 5-6, trucking solids to SMCSD was the assumed method for solids handling.

Table 5-6: Satellite Treatment Plant Capital Cost Estimate

Item	Quantity	Unit	Unit Cost	Estimated Amount
Mobilization/Demobilization	7%	ALL	\$76,700	\$76,700
Installation	10%	ALL	\$109,500	\$109,500
Instrumentation and Controls	9%	ALL	\$98,200	\$98,200
Electrical	10%	ALL	\$115,500	\$115,500
0.06 MGD Packaged WW Treatment Plant	1	EA	\$465,000	\$465,000
Fine Rotary Screen	1	EA	\$40,000	\$40,000
Odor Control Unit	1	EA	\$50,000	\$50,000
New Building w/ Architectural Considerations	2,700	sq. ft.	\$200	\$540,000
Solids Loading Station at SMCSD	1	EA	\$19,900	\$19,900
Fencing	420	LF	\$12	\$5,040
Fence Gate	1	EA	\$2,000	\$2,000
Asphalt Paving	6,600	sq. ft.	\$0.35	\$2,310
Potable Water System Stand-by	1	EA	\$20,000	\$20,000
Waste Line to Existing Pump Station	1	EA	\$10,000	\$10,000
Mechanical appurtenances/piping	20%	ALL	\$230,900	\$230,900
<i>Construction Subtotal</i>				<i>\$1,785,100</i>
Construction Mark-Ups				
Contractor Overhead and Profit	15%	MU	\$133,900	\$133,900
Sales Tax on Materials	8%	MU	\$71,500	\$71,500
<i>Construction Markups Subtotal</i>				<i>\$1,990,500</i>
<i>Estimated Construction Cost</i>				<i>\$1,990,500</i>
Construction Change Order Allowance	10%	ALL	\$199,100	\$199,100
Unknowns Allowance	10%	ALL	\$199,100	\$199,100
<i>Total Estimated Construction Budget</i>				<i>\$2,388,700</i>
Implementation Costs	35%			\$836,100
<i>Project Cost Subtotal</i>				<i>\$3,224,800</i>
Project Contingency	35%			\$1,128,700
<i>Total Estimated Project Cost</i>				<i>\$4,360,000</i>

*Treatment equipment cost

A planning level capital cost estimate for the storage tank (see Section 5.5), the recycled water pump station (see Section 5.6) and main distribution ring around the Parade Grounds is shown in Table 5-7. The estimated capital cost for storage and distribution is \$1,009,000.

Table 5-7: Storage and Distribution Capital Cost Estimate

Item	Quantity	Unit	Unit Cost	Estimated Amount
Mobilization/Demobilization	7%	ALL	\$23,000	\$23,000
Installation	10%	ALL	\$32,850	\$32,850
Instrumentation and Controls	9%	ALL	\$28,000	\$28,000
Electrical	10%	ALL	\$32,900	\$32,900
Recycled Water Storage Tank	1	EA	\$175,000	\$175,000
Chlorination System	1	EA	\$40,000	\$40,000
Distribution Pump Station	1	EA	\$100,000	\$100,000
Distribution Ring Around the Parade Grounds	1	EA	\$13,500	\$13,500
<i>Construction Subtotal</i>				\$445,300
Construction Mark-ups				
Contractor Overhead and Profit	15%	MU	\$33,400	\$33,400
Sales Tax on Materials	8%	MU	\$17,900	\$17,900
<i>Construction Markups Subtotal</i>				\$496,600
<i>Estimated Construction Cost</i>				\$496,600
Construction Change Order Allowance	10%	ALL	\$49,700	\$49,700
Unknowns Allowance	10%	ALL	\$49,700	\$49,700
<i>Total Estimated Construction Budget</i>				\$595,950
Implementation Costs	35%			\$208,600
<i>Project Cost Subtotal</i>				\$804,550
Project Contingency	35%			\$281,600
<i>Total Estimated Distribution Cost</i>				\$1,090,000

*Pump station equipment cost

For the operation and cost estimate shown in Table 5-6, trucking solids to SMCSD was the assumed method for solids handling. Estimated annual operation and maintenance costs are \$131,000 and shown in Table 5-8.

Table 5-8: Satellite Treatment Plant Annual O&M Cost Estimate

Package Plant O&M			Unit Cost	Total
Annual parts	1	EA	2,300	\$2,300
NaOH for pH adjustment	1	EA	300	\$300
Routine maintenance	208	hrs	75	\$15,600
Emergency calls	78	hrs	75	\$5,850
Yearly maintenance	24	hrs	75	\$1,800
Membrane replacement	0.1	EA	36,000	\$3,600
Power consumption	120,000	kwh	0.12	\$14,400
			Subtotal	\$43,850
Disposal O&M				
Screenings Disposal	1	EA	5,000	\$5,000
Solids Treatment and Disposal*	1	EA	5,000	\$5,000
			Subtotal	\$10,000
Monitoring O&M				
Analytical Analysis	1	EA	49,100	\$49,100
Labor/ Report Preparation	200	hrs	75	\$15,000
			Subtotal	\$64,100
Distribution O&M				
Routine Maintenance	40	hrs	50	\$2,000
Residual Disinfection	1	EA	5,000	\$5,000
Power Consumption	46,000	kwh	0.12	\$5,600
			Subtotal	\$12,600
Estimating Contingency	35%	All		\$45,700
Total Annual Operation and Maintenance Cost			Total/Year	\$131,000

*Does not include cost of solids treatment by SMCSD

A summary of the total capital cost for treatment, storage, distribution is included in Table 5-9. Based on the annualized capital cost and annual operation and maintenance cost the recycled water treatment facility would have a cost of \$9,754 per acre-foot of recycled water produced.

Table 5-9: Total Annual Cost Estimate Summary

Most Feasible Option	Capital Cost	30-Year Annualized Capital Cost	Annual O&M Cost	Avoided Potable Water Cost	Total Annual Cost
Fort Baker Satellite Treatment Plant	\$5,450,000	\$351,081	\$131,000	\$43,200	\$9,754/AF

Assumptions:

- Capital cost includes treatment, storage and distribution
- Annual recycled water production was estimated to be 45 AFY based on timing of demand and wastewater supply
- 30-year annualized capital cost calculated using a 5% interest rate
- Avoidable potable water cost calculated assuming a potable water cost of \$2.94 per thousand gallons

6. Recommendations and Next Steps

Based on the information available at the time of this study, it is feasible for the NPS to construct a 0.06 MGD recycled water facility on the building pad located east of the Bay Area Discovery Museum. The planning level capital cost estimate for the recycled water facility is \$5.45 million with an annual operating cost of approximately \$131,000.

6.1 Additional Studies/Information

If the NPS determines that it would like to proceed with a recycled water project, the NPS should further evaluate some aspects of the most feasible option during the preliminary design phase. As part of the preliminary design of the recycled water facility, the following should be evaluated:

- The NPS should evaluate the recycled water treatment plant building with respect to the Fort Baker Compatibility Study in order to achieve a compatible fit with the historic district in which it is located.
- If the NPS would like to further explore the possibility of using the existing storage tanks near Vista Point, the following studies are recommended
 - A seismic and structural analysis of the tanks and their foundations to identify any seismic or structural deficiencies.
 - Evaluate potential alternatives for connecting the existing storage tanks to the recycled water system including any environmental or cultural resource impacts.
 - Assess the hydraulic compatibility of the existing storage tanks with the NPS plans for recycled water distribution.
- Further assess the impacts of the proposed recycled water treatment building (e.g. Bay Trail, Environmental Assessment, Visual, Traffic, etc.)
- Determine how the NPS would address operation of the recycled water facility (i.e. contract with SMCSD or hire certified operator).
- Develop an agreement with SMCSD to treat winter time wastewater flows.
- Determine how the NPS would address solids handling issues, including the potential for treatment by SMCSD.
- Determine how the NPS would address recycled water demand that would exceed supply during peak summer months (i.e. supplement with potable versus under irrigation).
- Investigate the potential for using the recycled water facility as an interpretive center.
- Identify recycled water user connection points and pipeline alignments.
- Evaluate potential screenings disposal sites and identify any restrictions imposed by those sites.
- Investigate the possibility of using a soil bed filter for odor control.
- Evaluate other potential package plant suppliers and products.

6.2 Funding

A key factor for the NPS will be securing funding for the design and construction of the proposed recycled water facility. The majority of funding currently available for water recycling projects is targeted towards local public agencies. The NPS may be able to pursue some of these funding opportunities if they can partner with a local agency (e.g. SMCSD). However, the local agency would have to be the owner of the facility. A list of potential funding sources for local public agencies is included in Appendix J.

Due to the lack of available funding for federal projects, the NPS would most likely need to secure its own funding for implementing a recycled water project at Fort Baker.

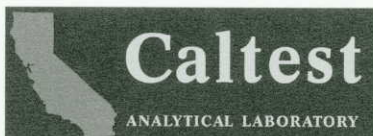
References

- Asano, Takashi and Audrey D. Levine, 1998. *Water Quality Management Library, Volume 10: Wastewater Reclamation, Recycling, and Reuse*.
- California Department of Health Services, Updated June 2001. *The Purple Book: Excerpts from the Health and Safety Code, Water Code, and Titles 22 and 17 of the California Code of Regulations*.
- Dames & Moore, June 1996. *Landscape and Irrigation Management Plan: The Presidio San Francisco, California*. Prepared for the National Park Service.
- Kennedy/ Jenks Consultants, October 2001. *Presidio Trust Recycled Water System, Phase 1: Task 3 - Project Alternatives Description (Rev2) Draft Technical Memorandum*.
- Kennedy/ Jenks Consultants, March 2002. *The Presidio Trust Water Recycling Project Plan*.
- Metcalf and Eddy, Inc., 1991. *Wastewater Engineering Treatment, Disposal, and Reuse 3rd Edition*. McGraw-Hill.
- National Park Service, October 1999. *Fort Baker Plan Final Environmental Impact Statement*.
- National Park Service, April 2001. *Request for Proposals: Retreat and Fort Baker Retreat and Conference Center at Fort Baker*.
- National Water Research Institute and American Water Works Association Research Foundation, December 2000. *UV Disinfection Guidelines for Drinking Water and Water Reuse*.
- Psomas and Associates, May 1997. *East Fort Baker Sewer System Study Addendum*.
- Psomas and Associates, March 2001a. *Executive Summary, Golden Gate National Recreation Area: Fort Baker Sewer*.
- Psomas and Associates, March 2001b. *Executive Summary, Golden Gate National Recreation Area: Fort Baker Water System Analysis*.
- Psomas and Associates, March 2001c. *Title I Report, Golden Gate National Recreation Area: Fort Baker Reclaimed Water Analysis*.
- Raines, Melton & Carella, Inc., February 2002. *SMCSD Suspended Solids Evaluation*.
- San Francisco Bay Regional Water Quality Control Board, 2000. *Waste Discharge Requirements for: Sausalito-Marin City Sanitary District*. Order No. 00-060. NPDES Permit No. CA0038067.
- San Francisco Bay Regional Water Quality Control Board, 2004. *Tentative Order Water Reuse Requirements for the Presidio Trust of San Francisco*.
- San Francisco Bay Regional Water Quality Control Board, 2004. *Water Reuse Requirements for the Presidio Trust of San Francisco*. Order R2-2004-0001.
- Wollenweber, Melanie, April 23, 2002. Transmittal Letter to Raines, Melton & Carella, Inc.

Appendices

Appendix A: Marin Headlands Wastewater Sampling Results
Appendix B: Microfiltration Membrane Information
Appendix C: Reverse Osmosis Information
Appendix D: Ultraviolet Disinfection Information
Appendix E: Most Feasible Option Treatment and Cost Information
Appendix F: SMCSD Recycled Water Treatment Capital and O&M Cost Estimates
Appendix G: Initial Treatment Plant Building Massing Diagrams
Appendix H: Solids Handling Options Cost Estimates
Appendix I: Water Reuse Permit for the Presidio Trust Recycled Water Facility
Appendix J: Potential Funding Sources for Local Pubic Agencies

Appendix A: Marin Headlands Wastewater Sampling Results



ENVIRONMENTAL ANALYSES

LAB ORDER No.:

C050916

Page 1 of 5

SUPPLEMENTAL QUALITY CONTROL (QC) DATA REPORT

Report Date:

14 JUN 2002

Received Date:

31 MAY 2002

Client: Mark Takemoto
RMC Consulting
3650 Mt. Diablo Blvd. Suite 200
Lafayette, CA. 94549

Project: FT BAKER PROJECT

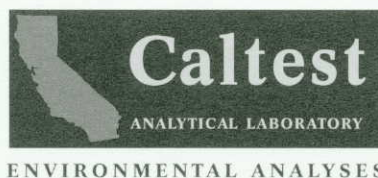
<u>QC Batch ID</u>	<u>Method</u>	<u>Matrix</u>
A020657GCP	200.7	AQUEOUS
A020657GCP	6010B	AQUEOUS
I020025ALK	310.1	AQUEOUS

Todd M. Albertson
Project Manager

Christine Horn
Laboratory Director

CALTEST authorizes this report to be reproduced only in its entirety.
Results are specific to the sample as submitted and only to the parameters reported.
All analyses performed by EPA Methods or Standard Methods (SM) 18th Ed. except where noted.
Results of 'ND' mean not detected at or above the listed Reporting Limit (R.L.).
Analyte Spike Amounts reported as 'NS' mean not spiked and will not have recoveries reported.
'RPD' means Relative Percent Difference and RPD Acceptance Criteria is stated as a maximum.
'NC' means not calculated for RPD or Spike Recoveries.





METHOD BLANK ANALYTICAL RESULTS

LAB ORDER No.:

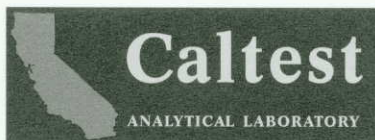
C050916
Page 2 of 5

<u>ANALYTE</u>	<u>RESULT</u>	<u>R.L.</u>	<u>UNITS</u>	<u>ANALYZED</u>	<u>NOTES</u>
QC BATCH: A020657GCP					
Boron	ND	0.1	mg/L	06.10.02	
Calcium	ND	0.5	mg/L	06.10.02	
Magnesium	ND	0.5	mg/L	06.10.02	
Sodium	ND	1.	mg/L	06.11.02	

QC BATCH: I020025ALK

ALKALINITY				06.05.02	
Bicarbonate as CaCO ₃	ND	10.	mg/L		
Hydroxide as CaCO ₃	ND	10.	mg/L		
Carbonate as CaCO ₃	ND	10.	mg/L		
Total Alkalinity as CaCO ₃	ND	10.	mg/L		





ENVIRONMENTAL ANALYSES

LABORATORY CONTROL SAMPLE ANALYTICAL RESULTS

LAB ORDER No.:

C050916

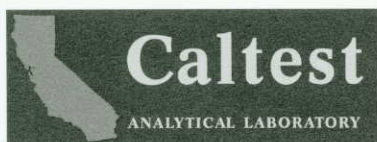
Page 3 of 5

ANALYTE	SPIKE AMOUNT	SPIKE\ DUP RESULT	SPK\ DUP %REC	ACCEPTANCE %REC \RPD	REL% DIFF	ANALYZED	NOTES
QC BATCH: A020657GCP							
Boron	1.00	1.02\	102\	80-120\20		06.10.02	
Calcium	20.0	20.8\	104\	80-120\20		06.10.02	
Magnesium	20.0	19.6\	98\	80-120\20		06.10.02	
Sodium	20.0	20.5\	102\	80-120\20		06.11.02	

QC BATCH: I020025ALK

ALKALINITY						06.05.02	
Bicarbonate as CaCO ₃	100.	100.\	100\	75-125\20			
Hydroxide as CaCO ₃		ND\		75-125\20			
Carbonate as CaCO ₃		ND\		75-125\20			
Total Alkalinity as CaCO ₃	100.	100.\	100\	75-125\20			





ENVIRONMENTAL ANALYSES

LAB ORDER No.:

C050916

DUPLICATE SAMPLES ANALYTICAL RESULTS

Page 4 of 5

<u>ANALYTE</u>	<u>R.L.</u>	<u>ORIGINAL RESULT</u>	<u>DUPLICATE RESULT</u>	<u>REL% DIFF</u>	<u>ACCEPT LIMIT</u>	<u>ANALYZED</u>	<u>NOTES</u>
QC BATCH: I020025ALK							
QC SAMPLE LAB NUMBER: C050895-1							
ALKALINITY							06.05.02
Bicarbonate as CaCO ₃	10.	20.	20.	0.0	20		
Hydroxide as CaCO ₃	10.	ND	ND	0.0	20		
Carbonate as CaCO ₃	10.	ND	ND	0.0	20		
Total Alkalinity as CaCO ₃	10.	20.	20.	0.0	20		





ENVIRONMENTAL ANALYSES

LAB ORDER No.:

C050916
Page 5 of 5

MATRIX SPIKE ANALYTICAL RESULTS

ANALYTE	ORIGINAL RESULT	SPIKE AMOUNT	SPIKE\ DUP RESULT	SPK\ DUP %REC	ACCEPTANCE %REC \RPD	REL% DIFF	ANALYZED	NOTES
QC BATCH: A020657GCP QC SAMPLE LAB NUMBER: C050923-1								
Boron	0.210	1.00	1.22\ 1.24	101\ 103	80-120\ 20	1.6	06.10.02	
QC BATCH: A020657GCP (continued) QC SAMPLE LAB NUMBER: C050923-1								
Calcium	73.9	20.0	93.9\ 93.5	100\ 98	80-120\ 20	0.4	06.10.02	
QC BATCH: A020657GCP (continued) QC SAMPLE LAB NUMBER: C050923-1								
Magnesium	279.	20.0	306.\ 307.	135\ 140	80-120\ 20	0.3	06.11.02	1
QC BATCH: A020657GCP (continued) QC SAMPLE LAB NUMBER: C050923-1								
Sodium	180.	20.0	204.\ 205.	120\ 125	80-120\ 20	0.5	06.11.02	1

1) Spike recovery outside control limits. Spike added less than one half sample concentration. LCS and Method Blank are in control.



Appendix B: Microfiltration Membrane Information

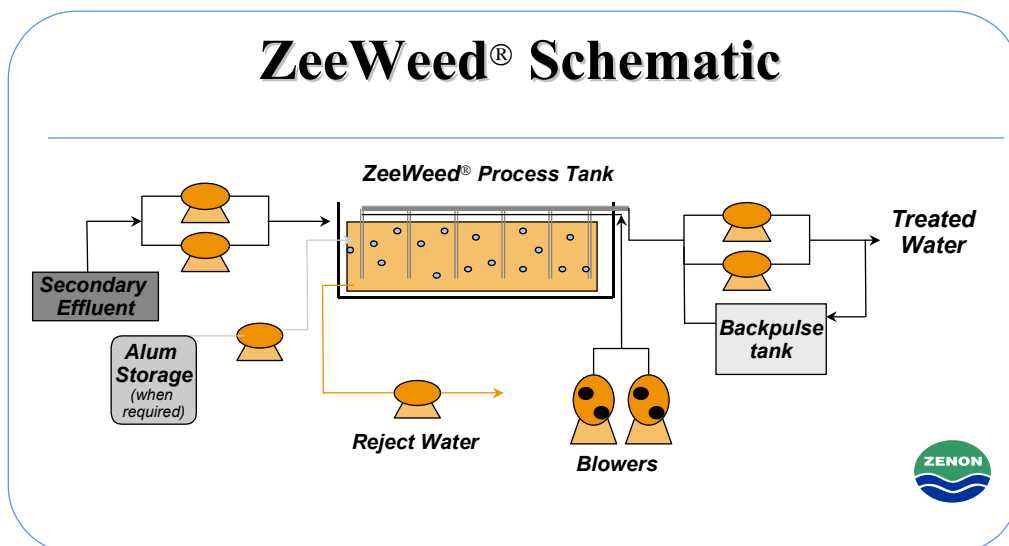
Summary of the ZeeWeed® Tertiary Filtration System

The ZeeWeed® process is a ZENON technology that consists of an optional chemical coagulation reactor integrated with a microfiltration membrane system, based on the ZeeWeed® hollow fibre membrane. Essentially, the microfiltration system replaces the solids separation function of secondary clarifiers and sand filters in a conventional system.

The ZeeWeed® microfiltration membranes are typically submerged in a new process tank downstream of the secondary clarifiers, in direct contact with the secondary effluent. Alternatively, the membranes may be immersed directly in the existing activated sludge process, but must operate at a lower flux. Through the use of a suction duty pump, a vacuum is applied to a header connecting the membranes. The vacuum draws the treated water through the hollow fibre microfiltration membranes and into the pump. Treated water is then discharged by the pump. The energy associated with permeate pumping is relatively small. An airflow is introduced to the bottom of the membrane module producing turbulence which scours the external surface of the hollow fibres transferring rejected solids away from the membrane surface, while providing some additional dissolved oxygen to the secondary effluent. Reject water is pumped directly from the process tank back to the activated sludge process.

The ZeeWeed® Tertiary Filtration System is significantly more efficient than granular media filtration; sidestream filtration combined with conventional filtration greatly reduces space requirements.

The ZeeWeed® process is ideally suited for phosphorus removal. Through the addition of metal salts such as alum or ferric chloride to the secondary effluent, soluble phosphorus can be precipitated. The ZeeWeed® membranes have a pore size that provides an absolute barrier to the discharge of precipitated phosphorus. The phosphorus is retained in the mixed liquor and removed with the waste activated sludge. The ZeeWeed® process can reliably achieve significantly lower effluent phosphorus concentrations than conventional municipal treatment processes.



ZeeWeed® Tertiary Filtration System
 Sausalito WW Scalping Plant for RO Pretreatment
 Northern California
 June 14, 2002

Scope of Supply - ZENON

- Process Tanks/Membrane Support Frames
- ZeeWeed® ZW500 Membrane Modules
- Permeate/Backpulse Pumps
- Permeate Collection Header Pipes
- Air Scour Distribution Header Pipes
- Membrane Air Scour Blowers
- Backpulse Tanks
- Chemical Addition System
- Control System
- Motor Control Equipment & VFD's
- Turbidimeter(s)
- Instrumentation Integral to the ZeeWeed® System
- Major Process Equipment is skid-mounted
- Equipment General Arrangement and Layout Drawings
- Operating & Maintenance Manuals
- Field Service and Process Start-Up Assistance
- Equipment delivery FOB Sausalito, California

ZeeWeed® Tertiary Filtration System Pricing

One (1) ZeeWeed® Tertiary Filtration System as described above, with the following design capacity.

Average Daily Flow	260,000	USgpd
Maximum Daily Flow	260,000	USgpd

Budgetary System Price	US\$ 532,119.00
-------------------------------	------------------------

The membrane system proposed is designed as a skid mounted system including fabricated steel packaged tanks. Since redundancy is not required, the system has been designed as a single train of membrane cassettes, designed to produce the maximum daily flow of 0.26 MGD. The system has been designed with automated addition of cleaning chemicals, and manual addition of neutralization chemicals. Future expansion would be accomplished by installing additional membrane cassettes and increasing the operating speed of the permeate pumps to reach design capacity.

Estimated Plant Operating and Maintenance Costs (0.26 MGD)

Estimated Annual Power Cost (@ 0.07 cents/kW.hr)	US\$ 4,117.00
Estimated Annual Cleaning Chemicals	US\$ 966.00
Suggested Annual Membrane Accrual* (2002 Dollars)	US\$ 4,466.00

Membrane Type	Preliminary Process Tank Dimensions (per train)			
	Number of Trains	Tank Length	Tank Width	Side Wall Height
ZW-500 Series	1	15 ft	8.1 ft	10.2 ft

The process equipment (i.e. permeate pumps and blowers) will add an additional 20 ft to the process skid.

Appendix C: Reverse Osmosis Information



OSMONICS

CORPORATE HEADQUARTERS

5951 Clearwater Drive
Minnetonka, MN 55343-8995 USA

Phone (952) 933-2277
Fax (952) 933-0141

June 4, 2002

VIA FAX: (925) 947-6784

Mr. Ray Ankaitis
DC FROST ASSOCIATES
2652 San Antonio Drive
Walnut Creek, CA 94598

Re: Waste Water Reclamation

Dear Ray:

I wanted to follow up on our phone conversation from last week. You mentioned a project for wastewater reclamation. The following is a budgetary price and footprint for a machine that will do approximately 200,000 gpd.

Reverse Osmosis Skid - Includes cartridge filters, high-pressure pump, membranes, elements and all interconnecting piping.
Footprint - 23' x 6'

Clean-In-Place Skid - Includes tank and pump. Footprint 7' x 7'

Chemical Injection System - Includes two (2) day tanks with pumps mounted on tanks. Footprint 2-foot diameter

BUDGETARY PRICE: \$150,000

Ray, if you need any additional information, please give me a call in my office at (605) 393-8280.

Sincerely,

OSMONICS, INC.

James L. Almond
Municipal Market Manager
JLA/njs

Appendix D: Ultraviolet Disinfection Information

P&H

facsimile transmission

date: June 28, 2002
msg#:
to: Mark Takemoto
Raines, Melton & Carella, Inc.
tel: 925-299-6733
fax: 925-299-6736
cc: P. Pfeiffer, P&H
Hard copy of this fax to follow: ☐ Yes ☐ No

pages: 3 including this page)
from: Debbie Gruber
P&H Representatives, Inc.
690 East. Tabor Ave., Suite I
Fairfield, CA 94533
707-425-0468
707-426-5237
email: dgruber@ph-reps.com

Subj: **Trojan System UV3000™ for the Ft. Baker Project**

Dear Mark,

In response to your request, we are pleased to provide the following **Trojan System UV3000™** proposal for the **Ft. Baker** project, based on the information provided. Since Trojan introduced the open channel approach to disinfection in 1982, many municipalities have selected ultraviolet as the preferred method pathogen destruction at their facilities.

The **Trojan System UV3000™** utilizes low pressure low intensity lamp technology. All of Trojan's UV systems are modular in design, with each design customized in response to the effluent criteria. The lamps are oriented in a horizontal configuration parallel to the flow.

Please review carefully our design criteria for peak flow rate, total suspended solids, disinfection limit, and UV transmittance to ensure that the criteria used match actual project parameters. When detailed project design commences, please contact our office for a review of all design parameters, including dimensions and equipment requirements. In addition, Trojan is able to provide analytical services to quantify effluent quality and confirm design criteria.

Trojan's price for the attached design is **\$126,000** (in US\$). This quoted price includes the equipment as described, freight to site and start-up by qualified personnel. This quote **excludes** any taxes that may be applicable. The above information is to be used for budget estimates and is valid for 90 days from this day.

Phil Pfeiffer will return from vacation on Tuesday, 7/2/02. At that time he will review the attached and be able to discuss any questions or changes that may need to be made to the recommended design.

Thank you for the opportunity to quote the **Trojan System UV3000™** on this project.

Regards,
P&H Representatives, Inc.
Debbie Gruber

DESIGN CRITERIA

Current Peak Design Flow: **0.2 US_MGD**
Future Peak Design Flow: **0.2 US_MGD**
UV Transmission: **65%, minimum**
Total Suspended Solids: **5 mg/l (Maximum; grab samples)**
Max Average Particle Size: **30 microns**
Disinfection Limit: **2.2 total coliform per 100 ml, based on a 7 day Median of consecutive daily grab samples**

DESIGN SUMMARY

Based on the above design criteria, the Trojan System UV3000™ proposed consists of:

Number of Channels: **1**
Total Number of Banks: **4 (3 duty, 1 redundant)**
Number of Modules per Bank: **2**
Number of Lamps per Module: **4**
Total Number of Lamps: **32**
Number of Power Distribution Centers: **4**
Number of System Control Centers: **1**
Number of Level Controllers: **0**
Type of Level Controller: **Wet**
Cleaning System: **Cleaning Tank**

EFFLUENT CHANNEL DIMENSIONS

L = Minimum length required for flow equalization: **46 ft**
W = Channel width based on number of UV modules: **6 in**
D = Maximum depth required for UV Modules access: **36 in**

Dimensions are given for reference only. Consult Trojan Technologies for overall system detailed dimensions.

ELECTRICAL REQUIREMENTS

1. The UV System Control Center requires an electrical service of one (1) 120 Volts, 1 phase, 2 wire (plus ground), 15 Amps.
2. Each Power Distribution Center requires an electrical service of one (1) 208 Volts, 3 phase, 2 wires (plus ground), 0.8 kVA.

NOTES

1. UV Disinfection Equipment specification is available upon request.
2. If there are site-specific hydraulic constraints that must be applied, please consult the manufacturer's representative to ensure compatibility with the proposed system.
3. Standard spare parts and safety equipment are included with this proposal.
4. The weighted controller (automatic level controller) is not designed to handle periods of no flow.
5. Electrical disconnects required as per local state code are not included in this proposal.
6. Trojan Technologies Inc. warrants all components of the system (excluding UV lamps) against faulty workmanship and materials for a period of 12 months from date of start-up or 18 months after shipment, whichever occurs first.

OPERATING COSTS FOR TROJAN SYSTEM UV3000™

Design Criteria

Average Flow:	0.1 US_MGD
Yearly Usage:	8760 hours
UV Transmission:	65%, minimum

Power Requirements

Total Power Draw:	2.8kW
Average Power Draw:	1.4 kW
Annual Operating Hours:	8760 hours
Cost per kW Hour:	\$0.050
Annual Power Cost:	\$ 613

Replacement Lamp Costs

Number of lamps replaced per year:	14
Price per lamp:	\$35
Annual Lamp Replacement Cost:	\$ 491

Total Annual Operation and Maintenance Costs are: \$1,104

NOTES

1. O&M costs are based on system flow-pacing using a 4-20 mA signal from a flow meter (supplied by others).
2. All costing has been based on the system operating at the average flow conditions.
3. All power requirements are based solely on the UV lamps.

P&H

facsimile transmission

date: July 16, 2002
msg#:
to: Mark Takemoto
Raines, Melton & Carella, Inc.
tel: 925-299-6733
fax: 925-299-6736
cc: P. Pfeiffer, P&H
Hard copy of this fax to follow: ☐ Yes ☐ No

pages: 3 including this page)
from: Debbie Gruber
P&H Representatives, Inc.
690 East. Tabor Ave., Suite I
Fairfield, CA 94533
707-425-0468
707-426-5237
email: dgruber@ph-reps.com

Subj: **Trojan System UV3000™ for the Ft. Baker Project**

Dear Mark,

In response to your request of July 10 for a revised proposal based on a design flow of 100,000 gpd, we are pleased to provide the following **Trojan System UV3000™** proposal for your review.

Please review carefully the design criteria for peak flow rate, total suspended solids, disinfection limit, and UV transmittance to ensure that the criteria used match actual project parameters. When detailed project design commences, please contact our office for a review of all design parameters, including dimensions and equipment requirements. In addition, Trojan is able to provide analytical services to quantify effluent quality and confirm design criteria.

Trojan's price for the attached **revised** design is **\$119,000** (in US\$). This quoted price includes the equipment as described, freight to site and start-up by qualified personnel. This quote **excludes** any taxes that may be applicable. The above information is to be used for budget estimates and is valid for 90 days from this day.

Thank you for the opportunity to quote the **Trojan System UV3000™** on this project.

Regards,
P&H Representatives, Inc.


Debbie Gruber

OPERATING COSTS FOR TROJAN SYSTEM UV3000™

Design Criteria

Average Flow:	0.05 US_MGD
Yearly Usage:	8760 hours
UV Transmission:	65%, minimum

Power Requirements

Total Power Draw:	1.4kW
Average Power Draw:	0.7 kW
Annual Operating Hours:	8760 hours
Cost per kW Hour:	\$0.050
Annual Power Cost:	\$ 307

Replacement Lamp Costs

Number of lamps replaced per year:	7
Price per lamp:	\$35
Annual Lamp Replacement Cost:	\$ 245

Total Annual Operation and Maintenance Costs are: \$ 552

NOTES

1. O&M costs are based on system flow-pacing using a 4-20 mA signal from a flow meter (supplied by others).
2. All costing has been based on the system operating at the average flow conditions.
3. All power requirements are based solely on the UV lamps.

DESIGN CRITERIA

Current Peak Design Flow:	0.1 US_MGD
Future Peak Design Flow:	0.1 US_MGD
UV Transmission:	65%, minimum
Total Suspended Solids:	5 mg/l (Maximum; grab samples)
Max Average Particle Size:	30 microns
Disinfection Limit:	2.2 total coliform per 100 ml, based on a 7 day Median of consecutive daily grab samples

DESIGN SUMMARY

Based on the above design criteria, the Trojan System UV3000™ proposed consists of:

Number of Channels:	1
Total Number of Banks:	4 (3 duty, 1 redundant)
Number of Modules per Bank:	2
Number of Lamps per Module:	2
Total Number of Lamps:	16
Number of Power Distribution Centers:	4
Number of System Control Centers:	1
Number of Level Controllers:	0
Type of Level Controller:	Weir
Cleaning System:	Cleaning Tank

EFFLUENT CHANNEL DIMENSIONS

L =	Minimum length required for flow equalization:	46 ft
W =	Channel width based on number of UV modules:	6 in
D =	Maximum depth required for UV Modules access:	30 in

Dimensions are given for reference only. Consult Trojan Technologies for overall system detailed dimensions.

ELECTRICAL REQUIREMENTS

1. The UV System Control Center requires an electrical service of one (1) 120 Volts, 1 phase, 2 wire (plus ground), 15 Amps.
2. Each Power Distribution Center requires an electrical service of one (1) 208 Volts, 3 phase, 2 wires (plus ground), 0.4 kVA.

NOTES

1. UV Disinfection Equipment specification is available upon request.
2. If there are site-specific hydraulic constraints that must be applied, please consult the manufacturer's representative to ensure compatibility with the proposed system.
3. Standard spare parts and safety equipment are included with this proposal.
4. The weighted controller (automatic level controller) is not designed to handle periods of no flow.
5. Electrical disconnects required as per local state code are not included in this proposal.
6. Trojan Technologies Inc. warrants all components of the system (excluding UV lamps) against faulty workmanship and materials for a period of 12 months from date of start-up or 18 months after shipment, whichever occurs first.

Appendix E: Most Feasible Option Treatment and Cost Information

The enclosed materials are considered proprietary property of ZENON Environmental Inc. No assignments either implied or expressed, of intellectual property rights, data, know how, trade secrets or licenses of use thereof are given. All information is provided exclusively to the addressee for the purposes of evaluation and is not to be reproduced or divulged to other parties, nor used for manufacture or other means or authorize any of the above, without the express written consent of ZENON Environmental Inc. The acceptance of this document will be construed as an acceptance of the foregoing conditions.

**ZeeWeed®/ZenoGem®
Wastewater Treatment System
Budget Proposal**

for

**Residential Development,
Ft. Baker, CA**

Proposal Reference No. 02-236-B

Submitted to:

Ray Ankaitis,
DC Frost & Associates,
CA

Copied to:

Jodi Cumin,
ZENON Environmental Corp.,
San Diego, CA

Submitted by:

James W. Hotchkies,
ZENON Environmental Inc.
3239 Dundas Street West,
Oakville, ON L6M 4B2
Tel: 905-465-3030 ext. 3208
FAX: 905-465-3050

2002-06-03

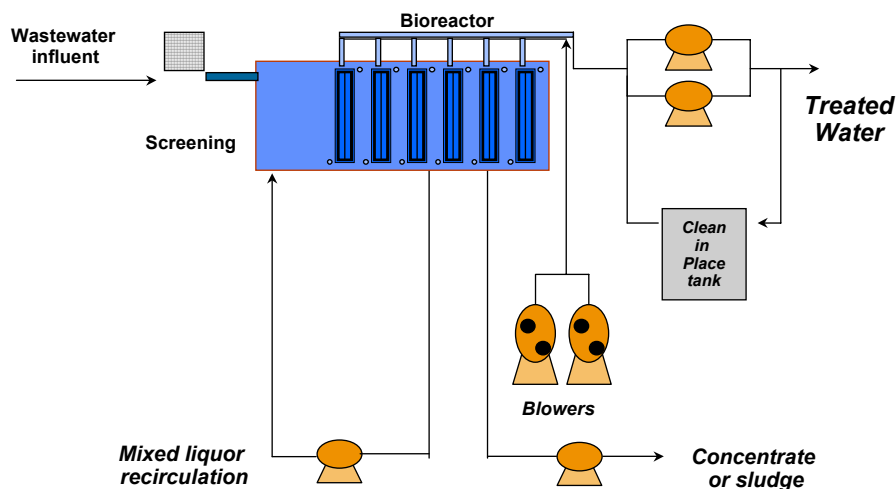
Synopsis of the ZenoGem® Wastewater Treatment Process

The ZenoGem® Process is a proprietary ZENON technology that consists of a suspended growth biological reactor integrated with an ultrafiltration membrane system. Essentially, the ultrafiltration system replaces the solids separation function of secondary clarifiers and sand filters in a conventional activated sludge system. For municipal applications, the ultrafilter employed is the ZeeWeed® ZW500-WW hollow fiber membrane, which has a 0.1 micron pore size which ensures that no particulate matter is discharged in the effluent.

The ZeeWeed® ultrafiltration membranes are typically submerged in the aeration tank, in direct contact with the mixed liquor. Through the use of a suction duty pump, a vacuum is applied to a header connecting the membranes. Treated water is drawn by the vacuum through the hollow fiber ultrafiltration membranes, into the pump and then discharged. The energy associated with permeate pumping is relatively small, due to the use of a vacuum rather than positive pressure. An airflow is introduced to the bottom of the membrane module producing turbulence which scours the external surface of the hollow fibers transferring rejected solids away from the membrane surface. This airflow also provides a portion of the biological process oxygen requirements; the remainder is provided by a diffused aeration system. Waste sludge is pumped directly from the aeration tank.

The ZenoGem® technology effectively overcomes the problems associated with poor settling of sludge in conventional activated sludge processes. The ZenoGem® technology permits bioreactor operation with considerably higher mixed liquor solids concentrations than conventional activated sludge systems which are limited by sludge settling. The ZenoGem® process is typically operated at a mixed liquor suspended solids

ZenoGem® Schematic



(MLSS) concentration in the range of 12,000 to 15,000 mg/L. The elevated biomass concentrations allow for highly effective removal of both soluble and particulate biodegradable material in the waste stream. The ZenoGem® process combines the unit operations of aeration, secondary clarification and filtration into a single process, simplifying operation and greatly reducing space requirements.

Occasionally, the ZeeWeed® ZW-500 Membranes may require removal from the ZenoGem® bioreactor tank for a thorough cleaning. The frequency of cleaning is a site-specific factor. Typically, removal of membranes for cleaning is required every three to six months. For this type of cleaning, the membrane cassette is removed and placed in a Dip Tank. The membranes soak in a cleaning solution for a period of time before being returned to the ZenoGem® Process Tank. Typically a 200 to 1,000 mg/L solution of sodium hypochlorite is used for cleaning the membranes. However, in certain cases, a mild acid or caustic solution may be required. The required Dip Tank(s) may be of fiberglass, concrete construction or fabricated steel, whichever suits the Customer's preferences. Each Dip Tank is approximately 8.0 ft. (L) x 4.0 ft. (W) x 8.5 ft. (D).

ZW-500 Ultrafiltration Membrane Modules

Membrane Design Flux Rate	10.5	gfd at average day flow
	21	gfd at Peak Hour flow
Minimum Design Liquid Temperature	13	°C
# Membrane Elements	12	
# Membrane Cassettes	2	(8-module Cassettes)

The ZenoGem® process is readily adapted for denitrification, where total nitrogen removal is required. The elevated levels of biomass become readily anoxic in the absence of aeration, ensuring high denitrification rates. An upstream anoxic zone is incorporated in the ZenoGem® tank design to accommodate denitrification. The ZenoGem® process is ideally suited for phosphorus removal, where required. Through the addition of metal salts, such as alum or ferric chloride, to the raw wastewater or mixed liquor, soluble phosphorus in the waste stream can be precipitated. The ZeeWeed® membranes have a pore size that provides an absolute barrier to the discharge of precipitated phosphorus. The phosphorus is retained in the mixed liquor and removed with the waste activated sludge. The ZenoGem® process can reliably achieve significantly lower effluent phosphorus concentrations than conventional municipal treatment processes.

However, for this project neither denitrification nor phosphorus reduction is considered. These options may be added, at the client's request.

Overview of Equipment Provided

The ZenoGem®/ZeeWeed® Membrane Wastewater Treatment Plant is designed with major process equipment supplied as fully assembled, skid-mounted units, for installation on concrete pads. The ZeeWeed® membranes are supplied for installation in a ZENON-supplied steel vessel.

The permeate from each membrane train is pumped via permeate pumps, supplied in main & standby configuration. Backpulsing of the membranes is by dedicated backpulse pumps, from backpulse water storage tanks supplied by ZENON. The backpulse tank is filled from the common permeate discharge header pipe. Recirculation pumps are provided and are designed for a recycle ratio of 6 times ADF.

The complete permeate and backpulse pump trains are fully assembled by ZENON on a steel process skid. The recirculation pumps, the blowers & the control system are shipped loose. All valves & fittings for the permeate system are within the ZENON scope of supply, to ensure compatibility with the control system provided. All instrumentation, motor controls, operator controls, PLC(s) and any VFDs required for the ZENON supplied equipment are within the ZENON scope of supply. The skid is suitable for installation on a slab, with protection from the elements supplied and installed by others. Alternatively, a ZENON-supplied equipment shell may be supplied, at additional cost, to provide the equipment protection.

The interconnecting piping from the blowers to the air headers in the membrane tanks is for the supply & installation by others. A fine bubble diffused aeration system is supplied for installation in the aerated zone of the process tanks.

Sludge wasting is accomplished by periodically diverting mixed liquor from the recirculation line, via manual control, and is a function of influent characteristics, reactor design and operator preference. Mixed liquor wasting may be weekly, monthly or at even longer periods.

Influent screening is not within the ZENON scope of supply. However, effective operation of the ZENON system requires appropriate screening upstream of the ZenoGem® aeration (bioreactor) tanks. A mechanical screening device, capable of screening particles down to 2.0 mm, should be used to prevent hair and other stringy materials from tangling with the membranes.

Design Parameters

The table below summarizes the main design parameters on which the ZenoGem[®] system has been designed. The column titled “influent” are characteristics of typical medium strength sanitary wastewater as to be approved for use by the client’s representative. The column titled “effluent” is the anticipated treated water quality ZENON expects to be able to achieve based on current ZENON design.

Parameter	Influent	Effluent	Units
Average Daily Flow	56,000	56,000	USgpd
Maximum Daily Flow	80,000	80,000	USgpd
Design Water Temperature	13	13	°C
BOD ₅	250	<5	mg/L
TSS	250	<5	mg/L
Total Coliform		<2.2	cfu/100mL
Turbidity		<0.5	NTU

Design Concept

The design configuration proposed by ZENON for this project is a single train system, with a nominal design capacity of 56,000 USgpd (average day flow). During maximum day events, the system is designed to process up to 80,000 USgpd. For any flow conditions above these values, equalization should be installed ahead of the ZENON process reactor. The design includes all process equipment required to treat the specified flows, with sufficient redundancy that the full ADF can be accommodated with any single piece of equipment out of service. All major equipment items are supplied as a minimum of one service component per cell plus a common stand-by unit.

Bioreactor Design

Design HRT		9.4	Hours
Reactor Volume Required		21,900	USgal
Tank Width		8	ft
Tank Length		44	ft
Tank Height		10	ft
Volume Provided		23,160	USgal

Tank requirements are preliminary only and may change slightly once final detail design commences.

Scope of Supply - ZENON

The main equipment included with the supply of ZenoGem® Wastewater Treatment System is summarized below.

Item & Description	Quantity
ZeeWeed® (ZW500a) Membrane Cassettes, complete with SS316 framing for installing the modules in the membrane vessel	2
Steel bioreactor tank – as previously described	1
Permeate pumps c/w valves & fittings	2
Backpulse pumps c/w valves & fittings	2
Air Blowers, for membrane air scour & process air requirements	2
Permeate collection header pipe	1
Air distribution header pipe	1
Mixed liquor transfer (recirculation) pump	2
Air diffusers for supply of process air	91
Membrane dip tank	1
Process control panel c/w motor control equipment & instrumentation integral to the ZenoGem® System	1
Backpulse tank	1
Clean in Place (CIP) membrane cleaning system	1
pH control system	1
UV disinfection system	2
Turbidity meter	1
Equipment general arrangement and layout drawings	3 sets
Operating & Maintenance manuals	3
Field service and process start-up assistance (days)	10

Additional man-hours will be billed separately from the proposed system capital cost at a rate of \$650 US per day plus living and traveling expenses.

Scope of Supply – by Others

Items for supply by others include, and are not limited to:

Item & Description
Overall plant design
Review of design parameters
Review of equipment drawings and specifications
Equipment foundations, civil work, equipment mounting pads, buildings etc.
Permits including construction permits, discharge permits, and plant design approvals
HVAC equipment design, specifications, and installation (where applicable)
Emergency power supply and specifications (where applicable)
Receiving and safe storage of equipment at site until ready for installation
Shipping, handling, duties and taxes (as applicable)
Unloading of delivered equipment from the transportation vehicle to the plant site
Equipment installation
Dual intake screen – 2 mm travelling band screen recommended – complete with washer & compactor
Membrane removal system – hoist
Sludge holding (if desired)
Disposal field (if required)
Process and utilities piping, pipe supports, hangers, valves etc. including but not limited to: – Piping, pipe supports and valves between ZENON supplied equipment and other plant process equipment – Piping between any loose-supplied ZENON equipment – Process tank aeration system air piping, equalization tank system piping, etc – Permeate discharge piping
Electrical wiring, conduit and other appurtenances required to provide power connections as required from the electrical power source to the ZENON control panel and from the control panel to any electrical equipment, pump motors and instruments external to the ZENON-supplied enclosure
Any handrails, walkways, ladders, general grating, etc.
Raw materials, chemicals and utilities etc. during equipment start-up and operation
Laboratory services operating and maintenance personnel during equipment checkout, start-up and operation

ZenoGem® Wastewater Treatment System Pricing

One (1) ZenoGem® Wastewater Treatment System as described above, and with the following design capacity.

Average Daily Flow		56,000	USgpd
Maximum Daily Flow		80,000	USgpd

Budgetary Pricing: US\$ 406,500.00

Validity

Pricing is for budgetary purposes only and does not constitute a final offer of sale.

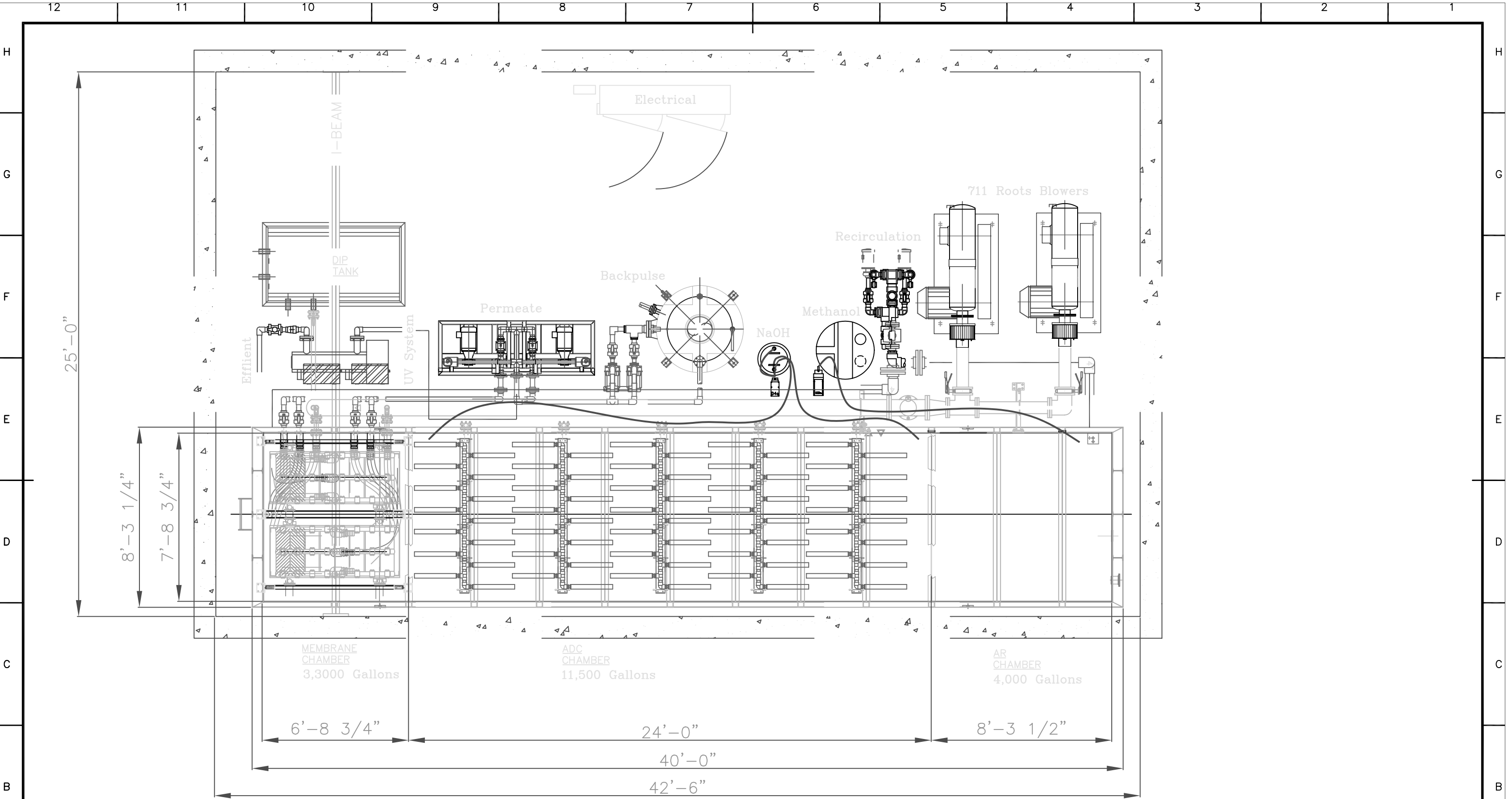
Freight, Taxes and Duties

All equipment is quoted FOB Oakville, Ontario. No freight, taxes, duties or brokerage are included in the above pricing. Any freight, taxes, duties or tariffs, of any type, are for the account of the purchaser.

Terms of Payment

The budgetary pricing quoted in this proposal is based on the following terms of payment:

- 15% with Purchase Order
- 30% on submission of General Arrangement Drawings
- 30% prior to shipment of equipment
- 20% prior to shipment of membranes
- 5% within thirty (30) days of equipment start-up or within sixty (60) days of equipment shipment, whichever is sooner.



THIS DOCUMENT EMBODIES DESIGNS AND INFORMATION IS PROPRIETARY TO ZENON ENVIRONMENTAL SYSTEMS INC. IT IS TO BE USED ONLY FOR THE PURPOSE AND BY THE ENTITY FOR WHICH IT WAS ORIGINALLY SUPPLIED. THE DOCUMENT MAY NOT BE DUPLICATED, DISCLOSED TO ANY OTHER PERSON OR ENTITY, OR USED FOR MANUFACTURE OF THE ITEM IN PART OR IN WHOLE WITHOUT THE PRIOR WRITTEN PERMISSION OF ZENON ENVIRONMENTAL SYSTEMS INC.

		A		03/09/12 PRELIMINARY – NOT FOR CONSTRUCTION		LDS		RK		–			
		REV.		DATE				ZONE		DSGN		APPD	
UNLESS OTHERWISE SPECIFIED:		APPROVAL		DATE (Y/M/D)				ZENON Environmental Inc.					
1. DIMENSIONS ARE IN INCHES		DRWN: RK		03/09/12				ZEI – OAKVILLE					
2. TOLERANCES		DSGN: RK		03/09/12				ONTARIO					
FRACTIONS ± 1/8"		CHKD:				CUSTOMER:		RESIDENTIAL DEVELOPMENT; BAKER, CA					
DECIMALS .X ± .030		APPD:				TITLE:		GENERAL ARRANGEMENT					
DECIMALS .XX ± .015		CADD FILE:		02_236-G-001.dwg		WASTEWATER TREATMENT PLANT							
ANGLES ± .5 DEG		SCALE:		1/2" = 1'-0" (1:24)		SIZE: D		DRAWING NO.		02-236-G-001		SHEET 1 of 1	
HOLE SIZES ± 1/32"												REV. A	
HOLE CENTRES ± 1/32"													
DRAWING INTERPRETATION: ANSI Y14.5 M													

Odor Control Unit Sizing

Item	Criteria	Air Flow Required (cfm)
Membrane Process Air Flow	Blower Rate	10
Aerobic Digester Air Flow*	Blower Rate	25
Misc. Annular Process Space	12 air changes/hour	59
Building Volume	0.3 cfm/sq.ft.	810
Total		904

*Only required if on-site solids handling is desired.

Process	Estimated Air Space Volumes
Dumpster	2 ft3
AR Chamber	72.25 ft3
Mebrane chamber	59.5 ft3
Fine Screen	128 ft3
Dip tank	32 ft3
Total	293.75 ft3
Required Flow For 12 changes per hour	58.8 cfm

Fort Baker Recycled Water Project

Cost Estimate

60,000 gpd Capacity - Satellite Wastewater Facility Distribution

DRAFT

Item	Quantity	Unit	Unit Cost	Estimated Amount
Mobilization/Demobilization	7%	ALL	\$23,000	\$23,000
Installation	10%	ALL	\$32,850	\$32,850
Instrumentation and Controls	9%	ALL	\$28,000	\$28,000
Electrical	10%	ALL	\$32,900	\$32,900
Recycled Water Storage Tank	1	EA	\$175,000	\$175,000
Chlorination System	1	EA	\$40,000	\$40,000
Distribution Pump Station	1	EA	\$100,000	\$100,000
Distribution Ring Around the Parade Ground	1	EA	\$13,500	\$13,500
<i>Construction Subtotal</i>				<i>\$445,300</i>
Construction Markups				
Contractor Overhead and Profit	15%	MU	\$33,400	\$33,400
Sales Tax on Materials	8%	MU	\$17,900	\$17,900
<i>Construction Markups Subtotal</i>				<i>\$496,600</i>
<i>Estimated Construction Cost</i>				<i>\$496,600</i>
Construction Change Order Allowance	10%	ALL	\$49,700	\$49,700
Unknowns Allowance	10%	ALL	\$49,700	\$49,700
<i>Total Estimated Construction Budget</i>				<i>\$595,950</i>
Implementation Costs	35%			\$208,600
<i>Project Cost Subtotal</i>				<i>\$804,550</i>
Project Contingency	35%			\$281,600
<i>Total Estimated Project Cost</i>				<i>\$1,090,000</i>

*Pump Station

Fort Baker Recycled Water Project

Cost Estimate

Parade Ground Distribution Piping

Item	Quantity	Unit	Unit Cost	Estimated Amount
Mobilization/Demobilization	7%	ALL	\$ 877	\$ 877
8-inch Pipe	80	L.F.	\$ 12	\$ 960
6-inch Pipe	280	L.F.	\$ 8	\$ 2,240
2-inch Pipe	100	L.F.	\$ 4	\$ 400
Thrust Blocks/ Restrained Joints	10	EA	\$ 488	\$ 4,880
Saw Cutting	360	L.F.	\$ 1.21	\$ 435
Pavement Removal	40	S.Y.	\$ 3.93	\$ 157
Trenching, 2' wide, 4' deep	280	LF	\$ 3	\$ 804
Dewatering	10	DAYS	\$ 141	\$ 1,414
Bedding, 2' wide, 12" thick	280	LF	\$ 1.20	\$ 336
Pavement Repairs	360	S.F.	\$ 2	\$ 637
Traffic Control	10	DAYS	\$ 1.77	\$ 18
Pipeline Appurtenances	2%	ALL	\$ 251	\$ 251
<i>Construction Subtotal</i>				\$ 13,409
Construction Markups				
Contractor Overhead and Profit	15%	MU	\$ 2,011	\$ 2,011
Sales Tax on Materials	8%	MU	\$ 536	\$ 536
<i>Construction Markups Subtotal</i>				\$ 2,548
<i>Estimated Construction Cost</i>				\$ 15,956
Construction Change Order Allowance	10%	ALL	\$ 1,596	\$ 1,596
Unknowns Allowance	10%	ALL	\$ 1,596	\$ 1,596
<i>Total Estimated Construction Budget</i>				\$ 19,147
Implementation Costs				
Administration	35%	ALL	\$ 6,702	\$ 6,702
<i>Project Cost Subtotal</i>				\$ 25,849
Project Contingency	35%		\$	\$ 9,047
<i>Total Estimated Project Cost</i>				\$ 34,896

Appendix F: SMCSD Recycled Water Treatment Capital and O&M Cost Estimates

Fort Baker Recycled Water Project

Cost Estimate

0.2 MGD Capacity - MF/RO Facility

Item	Quantity	Unit	Unit Cost	Estimated Amount
Mobilization/Demobilization	7%	ALL	\$102,768	\$102,768
Demolition	10%	ALL	\$146,812	\$146,812
Installation	10%	ALL	\$146,812	\$146,812
Instrumentation and Controls	9%	ALL	\$124,800	\$124,800
Electrical	10%	ALL	\$134,100	\$134,100
0.26 MGD MF Treatment Process	1	EA	\$532,119	\$532,119
0.2 MGD RO Treatment Processes	1	EA	\$150,000	\$150,000
0.2 MGD UV Disinfection Process	1	EA	\$126,000	\$126,000
Transmission pipeline	4000	L.F.	\$50	\$200,000
Modify treatment processes platform	2100	sq. ft.	\$200	\$420,000
Potable Water System Stand-by	1	EA	\$40,000	\$40,000
Mechanical appurtenances/piping	50%	TRT*	\$404,100	\$404,100
<i>Construction Subtotal</i>				\$2,123,411
Construction Markups				
Contractor Overhead and Profit	15%	MU	\$159,300	\$159,300
Sales Tax on Materials	8%	MU	\$84,936	\$84,936
<i>Construction Markups Subtotal</i>				\$84,936
<i>Estimated Construction Cost</i>				\$2,771,748
Construction Change Order Allowance	10%	ALL	\$277,175	\$277,175
Unknowns Allowance	10%	ALL	\$277,175	\$277,175
<i>Total Estimated Construction Budget</i>				\$3,326,097
Implementation Costs	35%			\$1,164,134
<i>Project Cost Subtotal</i>				\$4,490,231
Project Contingency	35%			\$1,571,581
<i>Total Estimated Project Cost</i>				\$6,070,000

Fort Baker Recycled Water Project

Cost Estimate

0.1 MGD Capacity - MF/RO Facility

Item	Quantity	Unit	Unit Cost	Estimated Amount
Mobilization/Demobilization	7%	ALL	\$86,730	\$86,730
Installation	10%	ALL	\$123,900	\$123,900
Instrumentation and Controls	9%	ALL	\$105,400	\$105,400
Electrical	10%	ALL	\$123,900	\$123,900
0.13 MGD MF Treatment Process	2	EA	\$135,000	\$270,000
0.1 MGD RO Treatment Processes	1	EA	\$85,000	\$85,000
0.1 MGD UV Disinfection Process	1	EA	\$119,000	\$119,000
Transmission pipeline	4000	L.F.	\$50	\$200,000
New treatment processes platform	2100	sq. ft.	\$250	\$525,000
Potable Water System Stand-by	1	EA	\$40,000	\$40,000
Mechanical appurtenances/piping	50%	TRT*	\$237,000	\$237,000
<i>Construction Subtotal</i>				<i>\$1,915,930</i>
Construction Markups				
Contractor Overhead and Profit	15%	MU	\$143,700	\$143,700
Sales Tax on Materials	8%	MU	\$76,637	\$76,637
<i>Construction Markups Subtotal</i>				<i>\$76,637</i>
<i>Estimated Construction Cost</i>				<i>\$2,136,267</i>
Construction Change Order Allowance	10%	ALL	\$213,627	\$213,627
Unknowns Allowance	10%	ALL	\$213,627	\$213,627
<i>Total Estimated Construction Budget</i>				<i>\$2,563,521</i>
Implementation Costs	35%			\$897,232
<i>Project Cost Subtotal</i>				<i>\$3,460,753</i>
Project Contingency	35%			\$1,211,264
<i>Total Estimated Project Cost</i>				<i>\$4,672,016</i>

*Treatment Equipment

SMCSD Recycled Water Facility O&M Cost Estimate

Facility	Quantity	Unit	Unit Cost	Estimated Amount
Treatment				
Cleaning chemicals	1 EA		\$ 1,000	\$ 1,000
Membrane Replacement	0.1 EA		\$ 45,000	\$ 4,500
Power Consumption	60000 kWh/yr		\$ 0.12	\$ 7,200
Subtotal				\$ 12,700
Reverse Osmosis				
Cleaning chemicals	1 EA		\$ 1,573	\$ 1,573
Membrane Replacement	0.2 EA		\$ 8,000	\$ 1,600
Power Consumption	55000 kWh/yr		\$ 0.12	\$ 6,600
Subtotal				\$ 9,773
UV Disinfection				
Cleaning chemicals	1 EA		\$ 1,000	\$ 1,000
Part Replacement	14 EA		\$ 35	\$ 490
Power Consumption	12000 kWh/yr		\$ 0.12	\$ 1,440
Subtotal				\$ 2,930
Routine Maintenance	300 hrs		\$ 75	\$ 22,500
Estimating Contingency	35% All		\$ 14,371	\$ 14,371
Total O&M Cost/year				\$ 62,300

Appendix G: Initial Treatment Plant Building Massing Diagrams



MASSING DIAGRAM
RECLAIMED WATER PLANT
VIEW ACROSS LOOKOUT COVE

SKETCH: BAJ

NOVEMBER 3, 2003



MASSING DIAGRAM
RECLAIMED WATER PLANT
VIEW ACROSS BENCH LOOKING SOUTH
SKETCH: BAJ
NOVEMBER 3, 2003



MASSING DIAGRAM:
RECLAIMED WATER PLANT
VIEW ACROSS BENCH LOOKING NORTH

SKETCH: BAJ

NOVEMBER 3, 2003

Appendix H: Solids Handling Options Cost Estimates

Fort Baker Recycled Water Project

DRAFT

Cost Estimate

60,000 gpd Capacity - Satellite Wastewater Facility Existing Forcemain Modification

Item	Quantity	Unit	Unit Cost	Estimated Amount
Mobilization/Demobilization	7%	ALL	\$800	\$800
Installation	10%	ALL	\$1,100	\$1,100
Instrumentation and Controls	9%	ALL	\$1,000	\$1,000
Electrical	10%	ALL	\$1,100	\$1,100
Control Valves	2	EA	\$3,000	\$6,000
Excavation and Pipe Modifications	1	EA	\$5,000	\$5,000
<i>Construction Subtotal</i>				<i>\$15,000</i>
Construction Markups				
Contractor Overhead and Profit	15%	MU	\$1,200	\$1,200
Sales Tax on Materials	8%	MU	\$600	\$600
<i>Construction Markups Subtotal</i>				<i>\$16,800</i>
<i>Estimated Construction Cost</i>				<i>\$16,800</i>
Construction Change Order Allowance	10%	ALL	\$1,700	\$1,700
Unknowns Allowance	10%	ALL	\$1,700	\$1,700
<i>Total Estimated Construction Budget</i>				<i>\$20,200</i>
Implementation Costs	35%			\$7,100
<i>Project Cost Subtotal</i>				<i>\$27,300</i>
Project Contingency	35%			\$9,600
<i>Total Estimated Project Cost</i>				<i>\$40,000</i>

Fort Baker Recycled Water Project

Cost Estimate

New Pump Station and Solids Force Main to SMCSO

DRAFT

Item	Quantity	Unit	Unit Cost	Estimated Amount
Mobilization/Demobilization	7%	ALL	\$ 4,574	\$ 4,574
Installation	10%	ALL	\$6,407	\$ 6,407
Instrumentation and Controls	9%	ALL	\$5,500	\$ 5,500
Electrical	10%	ALL	\$6,500	\$ 6,500
1-HP Pump	2	E.A.	\$ 5,000	\$ 10,000
4-inch Pipe	3800	L.F.	\$ 6	\$ 22,800
Thrust Blocks/ Restrained Joints	10	EA	\$ 400	\$ 4,000
Saw Cutting	6000	L.F.	\$ 1.21	\$ 7,244
Pavement Removal	667	S.Y.	\$ 3.93	\$ 2,620
Trenching, 2' wide, 4' deep	2	LF	\$ 3	\$ 6
Dewatering	10	DAYS	\$ 141	\$ 1,414
Bedding, 2' wide, 12" thick	2	LF	\$ 1.20	\$ 2
Pavement Repairs	6000	S.F.	\$ 2	\$ 10,620
Traffic Control	10	DAY	\$ 536	\$ 5,360
Pipeline Appurtenances	2%	ALL	\$ 1,281	\$ 1,281
<i>Construction Subtotal</i>				\$ 88,329
Construction Markups				
Contractor Overhead and Profit	15%	MU	\$ 13,249	\$ 13,249
Sales Tax on Materials	8%	MU	\$ 3,533	\$ 3,533
<i>Construction Markups Subtotal</i>				\$ 16,783
<i>Estimated Construction Cost</i>				\$ 105,111
Construction Change Order Allowance	10%	ALL	\$ 10,511	\$ 10,511
Unknowns Allowance	10%	ALL	\$ 10,511	\$ 10,511
<i>Total Estimated Construction Budget</i>				\$ 126,134
Implementation Costs				
Administration	35%	ALL	\$ 44,147	\$ 44,147
<i>Project Cost Subtotal</i>				\$ 170,281
Project Contingency	35%			\$ 59,598
<i>Total Estimated Project Cost</i>				\$ 229,900

Fort Baker Recycled Water Project

DRAFT

Cost Estimate

60,000 gpd Capacity - Satellite Wastewater Facility Solids Loading Station

Item	Quantity	Unit	Unit Cost	Estimated Amount
Mobilization/Demobilization	7%	ALL	\$1,200	\$1,200
Installation	10%	ALL	\$1,700	\$1,700
Concrete Slab 6'x6'	1	EA	\$2,000	\$2,000
Pipe Connection to Existing Solids Facility	1	EA	\$10,000	\$10,000
Potable Water Connection	1	EA	\$5,000	\$5,000
<i>Construction Subtotal</i>				<i>\$19,900</i>
Construction Markups				
Contractor Overhead and Profit	15%	MU	\$1,500	\$1,500
Sales Tax on Materials	8%	MU	\$800	\$800
<i>Construction Markups Subtotal</i>				<i>\$22,200</i>
<i>Estimated Construction Cost</i>				<i>\$22,200</i>
Construction Change Order Allowance	10%	ALL	\$2,300	\$2,300
Unknowns Allowance	10%	ALL	\$2,300	\$2,300
<i>Total Estimated Construction Budget</i>				<i>\$26,800</i>
Implementation Costs	35%			\$9,400
<i>Project Cost Subtotal</i>				<i>\$36,200</i>
Project Contingency	35%			\$12,700
<i>Total Estimated Project Cost</i>				<i>\$50,000</i>

Fort Baker Recycled Water Project

Option 3 Cost Estimate

On-Site Solids Handling Process

Item	Quantity	Unit	Unit Cost	Estimated Amount
Mobilization/Demobilization	7%	ALL	\$12,000	\$12,000
Installation	10%	ALL	\$17,100	\$17,100
Electrical	10%	ALL	\$17,100	\$17,100
Instrumentation and Controls	9%	TRT*	\$14,600	\$14,600
Tank	2	EA	\$8,000	\$16,000
Blowers	3	EA	\$1,000	\$3,000
Diffusers	120	EA	\$40	\$4,800
Odor Control Equipment	1	EA	\$25,000	\$25,000
Centrifuge	1	EA	\$50,000	\$50,000
Polymer System	1	EA	\$15,000	\$15,000
Mechanical appurtenances/piping	50%	ALL	\$56,900	\$56,900
Expanded Building w/ Architectural Considerations	960	sq. ft.	\$200	\$192,000
<i>Construction Subtotal</i>				<i>\$423,500</i>
Construction Markups				
Contractor Overhead and Profit	15%	MU	\$31,800	\$31,800
Sales Tax on Materials	8%	MU	\$17,000	\$17,000
<i>Construction Markups Subtotal</i>				<i>\$472,300</i>
<i>Estimated Construction Cost</i>				<i>\$472,300</i>
Construction Change Order Allowance	10%	ALL	\$47,300	\$47,300
Unknowns Allowance	10%	ALL	\$47,300	\$47,300
<i>Total Estimated Construction Budget</i>				<i>\$566,900</i>
Implementation Costs	35%			\$198,500
<i>Project Cost Subtotal</i>				<i>\$765,400</i>
Project Contingency	35%			\$267,900
<i>Total Estimated Project Cost</i>				<i>\$1,040,000</i>

Solids Handling O&M Cost Estimates

Solids Handling Option 1 - Existing Pump Station

Annual Operating Costs	Unit	Unit Cost	Quantity	Total Cost
Pumping	KW-hr	\$0.12	10,000	\$1,200
Chemical costs	LS	\$1,000	1	\$1,000
Labor	MH	\$75	64	\$4,800
Total Annual Operating Costs				\$7,000

Solids Handling Option 1 - New Solids Pump Station

Annual Operating Costs	Unit	Unit Cost	Quantity	Total Cost
Pumping	KW-hr	\$0.12	2,000	\$200
Chemical costs	LS	\$1,000	1	\$1,000
Labor	MH	\$75	50	\$3,750
Total Annual Operating Costs				\$5,000

Solids Handling Option 2

Annual Operating Costs	Unit	Unit Cost	Quantity	Total Cost
Truck Solids to SMCSO	EA	\$5,000	1	\$5,000
Total Annual Operating Costs				\$5,000

Solids Handling Option 3

Annual Operating Costs	Unit	Unit Cost	Quantity	Total Cost
Blowers, assume 2 at 1 HP	KW-hr	\$0.12	7,517	\$900
Centrifuge, assume 10 hp	KW-hr	\$0.12	835	\$100
Miscellaneous electrical	KW-hr	\$0.12	835	\$100
Chemical costs	LS	\$2,000	1	\$2,000
Labor	MH	\$75	280	\$21,000
Total Annual Operating Costs				\$24,100

Appendix I: Water Reuse Permit for the Presidio Trust Recycled Water Facility

**CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION**

**ORDER R2-2004-0001
WATER REUSE REQUIREMENTS FOR:**

THE PRESIDIO TRUST of SAN FRANCISCO

The California Regional Water Quality Control Board, San Francisco Bay Region (hereinafter called the Board), finds that:

1. The Presidio of San Francisco (Presidio), is being converted from a U.S. Army base to a national park site. The Presidio Trust (Trust), a federal government corporation, was created by Congress in 1996 to administer and manage in accordance with the Presidio Trust Act (16 U.S.C. sections 460bb appendix) the 1,168 acre inland area of the Presidio, known as Area B. The National Park Service (NPS) administers and manages the 323 acre shoreline area of the Presidio, or Area A, which includes Crissy Field and the newly restored Crissy Marsh.

The Trust submitted a Report of Waste Discharge and Draft Engineering Report for the *Production, Distribution and Use of Recycled Water*, dated December 6, 2002, for the construction and operation of a new tertiary wastewater treatment and disposal system (the project) to serve the Presidio and adjacent facilities. The Presidio abuts the Pacific Ocean and San Francisco Bay, at the northwestern tip of the San Francisco peninsula, just south of the Golden Gate Bridge. A regional location map of the Presidio is in Figure 1, Attachment 1.

2. The purpose of the proposed project is to reduce potable water demand and the amount of potable water consumed for non-potable uses (i.e., landscape irrigation) at the Presidio, and to provide a reliable year-round and drought-proof source of recycled water for the Presidio that meets or exceeds Title 22 standards for Disinfected Tertiary Recycled Water. An additional objective is to reduce wastewater flows entering the City and County of San Francisco's (CCSF's) combined sewer system, and in particular reduce the Presidio's contribution to cumulative flows affecting the operation of the (CCSF's) Southeast Water Pollution Control Plant (SEWPCP).

By this Order, the Trust is authorized a) to operate the recycled water treatment system specified in this Order within Area B of the Presidio; b) to use recycled water in designated areas within Area B of the Presidio; and c) to supply users outside or adjacent to Area B of the Presidio as specified by this Order.

EXISTING WASTEWATER/STORMWATER COLLECTION SYSTEMS

3. Currently the Presidio has two separate sewer systems: one for sanitary sewage (wastewater) and one for stormwater. Stormwater is collected and conveyed to the Pacific Ocean, San Francisco Bay and Crissy Marsh. Wastewater is presently collected and conveyed to the City and County of San Francisco (CCSF) combined sewer system. The majority of these flows are transported via the "Presidio Main," which is located at the park's northeastern corner near Gorgas/Lyon Gate within the Letterman District (see Figure 1).

SURFACE WATER ON THE PRESIDIO

4. There are several water bodies within the Presidio. Lobos Creek, the only remaining naturally occurring surface water drainage in the Presidio, originates near the southern boundary of the Presidio and discharges to the Pacific Ocean. Just over one mile in length and recharged by groundwater released from springs and seeps, it is the primary potable water source for the park. Recycled water irrigation is specifically prohibited in the Lobos Creek watershed. Crissy Marsh, located on San Francisco Bay on the northern boundary of the Presidio, is an 18-acre tidal salt marsh that was restored as part of the larger 100-acre Crissy Field Restoration Project. In addition there are several small water bodies in the Presidio: Mountain Lake, Tennessee Hollow's El Polin Spring, and Dragonfly Creek. Mountain Lake is a natural, unlined lake occupying approximately four acres and likely fed by groundwater, with some contribution from surface water runoff. The area around El Polin Spring, also referred to as Tennessee Hollow, contains three tributaries and is currently being studied by the Trust for ecological restoration opportunities.

Except as specified, use of recycled water is prohibited in the areas of the above-identified surface waters and will not have a significant impact on their water quality. Subject to NPS consent, recycled water irrigation is allowed on Crissy Field, which is adjacent to Crissy Marsh.

5. PRODUCER, DISTRIBUTOR and USERS

The Trust will produce and distribute recycled water to designated Recycled Water Use areas. Phase 1 of the recycled water project will produce up to 200,000 gallons per day (gpd) for use at both the Letterman Digital Arts Center (LDAC) site in Area B and Crissy Field in Area A. The recycled water project will eventually be expanded under Phase II for flows up to 500,000 gpd. Additional designated Recycled Water Use Areas include the Main Post, National Cemetery, Fort Scott, the Lombard Corridor areas, and possibly areas within CCSF jurisdiction if requested by the City. These areas are not expected to be supplied by the project, if at all, until Phase 2. The designation of Phase I and Phase II Use Areas is not intended to be restrictive: a Use Area may become part of a different project phase, provided that the alternative Use Area is supplied and managed in accordance with the terms of this Order. The proposed Recycled Water Use Areas are presented in Figure 2, Attachment 2.

Users supplied by the project, either Phase 1 or Phase II, will be responsible for operation and maintenance of the on-site distribution systems under their respective jurisdiction and for compliance with use conditions and prohibitions as specified in separate user agreements entered into between the Trust and Users and consistent with this Order.

The LDAC, which is currently in the beginning stages of construction, will be a building complex on 23 acres within the Presidio's Letterman District. The LDAC designated Recycled Water Use Area will be operated and maintained by Letterman Digital Arts Ltd., or a successor entity related to the LDAC, pursuant to a user agreement consistent with this Order and entered into with the Trust. The intended uses of recycled water at LDAC are anticipated to include landscape irrigation and impoundments (e.g., water features such as constructed pools, fountains, and waterfalls).

Crissy Field north of Mason Street is under the jurisdiction of the NPS. The Crissy Field designated Recycled Water Use Area will be operated and maintained by NPS pursuant to a user agreement consistent with this Order and entered into between the Trust and NPS.

WASTEWATER TREATMENT FACILITY

6. The new state-of-the-art wastewater treatment system will produce disinfected tertiary recycled water suitable for ‘unrestricted’ irrigation reuse in accordance with current State of California Water Recycling Criteria (Title 22 regulations and criteria for wastewater reclamation). Recycled water produced by the tertiary treatment facility will be used for on-site irrigation of landscape features (utilizing spray, drip, and subsurface applications) and decorative water features (fountains, etc). All wastewater generated will be primarily of domestic origin (residences and offices), several small restaurants, light industrial uses such as an equipment wash pad (equipped with an oil/water separator), general storage and warehouse uses, and possibly a small commercial laundry. The nature of wastewater from non-office uses that connect to the system will be reviewed for consistency with the Trust’s recycled water permit, and appropriate pretreatment measures will be instituted as needed to meet the requirements of this Order.

The new recycled water treatment system will consist primarily of a fine screen for clarification, submerged membrane bio-reactor (MBR) for activated sludge biological treatment and filtration, and ultraviolet light (UV) irradiation for primary disinfection. Sodium hypochlorite storage and dosing facilities will be installed to provide disinfection residual. In addition, sodium hypochlorite will be used for periodic odor suppression, for filamentous organism suppression, and for bio-slime prevention in recycled water pipelines and irrigation systems. Other ancillary systems include odor control scrubbers, air blowers with sound attenuation devices housed in a separate room, pumping systems, mechanical piping, electrical and control systems, fire sprinkling systems, and HVAC systems. The process schematic is shown in Figure 3, Attachment 3.

The Recycled Water Treatment Plant (RWTP) will be located in the Letterman District of Area B inside Presidio Building 1063 after the building is upgraded to meet applicable seismic criteria and modified to create space for the required equipment.

Wastewater will continue to be collected in the existing sewer system from throughout the Presidio and will flow by gravity to an equalization/emergency storage facility at the RWTP. After screening, the influent will flow to the microfiltration membrane bioreactor (MBR). The MBR system will have a configuration that has been approved by the California Department of Health Services (DHS) for production of tertiary recycled water. The MBR process train will consist of an aeration basin, an anoxic basin, recirculation/sludge wasting pump, immersed microfiltration membranes, and permeate pumps. Dissolved BOD will be converted into filterable solid material in the aeration basin by an aerobic suspended growth process. In addition, nitrification will occur in the aeration basin. Nitrified effluent will be re-circulated to the anoxic basin and blended with raw wastewater for denitrification. Several “cassettes” with microfiltration membranes will be immersed at one end of the aeration basin. An automated programmable controller will control the backwashing of the bio-filter membranes. Sodium hypochlorite will also be injected into the back pulse flow to remove biological growth in the membrane filters. Waste activated sludge will be periodically pumped from the bottom of the aeration basin and will be pumped into the CCSF’s wastewater collection system for treatment. A flushing system will be designed to facilitate transfer of the solids to the CCSF system.

RECYCLED WATER STORAGE TANK

7. The recycled water will be pumped through the UV disinfection system and into a 500,000 gallon recycled water storage tank, which is equivalent to the one-day treatment capacity for Phase 2. This will provide operational storage to meet peak demands and maintain service during minor treatment plant upsets or during maintenance. The tank will be a buried rectangular reinforced concrete structure equipped with low and high level float switches and level alarms, overflow pipe to the Gorgas Gate manhole (CCSF sewer system), and distribution pumps.

To prevent inadequately treated wastewater from entering the storage tank, the RWTP will be equipped with a shut off valve and a diversion tee after the turbidity meter. When closed, the shutoff valve will prevent water from exiting the RWTP towards the UV system and the storage tank. The water would then be conveyed into the CCSF's collection system for treatment. Whenever there is a diversion to the CCSF's system, the sewage lift pumps will automatically stop pumping wastewater to the RWTP, instead pumping the flow to the CCSF system.

WATER RECYCLING TREATMENT PLANT STAFFING

8. The RWTP will not be staffed full-time. However, the plant will have automatic monitoring and alarm systems. A certified operator from the Presidio's Lobos Creek Water Treatment Plant (LCWTP) or designated backup personnel will periodically, but no less than three times per week, visit the RWTP to collect samples and check on the treatment operations. The operator will be on call at all times, unless a backup operator is designated by the Trust. The Trust may also contract with an outside certified wastewater treatment operator to provide assistance as needed.

WINTERTIME DISCHARGES TO RECEIVING WATERS

9. During wintertime rainy periods, soils may be saturated, requiring the curtailment of the use of recycled water for irrigation purposes. During these periods, wastewater would either be discharged to the CCSF's collection system for treatment at the SESWPCP or discharged to waters of the State and United States under a separate Permit from this Regional Board that has not been applied for at this time..

BASIS FOR WASTEWATER TREATMENT DESIGN

10. The design criteria for the RWTP are presented in Table 1, Attachment 4.
11. Water Conservation

Consistent with the Presidio Trust's Management Plan (PTMP), the Trust in cooperation with its tenants and residents will continue to implement Best Management Practices that encourage water conservation, including, wherever practical, installation of low-flow toilets, shower fixtures, and faucet aerators as part of building rehabilitation projects. A grease trap will collect grease from restaurant kitchens prior to flow into the wastewater treatment system.

RECYCLED WATER IRRIGATION DEMAND

12. Wastewater Reuse Through Landscape Irrigation:

A water balance was prepared to estimate irrigation demands. The data is presented in Table 2 (Attachment 5). Applied irrigation demands were estimated by subtracting monthly precipitation from monthly evapotranspiration, assuming 80 percent efficiency for rainfall irrigation and 90 percent efficiency for applied irrigation. The estimated annual rainfall for a 10-year wet season occurrence interval is 20.4 inches. The total estimated irrigation demand by designated Recycled Water Use Areas at the Presidio is 105 acre-feet per year (AFY) in Phase 1 and 257 AFY at the end of Phase 2.

GROUNDWATER ISSUES

13. Nitrate loading from on-site wastewater disposal systems can potentially degrade ground water supplies. The groundwater at the Presidio associated with the designated Recycled Water Use Areas specified in this Order is not currently used as a drinking water supply (see Finding 15). The tertiary treatment unit is expected to produce less than 10 mg/l of nitrate-N in the effluent. Near complete nitrification and significant denitrification is expected. Nitrification is achieved in the aerobic reactor, which is highly aerated. Denitrification occurs in the anoxic reactor, by recirculating the nitrified effluent from the aerobic reactor and blending it with the influent wastewater. The proposed lined storage tank will prevent wastewater from infiltrating to groundwater and the subsurface irrigation system is designed to maximize nitrogen uptake and minimize nitrates from reaching groundwater. The combination of these factors is expected to significantly reduce any risk of nitrate contamination of the underlying groundwaters.

BASIN PLAN AND BENEFICIAL USES

14. The Board on June 21, 1995, adopted, in accordance with Section 13240 et. seq. of the California Water Code (CWC), a revised Water Quality Control Plan, San Francisco Bay Basin (Basin Plan). This updated and revised Basin Plan was approved by the State Water Resources Control Board and the Office of Administrative Law on July 20 and November 13, 1995, respectively. A summary of revisions to regulatory provisions is contained in 23 CCR 3912. The Basin Plan defines beneficial uses and water quality objectives for waters of State, including surface waters and groundwaters. This Order is in compliance with the Basin Plan.
15. The Basin Plan defines beneficial uses and water quality objectives for waters of the State within the San Francisco Bay Region, including surface and ground waters. None of the limited water bodies on the Presidio property are specifically identified in the Basin Plan. Lobos Creek, however, is a source of and used for Presidio drinking water, and the Trust's Domestic Water Supply Permit specifically prohibits the use of recycled water in the Lobos Creek watershed. The Basin Plan designates the groundwater beneath the Presidio's groundwater as a potential source of drinking water.
16. The proposed recycled water projects authorized under this Order do not pose any significant threat to water quality in the surface freshwater bodies identified in Finding 4, the Pacific Ocean, San Francisco Bay or to groundwater. The diversion of the Trust's wastewater from San Francisco's SEWPCP to land irrigation of highly treated (tertiary) recycled water not only reduces direct loading of pollutants to San Francisco Bay, but also provides additional environmental benefits as identified in Finding 2.

REGULATORY ISSUES AND APPLICATIONS

17. The proposed recycled water project is consistent with the PTMP, the Trust's Management Plan for Area B of the Presidio, approved August 2002. The project is also consistent with the General Management Plan Amendment (GMPA), approved by the NPS in 1994 and applicable to Area A of the Presidio. The Trust prepared an *Environmental Assessment* (EA) for *The Presidio Recycling Project* (2002), and issued a Finding of No Significant Impact in accordance with the requirements of the National Environmental Policy Act (NEPA).
18. Section 13523 of the California Water Code provides that a regional board, after consultation with and receipt of recommendations from the State Department of Health Services (DHS), shall prescribe water reclamation requirements for water that is used as recycled water. These water reuse requirements are in conformance with the recently adopted statewide water reclamation criteria. The Trust's, *Engineering Report for the Production, Distribution and Use of Recycled Water*, prepared by Kennedy/Jenks Consultants, December 2002, was approved by DHS without conditions in February 2003.
19. The proposed uses of recycled water will maintain and enhance natural resources, and thus this Order is categorically exempt from the provisions of Chapter 3 (CEQA) Division 6, Title 14 of the California Administration Code pursuant to Section 15301 of that Chapter.
20. The project as regulated by this Order will not have a significant adverse impact on water quality.
21. The Board has notified the Trust and interested agencies and persons of its intent to prescribe waste discharge requirements for the discharge and has provided them with the opportunity for a public hearing and opportunity to submit their written views and recommendations.
22. The Board, in a properly noticed public meeting, heard and considered all comments pertaining to the discharge.

IT IS HEREBY ORDERED that the Presidio Trust, in order to meet the provisions contained in Division 7 of the California Water Code and regulations adopted thereunder, shall comply with the following:

A. Prohibitions

1. The treatment, storage, distribution, or reuse of waste shall not create a nuisance or pollution as defined in the California Water Code.
2. The Treatment by the RWTP of waste other than domestic waste and waste from limited light industrial uses such as an equipment wash pad (equipped with an oil/water separator), a small commercial laundry, and general storage and warehouse uses is prohibited, unless appropriate pretreatment measures satisfactory to the Executive Officer are implemented to meet the requirements of this Order.
3. Discharges of any wastes including overflow, bypass, over-spray and runoff from treatment, transport, or disposal systems to adjacent drainage ways or adjacent properties not controlled by this Order is prohibited.
4. There shall be no bypass or overflow of untreated or partially treated wastewater to waters of the State from the Trust's collection, treatment, storage or disposal facilities.
5. The discharge of wastewater or use of recycled water shall not cause the degradation of groundwater or cause any change in a water quality parameter that would make the groundwater unsuitable for potential drinking water use.

6. Recycled water shall not be used as a domestic or animal water supply. There shall be no cross-connection between the potable water supply and piping containing reclaimed water. Supplementing recycled water with water used for domestic supply shall not be allowed except through an air-gap separation. Double check valve assemblies will be installed for backflow prevention on all potable water pipes serving buildings in which recycled water will be used for fire protection. These assemblies shall be tested at least once per year by the Trust in accordance with requirements of Section 7602(a) and 7603(a) of Title 17, CCR.
7. Recycled water shall not be applied to irrigation sites when soils are saturated, when conditions are such that runoff or excessive ponding is likely to occur, during rainfall, or when rainfall is expected to occur within 24 hours.
8. The peak daily flow to the wastewater treatment system shall not exceed 200,000 gpd in Phase 1 and 500,000 gpd in Phase 2.

B. Recycled Water Quality Specifications

1. The Trust shall assure that the recycled water discharged to the storage tank is at all times an adequately oxidized, disinfected tertiary treated wastewater that meets the following quality limits.

- a. The effluent discharged to the storage tank shall not exceed the following limits:

<u>Constituent</u>	<u>Unit</u>	<u>Daily Maximum</u>
1) BOD ₅	mg/l	10
2) TSS	mg/l	10
3) Oil & Grease	mg/l	10
4) Nitrate Nitrogen as N	mg/l	10

- b. Turbidity: Turbidity is to not exceed 0.2 NTU more than 5% of the time within a 24-hour period and not exceed 0.5 NTU at any time.
- c. pH: The pH of the discharge shall not exceed 9.0 nor be less than 6.5
- d. Total Coliform Bacteria:

The treated wastewater shall meet the following limits of bacteriological quality:

The moving median value for the most Probable Number (MPN) of total coliform bacteria in any five consecutive samples shall not exceed 2.2 MPN/100 ml; and any single sample shall not exceed 23 MPN/100 ml when verified by a repeat sample taken within 48 hours.

2. Following the recycled water storage tank sodium hypochlorite will be used to provide a disinfection residual to control the growth of filamentous organisms and formation of bio-slime in the recycled water pipelines and irrigation systems.
3. The Trust shall discontinue the pumping of recycled water to the storage tank during any period when there is reason to believe that the limits specified in B.1.above are not being met. The pumping of recycled water shall not be resumed until all conditions that caused the limits specified in B.1. to be violated have been corrected.

4. The Trust shall provide the Board documentation that it has:
 - a. A qualified wastewater treatment “Operator” at the Presidio or on-call to oversee the wastewater treatment and disposal system(s). The Operator must be adequately trained to oversee daily operation of a tertiary recycled wastewater treatment facility; and
 - b. A ‘contingency’ contract, if needed, with an outside certified wastewater treatment operator that can respond promptly, at the request of the Trust, to any emergency or operating problem at the wastewater treatment facility.

C. Recycled Water Use Specifications

1. Recycled water will not be provided to any unit intended for human habitation unless the Trust obtains DHS approval for installation of dual plumbing systems in accordance with CCR Titles’ 22 and 17.
2. Designated Recycled Water Use Areas and recycled water irrigation will be managed and maintained in accordance with sound irrigation practices such that:
 - a. Irrigation practices will minimize any reasonable avoidable loss of recycled water from the irrigated areas. Recycled water will not be allowed to escape from the Recycled Water Use Areas by airborne spray or subsurface flow except in minor amounts such as are associated with sound irrigation practices.
 - b. Spray, mist or runoff will not enter dwellings, designated outdoor eating areas, or food handling facilities.
 - c. Drinking water fountains will be protected against contact with recycled water spray, mist or runoff.
3. The Trust shall adequately post signs informing the public that recycled water is being used for landscape irrigation in the designated Recycled Water Use Areas. Signs will be posted in areas where the recycled water is accessible to workers and the public, such as decorative fountains and where spray irrigation is conducted. These signs will be at least four inches high by eight inches wide, and include the following wording at a minimum: “RECYCLED WATER – DO NOT DRINK”. Each sign shall display an international “Do Not Drink” symbol. Placement of signage is site specific but must provide adequate means of notification to inform workers and the public that recycled water is being used. At a minimum signs are to be placed at public access points to an irrigated site and near other uses (i.e. decorative fountains, etc.).
4. Where possible, recycled water pipes will be installed at least ten feet horizontally from and one foot lower than the potable water pipes. Where a ten-foot horizontal separation cannot be achieved, a minimum horizontal separation of four feet will be maintained. At locations where this horizontal separation is between four feet and ten feet, special pipe will be used, as defined in the DHS *Criteria for the Separation of Water Mains from Sanitary Sewers and Pipes Carrying Reclaimed Water*. In addition, at locations where the horizontal separation is between four feet and ten feet, recycled water pipes will be at least one foot below potable water pipes, and trench tape will be used in the potable water system trenches. Where recycled water pipes and potable water pipes cross, recycled water pipes will be installed at least one foot below potable water pipes. The Trust will own all water, sewer, recycled water and storm drain utilities. The Trust is responsible for managing its facilities, and no alterations by tenants to utilities, building plumbing, or irrigation systems will be allowed without specific Trust approval. Operations and

maintenance personnel involved with utilities, plumbing, and irrigation systems will be educated on the importance of keeping the recycled and potable water systems strictly separated. The recycled pipelines shall be colored purple in accordance with Title 22 requirements.

5. The landscape irrigation programs shall be managed to prevent surface ponding of water or other conditions, which would provide a breeding area for mosquitoes, or other vectors of health significance, and to prevent the creation of odors, slimes, or unsightly deposits.
6. **Recycled Water Irrigation Manual.**

The Trust shall submit, acceptable to the Executive Officer, a **Recycled Water Irrigation Manual** to the Regional Board 60 days prior to distribution of recycled water to Designated Recycled Water Reuse Areas in Phase I. The Manual shall be updated as additional water reuse sites are brought online under Phase II. The Manual shall describe the landscape irrigation system, type of landscaping/flora to be maintained by the irrigation system, and operation and maintenance of the entire water reuse system.

D. Provisions

1. The Trust shall comply with all sections of this Order immediately upon commencement of discharge.
2. The Trust shall maintain a copy of this Order at the RWTP so that it will be available at all times to personnel operating and maintaining waste treatment and reuse facilities. A copy will also be provided to users supplied by and governed by a separate user agreement with the Trust.
3. The Trust shall maintain in good working order and operate as efficiently as possible any treatment, disposal, and monitoring facility or control system installed by the Trust to achieve compliance with these waste discharge requirements.
4. The Trust shall comply with the attached self-monitoring program (SMP) (Attachment 6) as adopted by the Board and as may be amended by the Executive Officer. The Trust will require its users to submit on-site observation reports, use data, and evidence of violations to the Trust, and the information submitted will be incorporated by the Trust into the reports filed under the SMP. The Trust will be responsible for submitting all the necessary SMP reports to the Regional Board.
5. The Trust shall designate a "Recycled Water Supervisor" to be responsible for managing the RWTP Operator specified in Provision B.3.a and designate backup personnel in the event the Operator is unavailable or cannot respond. Both the Operator and designated backup personnel shall be capable of repairing, maintaining, and operating the recycled water system according to the conditions in this Order, in order to prevent potential public health hazards and shall have sufficient training in wastewater treatment to oversee the daily operation of the recycled water system and to handle minor emergencies. However, if major problems occur and cannot be corrected by the Trust within a reasonable time, the Trust will be responsible for contacting a certified "Operator" for system corrections (see Provision: B.3.b).
6. The Trust shall be responsible for authorizing users, pursuant to separate user agreements with the Trust, to operate, repair and maintain recycled water irrigation systems supplied by the project according to the conditions in this Order, in order to prevent potential public health hazards.

7. Inspection, supervision, and employee training shall be provided by the Trust to assure proper operation of the RWTP collection, treatment and distribution system and related user facilities and to provide proper worker protection. A complete Record of inspections and training shall be maintained by the Trust.
8. The Trust shall implement a program to regularly review and evaluate its wastewater collection, treatment and disposal facilities in order to ensure that all facilities are adequately staffed, supervised, operated, maintained, and repaired as necessary, in order to provide adequate and reliable treatment, and disposal of all wastewater. A **Treatment Facilities Evaluation Program** report discussing the status of this evaluation program, including any recommended or planned actions, shall be submitted to the Board by **April 30** of each year.
9. The Trust shall submit, acceptable to the Executive Officer, to the Board an **Operational and Maintenance Manual** for the entire wastewater treatment and disposal facilities 60 days prior to startup of the RWTP. All personnel responsible for operation and maintenance of the wastewater treatment and reusel facilities shall be provided with a copy of the accepted Operation and Maintenance Manual.
10. In the event the Trust is unable to comply with any of the conditions of the Order due to:
 - a. Breakdown of wastewater treatment/transport equipment;
 - b. Accidents caused by human error or negligence; or
 - c. Other causes such as acts of nature;

the Trust shall notify the Board by telephone as soon as the Trust or its agents have knowledge of the incident. Written confirmation of this notification shall be submitted within two weeks of the telephone notification. The written notification shall include pertinent information explaining reasons for the non-compliance and shall indicate what steps were taken to correct the problem and the dates thereof, and what steps are being taken to prevent the problem from recurring.

11. The Trust shall permit the Regional Board or its authorized representative in accordance with California Water Code Section 13267(c):
 - a. Entry upon premises where a regulated facility or activity is located or conducted, or where records are kept under the conditions of this Order;
 - b. Access to and copy of, at reasonable times, any records required to be kept under the terms and conditions of this Order;
 - c. Inspection, at reasonable times, of any facility, equipment (including monitoring and control equipment), practices, or operations regulated or required under this Order; or
 - d. To photograph, sample or monitor, at reasonable times, for the purpose of assuring compliance with this Order.
12. In the event of any change in control or ownership of the land or the waste discharge facilities presently owned or controlled by the Trust, the Trust shall notify the succeeding owner or operator of the existence of this Order by a letter, a copy of which shall be forwarded to the Board.
13. This Board will review this Order periodically and may revise the requirements as necessary to comply with changing State and Federal laws, regulations, policies, or guidelines; changes in this Board's Basin Plan; or changes in the discharge characteristics.

14. After notice and opportunity for a hearing, this Order may be terminated or modified for cause including, but not limited to:
- a. Violation of any term or condition contained in this Order;
 - b. Obtaining this Order by misrepresentation, or failure to disclose fully all-relevant facts;
 - c. A change in any condition that requires either a temporary or permanent reduction or elimination of the authorized reuse; or
 - d. Endangerment to public health or environment that can only be regulated to acceptable levels by Order modifications or termination.

I, Bruce H. Wolfe, Executive Officer, do hereby certify the foregoing is a full, true, and correct copy of the Order adopted by the California Regional Water Quality Control Board, San Francisco Bay Region, on January 21, 2004.

Bruce H. Wolfe
Executive Officer

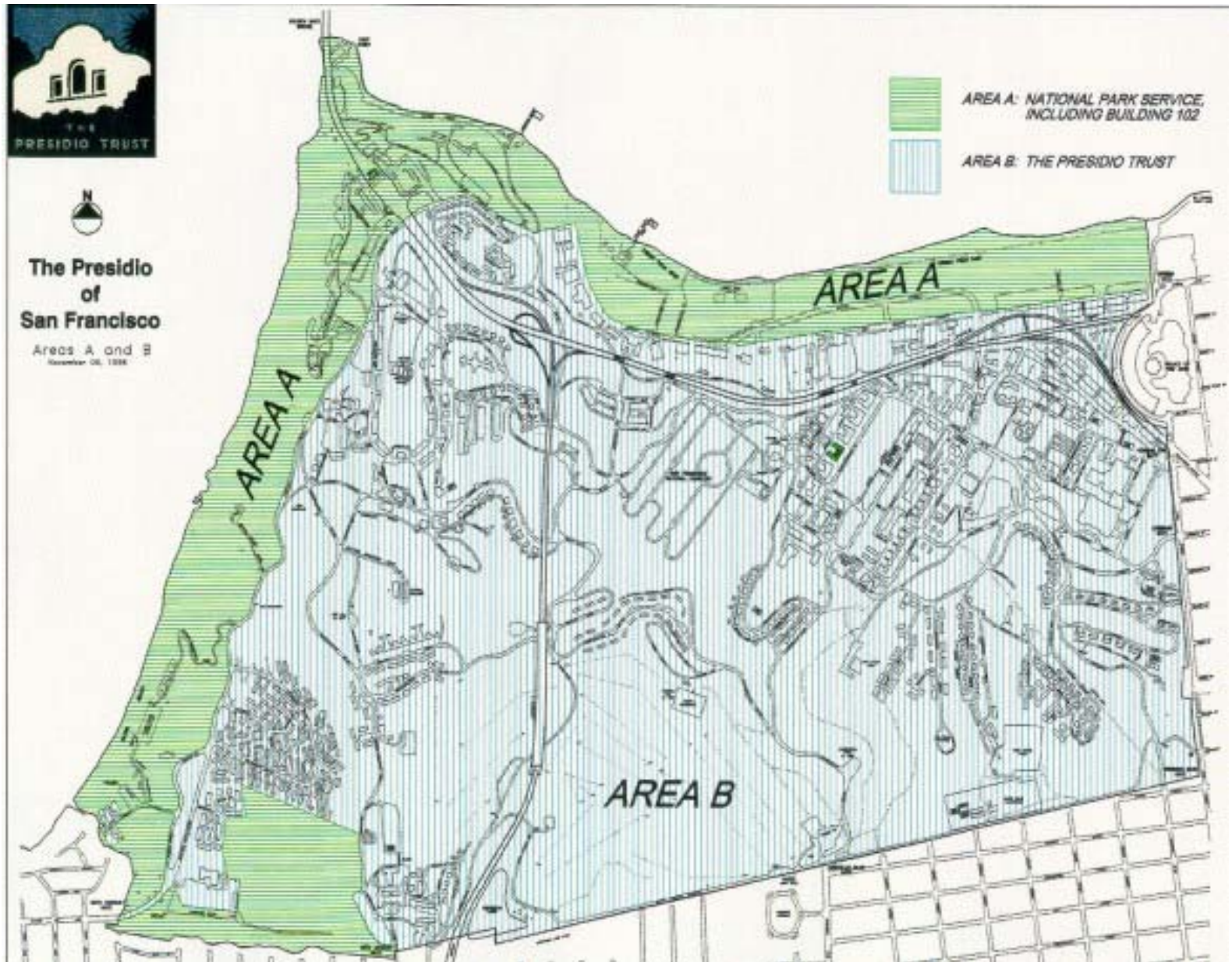
Attachments:

- 1. Location Map, Figure 1
- 2. Recycled Water Use Areas, Figure 2
- 3. Wastewater Treatment Flow Schematic, Figure 3
- 4. RWTP Design Criteria, Table 1
- 5. Site Water Balance Data, Table 2
- 6. Self-Monitoring Program

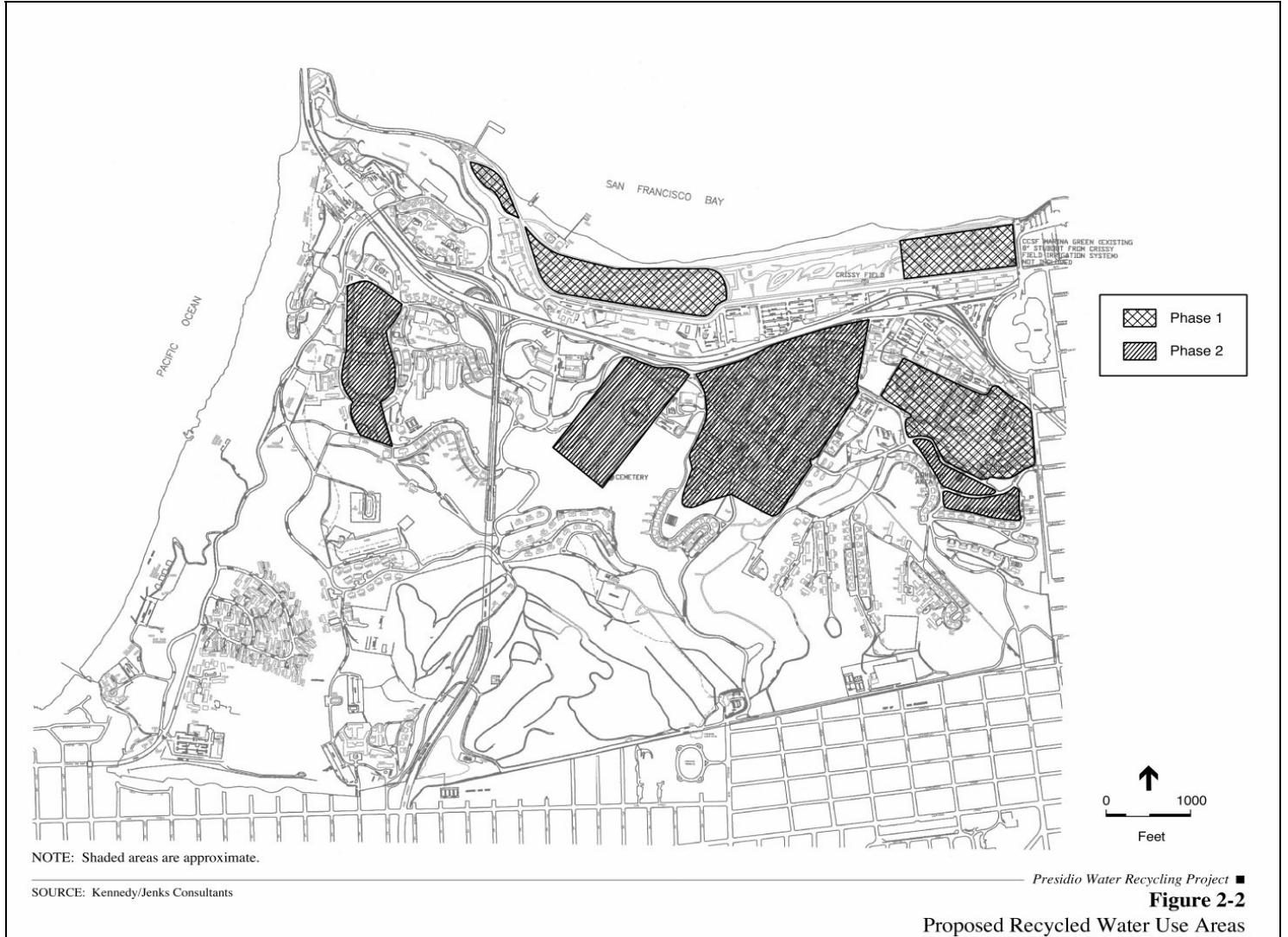
File No. 2169.6056

Originator: RJC

ATTACHEMENT 1
Figure 1 – Location Map



ATTACHMENT 2
Figure 2 - Recycled Water Reuse Areas



The designation of Phase I and Phase II Use Areas is not intended to be restrictive; a Use Area may become part of a different project phase, provided that the alternate Use Area is supplied and managed in accordance with the terms of this Order.

ATTACHMENT 4

Table 1 – Presidio Recycled Water Treatment Plant Design Criteria

Item	Units	Phase 1	Phase 2
1. RAW WATER			
A. Plant Flow Rate			
Average Day – Summer	GPD	200,000	500,000
Average Day – Winter	GPD	0 – 30,000	0 – 30,000
Peaking Factor	–	1.5	1.2
Peak 8-Hour Flow Rate	GPD	300,000	600,000
B. Water Quality Parameters			
BOD₅			
Influent	mg/L	220	260
Effluent	mg/L	10	10
TSS			
Influent	mg/L	490	490
Effluent	mg/L	10	10
Nitrogen			
Influent	mg/L	70	70
Effluent	mg/L	<10	<10
Phosphorus			
Influent	mg/L	9	9
Effluent	mg/L	< 10 ¹	<10
2. ROTARY FINE SCREEN			
Number	number	1	2
Maximum Flow Rate (Total)	gpd	300,000	600,000
Opening Size ²	mm	2	2
3. ANOXIC-AEROBIC TANKS			
Tanks ²	number	2	3
Compartments per Tanks ²	number	2	2
Total Volume ²	gallons	143,000	214,500
Hydraulic Retention Time @ 200,000 gpd Phase 1/500,000 gpd Phase 2 ²	hours	17.9	10.7
Sludge Retention Time (SRT) ²	days	38	23
Design MLSS ²	mg/l	10,000	10,000
4. ULTRAFILTER MEMBRANES			
Pore Size ²	micron	0.1 to 0.4	0.1 to 0.4
Flux Rate (max) ²	gfd	20	20
6. UV DISINFECTION			
UV Transmittance	%	65	65
Design Dose	mJ/cm ²	80	80
Number of Trains	number ²	2	4
Number of Reactors per Train	number ²	2	2
Operation	–	Parallel	Parallel
Flow per Reactor at Design Flow	MGD	0.3	0.6
Redundancy	percent	100	100
7. SODIUM HYPOCHLORITE STORAGE AND FEED SYSTEMS			
Typical Dosage – Avg./Max. ³	Mg/L	3.5/5	3.5/5
Maximum Dosage – Avg./Max. ³	Mg/L	5/20	5/20
Typical Use – Avg./Max.	ppd	7.8/18.7	19.5/37.3
Feed Pump	number	2	3
Capacity (each)	gallons/hour	0.03 – 1.3	0.2 – 1.3
Storage	gallons	350	700

Item	Units	Phase 1	Phase 2
Supply at Avg. Dose/ Avg. Flow ⁴	days	42	34
Supply at Avg. Dose/ Max. Flow ⁴	days	21	17

¹ Expected values with normal biotreatment.

² Criteria determined by MBR manufacturer, range given represents range of manufacturer valves.

³ Typical dosage for disinfection residual will be standard, maximum dosage will only be periodically used for odor suppression, filamentous organism suppression, and bioslime prevention. Backup pump(s) will be used to provide the maximum dosage.

⁴ Assumes 95 percent of tank volume is usable.

ATTACHMENT 5

Table 3 – Water Balance

The Water Balance will be provided by Monday, December 15.

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION

SELF-MONITORING PROGRAM

for

Presidio Trust
City and County of San Francisco, California

ORDER No. R2-2004-

January 21, 2004

I. GENERAL

Reporting responsibilities of waste dischargers are specified in Sections 13225(a), 13267(b), 13268, 13383, and 13387(b) of the California Water Code.

The principal purposes of a monitoring program by a waste discharger, also referred to as a self-monitoring program, are:

1. To document compliance with wastewater requirements and prohibitions established by this Regional Board; and
2. To facilitate self-policing by the discharger in the prevention and abatement of pollution arising from wastewater treatment and disposal.

II. SAMPLING AND ANALYTICAL METHODS

Sample collection, storage, and analyses shall be performed according to Code of Federal Regulations Title 40, Section 136 (40 CFR S136), or other methods approved and specified by the Executive Officer of this Regional Board.

Wastewater analyses shall be performed by a laboratory approved for these analyses by the State Department of Health Services (DHS), or a laboratory waived by the Executive Officer from obtaining a DHS certification for these analyses.

The director of the laboratory whose name appears on the certification, or his/her laboratory supervisor who is directly responsible for the analytical work performed shall supervise all analytical work including appropriate quality assurance/quality control procedures in his/her laboratory and shall sign all reports of such work submitted to the Regional Board.

All monitoring instruments and equipment shall be properly calibrated and maintained to ensure accuracy of measurements.

III. DEFINITION OF TERMS

RESPONSIBLE ENTITIES

1. Producer: Presidio Trust (Trust) has jurisdiction over the Presidio Area B, and is the recycled water producer and User within Area B. The Trust as producer is responsible for the quality of the recycled water released for distribution and for the operation and maintenance of the recycled water use facilities on site. The Trust is responsible for submittal of the required monitoring reports to the Regional Board.
2. The National Park Service (NPS) has jurisdiction over the Presidio Area A, and is the User at the Crissy Field Recycled Water User Area. The NPS is responsible for operation and maintenance of the recycled water use facilities within its jurisdiction. The NPS will submit self-monitoring data to the Trust to be incorporated into the Trust's SMP, and this requirement will be incorporated into a user agreement entered into between the Trust and NPS.

SAMPLES

1. A grab sample is an individual sample collected in a short period of time not exceeding 15 minutes. Grab samples represent only conditions existing at the time of sample collection. Grab samples are used primarily in determining compliance with daily or instantaneous maximum limits.
2. A flow sample is the accurate measurement of the average flow volume over a given period of time, using a properly calibrated and maintained flow measuring device. Flows calculated from properly maintained pump usage records for accurately calibrated pumps are acceptable.

STANDARD OBSERVATIONS

1. Recycled Water Use Areas
 - (a) Evidence of recycled water escaping the recycled water use area through surface runoff or airborne spray (show affected area on a sketch)
 - (b) Nuisance odor from pond: If present, indicate apparent cause, characterization, direction of travel, and any public use area or off-site facility affected.
 - (c) Evidence of prolonged ponding of recycled water, or of mosquitoes breeding within the use area due to ponding.
- (1) Observations recorded and reported along irrigation distribution system for broken or poorly adjusted spray equipment.

IV. DESCRIPTION OF SAMPLING AND OBSERVATIONS

NOTE: A sketch showing locations of all stations described below shall accompany the first monitoring report, and subsequent reports when locations are added or changed, or a violation is reported.

(1) WASTEWATER TREATMENT SYSTEM (Presidio Trust)

STATION DESCRIPTION

- A-1 At a point prior to the wastewater treatment system
- E-1 At a point in the wastewater system following the tertiary treatment system, following disinfection, and prior to the distribution system.

(2) RECYCLED WATER USE AREA (Trust -T/Users-U)

STATION DESCRIPTION

T-1 thru T-‘n’ (Presidio Trust)	Located at about 300 foot intervals around the perimeter of the recycled water use areas (Obs. Intervals adjusted to area being irrigated).
U-1 thru U-‘n’ (NPS)	Located at about 300 foot intervals around the perimeter of the recycled water use area (Obs. Intervals adjusted to area being irrigated).

V. SCHEDULE OF SAMPLING, ANALYSES AND OBSERVATIONS

Sampling, analyses and observations shall be conducted according to the schedule given in Table 1 and Table 1 Footnotes (SMP Attachment A).

Interim System Monitoring

To document that the new wastewater treatment and distribution system is working effectively, the chemical and coliform sampling and analyses program (see Table 1) shall be performed on a more frequent basis after initial start-up until a stable and consistent system performance is demonstrated.

VI. GENERAL OPERATION and MAINTENANCE (O&M)

1. The **O & M Manual** shall include scheduling of specific tasks to ensure the treatment and distribution systems will consistently and reliably perform according to the design criteria. All monitoring practices identified in the O&M Manual must be implemented
2. **Grease Interceptor:** Carryover of excessive concentrations of grease can be especially damaging to the irrigation system. as often as needed: at least weekly for the first month or until stable operations are demonstrated. Grease will be controlled before entry into the sanitary sewer system. The treatment system will be monitored for grease and cleaned as needed

VII. REPORTS TO BE FILED WITH THE REGIONAL BOARD

A. Self-Monitoring Reports (SMR)

Written reports shall be filed for each calendar month. Reports shall be submitted to this Regional Board’s office no later than the fifteenth day of the following month. Each SMR shall include the following:

1. Letter of Transmittal, including:
 - (a). Discharger’s name, address, phone number & contact person;
 - (b). The monitoring period being reported, by month and year;
 - (c). The name of the responsible Regional Board staff member;
 - (d). Discussion of violations found during the monitoring period, including causes and corrective actions taken or planned in order to prevent future violations;
 - (e). Discussion of any special events pertinent to maintaining compliance with water reuse requirements, such as equipment repair or replacement, or operational changes;
 - (f). Signatory statement by the Discharger or authorized agent, under penalty of perjury, that to the best of the signer’s knowledge the report is true, accurate and complete

2. Letter of Transmittal, including Results of Analyses and Observations, including:

- (a). Tabulations of the results from all required sampling and analyses specified in Table 1 and its Footnotes (SMP Attachment A) by date, sample type and station.
- (b). Recycled Water Irrigation Report

B. Report of Permit Violation

In the event the Discharger violates, or threatens to violate the conditions of water reuse requirements due to:

- 1. Maintenance work, power failure, or breakdown of wastewater treatment or transport equipment;
- 2. Accidents caused by human error or negligence; or
- 3. Other causes such as acts of nature,

The Discharger shall:

- (a). Notify the Regional Board office by telephone, as soon as the Presidio Trust, or agent, has knowledge of the event; and
- (b). Submit a written report is within two weeks of the event. The written report shall include pertinent information explaining reasons for the non-compliance, actions taken to correct the problem and dates thereof, and actions being taken to prevent the problems from recurring.

I, Bruce H. Wolfe, Executive Officer, do hereby certify that the foregoing Self-monitoring Program is effective on the date shown below and may be reviewed at any time subsequent to the effective date upon written notice from the Executive Officer or request from the Presidio Trust.

Bruce H. Wolfe
Executive Officer

Effective Date: January 21, 2004

SMP Attachments

- (1) Table 1: Schedule for Sampling, Analyses and Observations

**PRESIDIO TRUST of SAN FRANCISCO
Self-Monitoring Program, Attachment A**

TABLE 1

**SCHEDULE FOR SAMPLING, MEASUREMENTS, AND ANALYSIS
LEGEND FOR TABLE 1:**

Sampling Station		A-1	E-1	T/U	
Type of Sample		C	G	C/G	Ob
Parameter,	Units				(1)
Flow Rate	(mgd)	X			
BOD _s			W	W	
(mgL/)					
Tot. Susp. Solids			W	W	
(mg/L)					
Tot. inorganic Nitrogen	(mg/l)		W	W	
Total Coliform	(MPN/100ml)			2/W	
Turbidity	(NTU)			X	
pH	(units)		D	D	
D.O.	(mg/L)			D	
Standard Observations					2/W

Types of Samples

Frequency of Sampling

G = grab sample

C= Continuously Measured

Ob = Observations

D

Once each day

W

Once each week

2/W

Two days per week

X

Continuously Monitored by flow meter

Type of Stations

A = Treatment Plant Influent

E-1 = Effluent from Treatment Plant Effluent

E-2 = Effluent from Recycled Water Storage Tank

RP = (Producer)/RU(User) = Irrigation Site Observations

Notes:

(1) Measurements and analyses required only when effluent is discharged to the irrigation sites.

Appendix J: Potential Funding Sources for Local Pubic Agencies

Water Recycling Grants

1. Proposition 50, Chapter 5, Section 79540:
 - Administered by SWRCB
 - Total \$100M available
 - No info. available on RFP release date (I'm contacting SWRCB to clarify)
 - \$ may be linked to existing SWRCB's "Water Recycling Construction Program" and "Water Recycling Facilities Planning Grant Program". For more info., go to <http://www.swrcb.ca.gov/recycling/recyfund/index.html>
2. Proposition 50, Chapter 7, Section (g):
 - Administered by CA Bay-Delta Authority
 - Must show benefits to CA Bay-Delta Authority's Solution Area (Bay-Delta system, Sacramento Valley, San Joaquin Valley, and Southern California)
 - FY03-04 \$ allocated to water conservation only thus water recycling \$ might become available in FY04-05 or FY05-06
 - For more info, go to http://www.owue.water.ca.gov/docs/2004WUEPSP_rev12-18-03release.doc
3. Proposition 50, Chapter 8:
 - Administered by DWR and SWRCB
 - Projects must be in compliance with an adopted Integrated Water Management Plan
 - No news on RFP release (contacting DWR)
4. State Revolving Fund
 - Low interest loans
 - For more info, go to <http://www.swrcb.ca.gov/recycling/recyfund/guide.pdf> or <http://www.swrcb.ca.gov/recycling/recyfund/index.html>
5. U.S. Bureau of Reclamation Title XVI
 - <http://www.usbr.gov/pmts/writing/guidelines/>
6. Proposition 82 Local Water Supply Project Construction Loan Application
 - Construction and feasibility study loans for development of local water supplies.
 - Max. \$5M for construction projects
 - Max. \$500,000 for feasibility studies
 - <http://www.dpla2.water.ca.gov/grants-loans/pdfs/ConstructionLoan.pdf>
 - Continuous program (no deadline)

