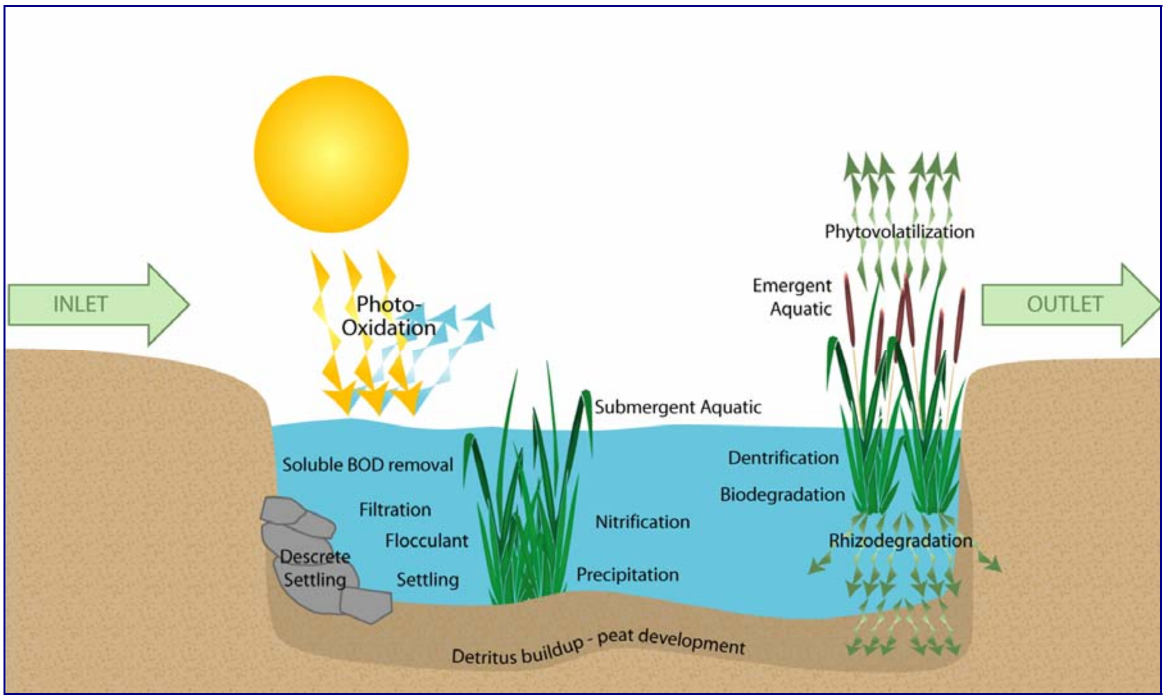
5.3 Vista Grande Wetland

5.3.1 An Overview of Constructed Stormwater Wetlands

Natural wetlands are one of the most diverse and productive ecosystems on the earth. Not only do they provide habitat for many plants and animals, they also provide important benefits to ecosystems. Water quality enhancement, through filtration and microbial breakdown of pollutants, is one of the most important benefits that natural wetlands provide. Constructed stormwater wetlands are designed to mimic and improve on the treatment mechanisms of natural wetlands to provide effective treatment of stormwater runoff.

Constructed wetlands remove pollutants through a variety of mechanisms. Abundant vegetation throughout the wetland causes the velocity of stormwater flowing into the wetland to drop, allowing many of the suspended solids to settle out, absorb to wetland sediments, or be trapped by the vegetation. In addition to the physical removal of pollutants, biological processes play an important role in improving water quality. For example, microorganisms breakdown pollutants, transforming them into less soluble forms that can be used by the wetland plants. Typical processes occurring in a wetland are illustrated in Figure 5-19. Through these mechanisms, constructed wetlands effectively treat stormwater while providing additional watershed benefits including increased habitat and recreational opportunities.

Figure 5-19: Typical Processes Occurring in a Treatment Wetland



5.3.2 Vista Grande Wetland Project Description and Location

As described in Chapter 1, the 10-year, 4-hour storm in the Vista Grande Watershed produces approximately 1,300 cfs of runoff each year. In order to treat this entire flow volume using a constructed wetland a very large area would be required (as much as 2,500 acres). Since Daly City and San Francisco are developed areas where land availability is limited and land acquisition costs are high, building a wetland to treat all of the stormwater from the Vista Grande watershed would be infeasible.

The Vista Grande Wetland (the wetland) would provide an aesthetically pleasing method to treat a portion of the stormwater from the Vista Grande watershed to augment the water levels of Lake Merced. The wetland would be located along the existing Vista Grande canal, between John Muir Drive and the

Olympic Club (Figure 5-21). Stormwater would be diverted from the inlet structure of the new tunnel into the wetland, where it will be treated before being discharged into South Lake. Approximately eight acres of land are available in this area for the construction of the wetland if the existing Vista Grande canal is abandoned after implementation of the Tunnel South of County Line (as described in Section 5.2).

This site is ideal for a constructed treatment wetland. Its elongated shape encourages plug-flow through the wetland and helps prevent stormwater from short-circuiting wetland features. It is located outside of existing natural waterways, avoiding damage to natural wetland areas and other aquatic resources. It is located nearby existing wetland habitat, providing an extension of this habitat to the local and migratory bird populations. In addition, this site's proximity to Lake Merced will minimize conveyance costs of treated water, making this location well suited for a lake level enhancement project. Finally, developing a wetland on this site will restore beneficial uses to this area once the existing Vista Grande canal is abandoned.

5.3.3 Objectives

The Vista Grande Wetland would meet many of the primary and secondary objectives developed for this watershed study including Lake Merced lake level enhancement, habitat protection, groundwater recharge, recreation, and public education opportunities.

The primary objective of the wetland is to supply water of an acceptable quality and quantity to augment the water levels of Lake Merced. In addition, the wetland would provide additional habitat for local and migratory birds adjacent to existing habitat along Lake Merced. It would protect existing recreational activities and provide additional educational opportunities for school groups and the general public. Overall, the Vista Grande Wetland would meet several project objectives, providing multi-faceted benefits and enhancing watershed activities.

5.3.4 Design Assumptions

The Vista Grande Wetland conceptual design consists of three cells, each approximately 1,100 feet long. The water would be pumped from a proposed concrete box where the existing 24-inch storm drain, the 60-inch storm drain and the 7-foot by 8-foot box culvert would discharge into the proposed Tunnel South of County Line. Flow control facilities installed at the concrete box would limit stormwater flows into the wetland to a maximum of 2.0 mgd (3.1cfs). The inlet to the wetland would be above the invert of the tunnel inlet structure so stormwater would need to be pumped into the wetland. Flows from the concrete basin would be pumped to the settling basin via an 8-inch pipeline. The 80-foot long, 5-foot deep settling basin would provide approximately 4 hours of residence time. Downstream of the settling basin, stormwater would flow by gravity into Cell No.1. Consecutive cells would be separated by a three to five foot high, fifteen foot wide berm (top width) and connected via three 8-inch pipelines located two feet above the cell invert, ensuring a cell depth of two feet. Water from one cell would overflow into the next cell when the water rises above two feet. The three 8-inch pipelines between the cells would be spaced equally to prevent short-circuiting within each cell. It is assumed that water from Cell No. 3 would flow by gravity into South Lake through the existing Lake Merced overflow structure.

5.3.5 Preliminary Layout

The proposed Vista Grande Wetland would be located between the northeast limits of the Olympic Golf Course and John Muir Drive, along 3,600 feet of the existing Vista Grande canal. The wetland encompasses approximately 8 acres. Cell No.1 and No. 3 would be planted with cattail, while Cell No. 2 would be planted with bulrush. Native bulrush and cattail species are preferred for use in the wetland. If it is determined that the bulrush and cattail species that are present at Lake Merced are unique from other native bulrush and cattail species in California, seeds or starts from Lake Merced species could be used in the wetland.

The cattail in Cell No. 1 and the bulrush in Cell No. 2 would be broken up by a deep open-water pool in each cell. In addition to the design elements discussed above, an access road located on the northeast edge of the wetland, southwest of John Muir Boulevard, would provide maintenance access along the wetland cells and berms. A 10-foot buffer would be introduced between John Muir Drive and the northeast edge of the wetland. A traffic barrier would be installed between the buffer and the access road. The 10-foot buffer would remove a five foot wide corridor from John Muir Boulevard. Narrowing John Muir Boulevard would serve the dual purpose of slowing traffic along this corridor, and providing additional area for the wetland. The layout for the wetland is provided in Figure 5-22.

Figure 5-20: Cattail and Bulrush

The Vista Grande Wetland depth, invert elevations and water levels are illustrated in the profile shown in Figure 5-23**.** Cross-sections of the Vista Grande Wetland at station 0+00 and 35+00 are provided in Figure 5-24. The data used as the basis for Figures 5-18 and 5-19 come from a series of sources, including field observation by RMC and existing reports. This level of data was appropriate for a planning level analysis but will need to be refined for further evaluations. As is illustrated in Figure 5-24, slopes of 2:1 (horizontal: vertical) were assumed along the cells. Slopes of 3:1 were considered for each berm. After slope adjustments, the wetland area available for treatment is estimated to be approximately 5.5 acres. The full-water depth in the wetland was set at two feet, in general, to enhance plant growth and provide sufficient volume to provide effective treatment. The corresponding wetland volume will be 11 AF.

Two alternatives were evaluated for the Vista Grande Wetland. Alternative A, discussed above, is located close to the existing road level, above the existing canal, providing a more aesthetic, accessible wetland which minimizes excavation costs. Alternative B is a passive wetland system, where the first cell of the wetland begins below the new tunnel invert so that stormwater can be conveyed into the wetland via gravity. A brief discussion of Alternative B is provided as follows, and associated profile and cross-sections for Alternative B are provided in Appendix F.

- The wetland invert would be 13 feet to 8 feet lower than John Muir Drive. Such a significant elevation drop over a short distance could pose a potential hazard for vehicles and pedestrians along John Muir Drive.
- The steep drop in elevation between John Muir Boulevard and the Vista Grande canal would require significant excavation. Additionally, a retaining wall would be needed along the access road, resulting in an estimated cost twice as high as the estimated cost for Alternative A.
- Because of the 2:1 slope requirements, a significant portion of the wetland area would be unusable. After adjusting the area to exclude the slopes, the wetland would cover about 2.25 acres; this would correspond to a volume of 4.5 AF, significantly lower than the 11 AF of Alternative A.

For these reasons, Alternative B is not the recommended alternative and is not further discussed in this document.

5.3.6 Water Quality Considerations and Treatment Characteristics

The water quality of the source and receiving waters must be considered in the design of the Vista Grande Wetland. The following describes the water quality of Vista Grande stormwater, the primary source water for the Vista Grande Wetland, and South Lake, the receiving water for treated wetland effluent. Based on the source water characteristics and receiving water quality requirements, the treatment characteristics of the wetland can be defined. Baseline concentrations of critical constituents in South Lake and Vista Grande stormwater are summarized in Table 5-8.

Table 5-8 Baseline Average Concentrations of Critical Constituents

Water Quality Parameter	Units	South Lake [a]	Vista Grande Canal Stormwater [a]
Alkalinity	mg/L	195	48.7
Ammonia (NH_3-N)	mg/L	0.05	0.7
Biochemical Oxygen Demand	mg/L	--	<3 - 22.0
Chlorophyll “a”	mg/L	0.029[b]	--
Dissolved Oxygen	mg/L	0.1-11.2	5.4-10.8
Hardness	mg/L	209	106
Nitrate	mg/L	0.02	2.3
pH		7.5-8.7	7.1-8.6
TDS	mg/L	414	41.5
Temperature	^oF	51.1-70.9	55.0-63.1
Total Coliform	MPN/100mL	0-2500[d]	126,421
Total Nitrogen	mg/L	3.69	6.7
Total Organic Nitrogen	mg/L	3.61[c]	--
Total Phosphorus	mg/L	0.16	0.4
TSS	mg/L	--	153
Turbidity	NTU	11.6	51

a. (EDAW, September 2004a), Table 4-14, except where noted
b. (EDAW, September 2004a), Table 2-4
c. (EDAW, September 2004a), Table 2-3
d. (EDAW, September 2004b), Table 2-21

South Lake Water Quality

Lake Merced, including South Lake, is one of the most significant natural resources of the San Francisco peninsula (CH2M Hill, 2001). It is a major recreational area and provides habitat for surrounding wildlife. Over time, urbanization and other human activities have increased the pollutants that flow into Lake Merced. Increased rates of nutrient addition, in particular those of nitrogen (N) and phosphorus (P), have contributed to algal blooms and decreased clarity (CH2M Hill, 2001). In addition, Lake Merced is listed as an impaired water body with respect to dissolved oxygen and pH (EPA, 2002). The critical constituents for South Lake’s water quality are shown in Table 5-8.

The concentration of algae, measured by chlorophyll “a”, is the primary indicator of water quality used to assess the water quality of the wetland. In most lakes, algal growth is controlled by either concentrations or nitrogen. The limiting nutrient can be determined by looking at the ratio of nitrogen to phosphorus (N:P ratio). Traditionally, this ratio is calculated using the total nitrogen and the total phosphorus concentration. However, high concentrations of organic nitrogen, which is not is easily used by algae or other organisms, can distort this ratio. In lakes that have high levels of organic nitrogen, it is more appropriate to use the ratio of the total bioavailable nitrogen to the total bioavailable phosphorus (Horne, 2005). The bioavailability of different forms of nitrogen and phosphorus, as wells as the N:P ratios for both the bioavailable and total concentrations of these nutrients is shown in Table 5-9.

Table 5-9 N:P Ratios for South Lake

Nutrient	Concentration (mg/L) [a]	Bioavailability	Total Bioavailable Concentration (mg/L)
Nitrate	0.02	High	0.02
Ammonia	0.05	High	0.05
Organic Nitrogen	3.61	Unavailable	0
Total Nitrogen	3.69	Mostly Unavailable	0.07
Total Bioavailable Nitrogen			**0.07**
Total Phosphorus	0.16	~80% available	0.128
Total Bioavailable Phosphorus			**0.128**
Total Bioavailable Nitrogen : Total Bioavailable Phosphorus			**0.55**
Balanced Growth Ratio			10-15

a. (EDAW, September 2004a), Table 2-3

As shown in Table 5-9, the nitrogen to phosphorus (N:P) ratio for South Lake indicates that the lake is strongly nitrogen limited. Because organic nitrogen concentrations are high, the ratio of total bioavailable nitrogen to total bioavailable phosphorus (Total Bioavailable Nitrogen: Total Bioavailable Phosphorus) should be used to determine if the lake is nitrogen or phosphorus limited (Horne, 2005). The balanced growth ratio, where the lake could be either phosphorus or nitrogen limited, ranges from 10 to 15. For a lake to be nitrogen limited, the N:P ratio should be less than 10; for the lake to be phosphorus limited, the N:P ratio should be greater than 15. As shown in Table 5-9, the Total Bioavailable Nitrogen: Total Bioavailable Phosphorus is 0.55, indicating that the lake is strongly nitrogen limited (Horne, 2005).

Because South Lake is nitrogen limited, the bioavailable nitrogen added to the lake will be converted into algae. Therefore, raising the nitrogen concentrations in the lake will have a direct impact on the water quality. However, raising the phosphorus concentrations will not affect the concentrations of algae in South Lake because phosphorus is already abundant in the lake's ecosystem. Thus, while it is important to consider both nitrogen and phosphorus in order to protect the water quality of Lake Merced from increased eutrophication, nitrogen is the primary nutrient of concern and is used to evaluate the treatment capacity of the wetland.

In addition to evaluating the impact of nutrients on the water quality of South Lake, it is also important to consider pathogen addition to the lake since they pose a threat to human health and water quality. Other parameters, such as total suspended solids (TSS) and temperature, can affect water quality but their effects are small compared to nutrient and pathogen loading.

Vista Grande Stormwater Quality

Stormwater is typically high in metals, nutrients, coliform, oil and grease, and other pollutants. Previous studies have shown that the composition of stormwater in the Vista Grande canal is typical of stormwater in other Bay Area communities except that it has elevated concentrations of total coliform (EDAW, September 2004a). Therefore, the primary constituents of concern in stormwater are nitrogen (as nitrate), phosphorus and total coliform, which is considered an indicator of the presence of pathogens, because of their impact on the water quality of South Lake.

Vista Grande Wetland Treatment Characteristics for Stormwater

General Treatment Parameters for Vista Grande Stormwater

The preliminary layout of the Vista Grande Wetland has been optimized to effectively remove the primary constituents of concern from Vista Grande stormwater: nitrogen, phosphorus, and pathogens. In addition to treating for nutrients and pathogens, the wetland will remove many heavy metals, hydrocarbons, pesticides, other exotic organic compounds, and suspended solids from its source water.

Anoxic conditions in wetlands can lead to slightly lower pH and dissolved oxygen levels in the wetland's effluent. However, it is assumed that the wetland effluent would be conveyed into South Lake via the existing Lake Merced overflow structure and allowed to cascade down the South Lake's banks before entering the water. This cascade would oxygenate the water and raise pH levels by modifying the carbon dioxide equilibrium.

Several different inflow rates were evaluated for the wetland conceptual design. To assess the treatment capacity of the Vista Grande Wetland the following parameters were calculated for each constituent of concern (nitrate, phosphorus, and pathogens):

- Total removal
- Effluent concentration
- Estimate chlorophyll "a" in South Lake.

Total Removal

The total removal for the primary constituents of concern (nitrate, total phosphorus, and total coliform) is dependent on the hydraulic residence time in the wetland and water temperature. During winter months, typical removal of nitrate is 200 mg/m^2day, whereas the removal of phosphorus is 8.1 mg/m^2day (Horne, 2005). Coliform die-off was modeled through the first-order kinetics equation, $C=C_0e^{-kt}$, where C_0 is the initial pathogen concentration, t is the hydraulic residence time, and k is a die-off constant which has been assumed to be 0.40/day, as it was for previous studies (EDAW, September 2004a). This die-off model does not account for removal processes added from treatment in the wetland. The wetland will enhance coliform and pathogen removal through several processes including grazing by microbes and other animals, sedimentation and sorption, and physical blockage by wetland vegetation (Horne, 2005). However, these processes are difficult to quantify so the die-off model was used as an estimate of the minimum coliform removal in the wetland. Thus, the actual coliform concentrations are expected to be lower than those calculated for the conceptual design of the wetland (as shown in Table 5-10).

Effluent Concentration

The effluent concentration of each parameter was based on the remaining concentration and the outflow volume of the wetland.

Estimated in chlorophyll "a" in South Lake.

Finally, the estimated chlorophyll "a" in South Lake, after the addition of treated water, provides a good assessment of the direct impact of nitrogen and phosphorus on the water quality and clarity of the lake. Chlorophyll "a" makes up 1% (by dry weight) of algae. Nitrate and total phosphorus make up 5% and 0.3% of algae (by dry weight), respectively. The estimated chlorophyll "a" due to nitrate and phosphorus addition was calculated using these values and an empirical model based on the research of Dr. Alex Horne (Horne, 2005). This calculation demonstrates how these nutrients are used within the lake's ecosystem.

Stormwater Treatment Characteristics

The total removal of the constituents of concern, the resulting effluent concentration, and the estimated chlorophyll "a" concentrations were calculated for inflow rates ranging from 0.5 mgd to 2.0 mgd. The effluent nitrate and phosphorus concentrations are calculated based on the average concentrations from existing water quality data as shown in Table 5-8, and removal assumptions for winter conditions. The existing South Lake concentration in chlorophyll "a" resulting from nitrate and phosphorus additions assumes that the additional chlorophyll "a" is added to the ambient chlorophyll "a" concentration into South Lake. The results of these analyses are shown in Table 5-10.

Table 5-10 Pollutants Removal for Different Stormwater Inflow Rates at the Vista Grande Wetland

Wetland Inflow (mgd)	0.5	0.7	1.0	1.50	1.90	2.0
Residence Time (days)	**7.2**	**5.1**	**3.6**	**2.4**	**1.9**	**1.8**
Nitrogen Removal						
Loading (kg/day)	4.4	6.1	8.7	13.1	16.5	17.4
Removal for residence time (kg)	31.9	22.8	16.0	10.6	8.4	8.0
Nitrate Remaining in Effluent (kg)	0.0	0.0	0.0	2.4	8.1	9.4
Effluent Concentration (mg/L)	0.000	0.000	0.000	0.426	1.132	1.246
Estimated Chlorophyll "a" (mg/l) [c]	0.026	0.026	0.024	0.025	0.029	0.030
Phosphorus Removal						
Loading (kg/day)	0.8	1.1	1.5	2.3	2.9	3.0
Removal for residence time (kg)	1.3	0.9	0.6	0.4	0.3	0.3
Phosphorus Remaining (kg)	0.0	0.1	0.9	1.8	2.5	2.7
Effluent Concentration (mg/L)	0.000	0.052	0.229	0.324	0.353	0.357
Estimated Chlorophyll "a" (mg/l) [c]	0.026	0.028	0.040	0.053	0.060	0.062
Pathogens Removal						
Influent Concentration (MPN/100mL)	126,421	126,421	126,421	126,422	126,423	126,424
Coliform Remaining in Effluent (MPN/100mL)	7,187	16,306	30,144	48,611	59,446	61,731
Coliform Remaining in Effluent (MPN/100mL) @ t+1	4,818	10,930	20,206	32,585	39,848	41,380
Coliform Remaining in Effluent (MPN/100mL) @ t+2	123	633	2,165	5,630	8,419	9,079
Coliform Remaining in Effluent (MPN/100mL) @ t+3	2	25	155	652	1,192	1,335
Total Coliform Remaining in Effluent (MPN/100mL)	12,130	27,895	52,670	87,478	108,905	113,526
Concentration in Lake (MPN/100mL)	1,273	1,329	1,468	1,797	2,113	2,197

a. (EDAW , September 2004a)
b. (EDAW , September 2004b)
c. For a 6-month period.

Given the treatment characteristics presented in Table 5-10, the wetland could be operated to handle stormwater inflow rates of up to 1.90 mgd with no impact to the water quality of Lake Merced, assuming that Lake Merced is nitrogen limited. The 1.90 mgd inflow into South Lake would result in an effluent concentration in nitrate of 1.132 mg/L. The nitrate loading from the wetland effluent would result in a concentration of chlorophyll "a" into South Lake of 0.029 mg/L after accounting for dilution.

If Lake Merced were to become phosphorus limited, the wetland could be operated to handle inflow rates of up to 0.70 mgd with no impact to the water quality of Lake Merced. The 0.70 mgd inflow into South Lake would result in an effluent concentration in phosphorus of 0.052 mg/L. The phosphorus loading from the wetland effluent would result in a concentration of chlorophyll "a" into South Lake of 0.028 mg/L after dilution is accounted for.

For diversion rates from 0.5 mgd to 1.5 mgd, and assuming a baseline coliform concentration of 1,250 MNP/100mL into South Lake, the coliform concentration in the lake after dilution would increase from 1,273 to 1,797 MPN/100mL. This increase is likely to be insignificant and numerically undetectable. Diversion rates higher than 1.5 mgd would result in a small but quantifiable increase in coliform in South Lake.

Over the past two years, NSMCSD and the SFPUC have been jointly conducting the Vista Grande-Lake Merced Wetland Pilot Stormwater Treatment Study. This study includes diverting stormwater through CDS units and a vegetated buffer along South Lake before diversion into Lake Merced. Findings of this project show that the stormwater diversions did not significantly increase concentrations of *E. coli* in South Lake and that the concentrations of the three bacterial indicators monitored during the study (total coliform, E.coli, and enteroccus) met single water quality criteria for bull body contact recreation. Monitoring results also suggest that a combination of die-off, dilution and treatment by the riparian buffer effectively reduced bacterial concentrations in the stormwater. In addition, no metals were detected in surface soil samples suggesting that metals did not accumulate in the riparian buffer soils (EOA Inc., 2005). Additional monitoring is recommended to address data gaps, and confirm the diversion volume threshold. However, the Pilot Project results are in line with expected water quality resulting from Vista Grande Canal diversions as discussed above.

Vista Grande Wetland Treatment Characteristics for Recycled Water

Wetlands require a continuous source of water to sustain their vibrant plant and aquatic life. Existing dry-weather flows from the Vista Grande Watershed may provide a sufficient water supply for this purpose but the volumes available have not been quantified. As an alternative, recycled water was analyzed for its suitability as a dry-weather water supply.

Recycled Water Quality

Unlike stormwater, where nutrient levels are generally low and pathogen concentrations high, recycled water typically has higher levels of nitrogen and phosphorus, and low pathogen concentrations. Recycled water from the Daly City recycled plant has a typical ammonia concentration of 25 mg/L. If this water is to be used as a dry-weather source for the wetland, it would require nitrification to protect the wetland's mosquitofish, which are necessary for mosquito abatement. For purposes of determining wetland performance with recycled water, the nitrate concentration for recycled water after nitrification was assumed to be 15 mg/l. Typical phosphorus concentrations of recycled water are around 4 mg/L. Total coliform concentrations are regulated by Chapter 3, Division 4, Title 22, California Code of Regulations (California Department of Health Services, 2003). Title 22 states that the total coliform concentration cannot exceed 240 MPN/100mL at any time over a thirty-day period. Since this thirty-day peak concentration of total coliform is an order of magnitude lower than the ambient total coliform concentration in South Lake, total coliform removal was not considered in the analysis of the wetland treatment characteristics for recycled water.

General Treatment Parameters for Recycled Water

To assess the treatment capacity of the Vista Grande Wetland for recycled water, the following parameters were calculated for each constituent of concern: the total removal, the effluent concentration, and the estimated chlorophyll "a". These calculations are the same as those used for the treatment of Vista Grande stormwater but are modified for the typical nutrient concentrations in recycled water and for increased temperatures during summer months. During the summer months, when recycled water would most likely run though the wetland, higher water temperatures raise the typical removal of nitrate to 500 mg/m^2day, and the removal of phosphorus to 50 mg/m^2day (Horne, 2005).

In addition, the warmer and drier weather during the summer months results in water losses as the water flows through the wetland. Losses occur through both evaporation and leakage. Evaporation and leakage were assumed to be 4ft per year per acre and 10% of the inflow, respectively.

Recycled Water Treatment Characteristics

The total removal of the constituents of concern, the resulting effluent concentration, and the estimated chlorophyll "a" concentrations were calculated for inflow rates ranging from 0.25 mgd to 1.0 mgd. Again, the effluent concentration calculations were based on the average concentrations from existing water quality data as shown in Table 5-8, and removal assumptions for summer conditions. The existing South Lake concentration in chlorophyll "a" assumes that the additional chlorophyll "a" generated by nitrate loading is added to the ambient chlorophyll "a" concentration into South Lake. Table 5-11 show the treatment characteristics of the wetland if recycled water is used as a water source.

Table 5-11 Pollutants Removal for Different Recycled Water Inflow Rates at the Vista Grande Wetland

Wetland Inflow (mgd)	0.25	0.45	0.50	0.75	0.85	1.0
Evaporation (mgd)	0.039	0.039	0.039	0.039	0.039	0.039
Leakage (mgd)	0.025	0.045	0.050	0.075	0.085	0.100
Flow Out (mgd)	0.19	0.37	0.41	0.64	0.73	0.86
Residence Time (days)	**14.3**	**8.0**	**7.2**	**4.8**	**4.2**	**3.6**
Nitrogen Removal						
Loading (kg/day)	14.2	25.5	28.4	42.6	48.3	56.8
Removal for residence time (kg)	159.5	88.6	79.8	53.2	46.9	39.9
Nitrate Remaining (kg)	0.0	0.0	0.0	0.0	1.3	16.9
Effluent Concentration (mg/L)	0.000	0.000	0.000	0.000	0.485	5.183
Estimated Chlorophyll "a" (mg/l) [c]	0.028	0.027	0.027	0.026	0.027	0.043
Phosphorus Removal						
Loading (kg/day)	4.7	8.5	9.5	14.2	16.1	18.9
Removal for residence time (kg)	16.0	8.9	8.0	5.3	4.7	4.0
Phosphorus Remaining (kg)	0.0	0.0	1.5	8.9	11.4	14.9
Effluent Concentration (mg/L)	0.000	0.000	0.955	3.688	4.147	4.584
Estimated Chlorophyll "a" (mg/l) [c]	0.028	0.027	0.056	0.193	0.236	0.295

a. (EDAW , September 2004a)
b. (EDAW , September 2004b)
c. For a 6-month period.

Given the treatment characteristics presented in Table 5-11, the wetland could be operated to handle recycled water inflow rates of up to 0.85 mgd with no impact to the water quality of Lake Merced, assuming that Lake Merced is nitrogen limited. The 0.85 mgd inflow into South Lake would result in an effluent concentration in nitrate of 0.485 mg/L. The nitrate loading from the wetland effluent would result in a concentration of chlorophyll "a" into South Lake of 0.027 mg/L after accounting for dilution.

If Lake Merced were to become phosphorus limited, the wetland could be operated to handle inflow rates of up to 0.45 mgd with no impact to the water quality of Lake Merced. With a 0.45 mgd inflow into South Lake, all the phosphorus would be removed from the effluent. The nitrate loading from the wetland effluent would result in a concentration of chlorophyll "a" into South Lake of 0.027 mg/L after accounting for dilution.

Water Quality Summary

As discussed earlier, the Vista Grande Wetland could treat stormwater and recycled water effluents, provided inflow rates are adjusted to produce an effluent of an acceptable water quality. A summary of the maximum inflow rates for stormwater and recycled water is presented in Table 5-12, along with the resulting chlorophyll "a" and coliform concentration in South Lake. The wetland could treat stormwater and recycled water flows of up to 1.9 mgd and 0.85 mgd, respectively, with no anticipated water quality impacts. To treat higher recycled water flows, additional denitrification and phosphorus removal processes would be required prior to wetland treatment in order to provide acceptable effluent water quality for discharge to Lake Merced (Horne, 2005.)

Table 5-12: Maximum Recommended Wetland Treatment Rates for Stormwater and Recycled Water

Water Supply	Flow (mgd)	Estimated Chlorophyll in Lake Merced (mg/L) [a]		Coliform bacteria in L. Merced (MPN/100 mL) [b]	
		With wetland	Ambient	With wetland	Ambient
Stormwater					
	1.9	0.029	0.029	2,113	1,250
Recycled Water					
	0.85	0.027	0.029	NA [c]	1,250

a. Chlorophyll "a" levels based on the limiting nutrient. Nitrogen appears to be the limiting element for plant growth in Lake Merced based on the bioavailable N:P ratio of 0.5 where < 10 = N-limiting, > 15 = P-limiting (see Table 4.2). If P becomes the limiting nutrient, then water volumes would need to be reduced by about two-thirds to half.

b. The fecal coliform standard for non-contact recreation is 2,000 MPN/mL (RWQCB, 1995). Values are based on a simple die-off model but wetlands would actually remove more pathogens due to physical and biological processes.

c. NA = Not applicable, water source is disinfected at the waste water treatment plant (WWTP) prior to entry to the wetland.

Metals are other pollutants of concern to consider when constructing treatment wetlands. Particulate metals (mineral or metal ores) will settle out and remain in the sediments without posing a hazard. Most soluble metals will become sulfides (insoluble metal ores) at the low redox present in the deeper sediments, and will not pose a hazard. The main potential hazard occurs between the initial sorbtion of the soluble metal and its entry into the sulfide mineral. This hazard appears to be small since no unusual metal concentration in biota has been found in the studies carried out for this purpose (Horne, 2005 - Preliminary Results). The few free metal ions not forming insoluble sulfide can be found in the outer root surfaces as detected by scanning electron microscopy (Horne, 2000).

5.3.7 Wetland Construction, Operation and Maintenance

Construction

Construction of the wetland would impact the area encompassed between John Muir Drive and the Olympic Club Golf Course. The area northeast of the existing Vista Grande canal is essentially covered with wild oat grassland at the southeastern end, evolving into mixed exotic and ice plant herbaceous. The San Francisco spine flower (Chorizanthe cuspidata), a Federal Species of Concern and a California Native Plant Society (CNPS) List 1b plant, occurs in the wild oat grassland. This area is also covered with approximately fifty pine trees, several eucalyptus trees, and approximately two small oak trees and two large oak trees. Construction of the wetland would result in removal of the plants and trees. However, it is believed that such loss will be minimal. This potential loss could be further minimized by planting trees and other plants in other appropriate habitats at Lake Merced. Mitigation of the removal of the large oak trees may include relocating those trees, or collecting acorns from the trees and propagating them for planting in the vicinity.

There are several structures above ground (including electric utilities), and there are several known utilities running along the Vista Grande canal. These existing underground utilities include a 33-inch pipeline and an abandoned 18-inch sewer pipeline from the NSMCSD wastewater treatment plant. Other existing utilities in the area include a sewer pipeline from the Olympic Club, and the Continuous Deflective Separation (CDS) units installed as part of the Vista Grande-Lake Merced Wetland Pilot Stormwater Treatment Project. It is assumed that the existing Lake Merced overflow structure could be used as the Vista Grande Wetland overflow into South Lake.

An important component of the wetland is the interface between the proposed Tunnel South of County Line and the wetland. It is anticipated that the interface would be a concrete box where the three existing storm drains (i.e. 24-inch and 60-inch storm drains and 7-foot by 8-foot box culvert) would discharge stormwater flows into the Tunnel South of the County Line (depending on the alignment selected).

Stormwater flows would be pumped to the proposed wetland. Regulating stormwater inflows into the wetland is critical to provide a level of treatment compatible with Lake Merced water quality objectives. Flows into the wetland would be regulated through flow control facilities located at the tunnel/wetland interface.

Another aspect of construction is the need for excavation. Prior to grading and other construction activities, the area shown in Figure 5-25 would need to be cleared of all vegetation and debris. Then the site should be excavated to design specifications. The Vista Grande Wetland will require approximately 15,000 cubic yards (CY) of excavation. After excavation is complete, the subgrade will have to be properly compacted to minimize settling.

Figure 5-25: Area Along Existing Canal Proposed for Construction of Vista Grande Wetland

Operation and Maintenance

Operation of the wetland will depend on the water source used for the wetland during different times of the year. Several water supplies could be used at the Vista Grande Wetland. Stormwater would be diverted into the wetland during winter (i.e. from November to April). In summer, depending on the availability of year-round flows, the Vista Grande Wetland could treat either dry weather flows or recycled water from the NSMCSD recycled water facility or recycled water from potential facilities in San Francisco. Alternatively, pumped water from Lake Merced could be used as an alternative water supply during the summer period. However, re-circulating water from Lake Merced will limit the lake level augmentation benefit of the wetland.

There are several maintenance activities that would have to be conducted to ensure the efficacy of the wetland. It is recommended that these maintenance activities be summarized in an O&M plan. Maintenance activities include maintenance of inlet and outlet structures, desilting of the settling basin, management of vegetation, odor control, control of nuisance pests and insects, and maintenance of berms and other constructed water control structures.

Water level control is the most critical operational parameter as it ensures the proper function of the system. Therefore, proper maintenance of water control structures such as berms, piping, inlet and outlet structures needs to occur routinely to ensure proper hydraulic conditions. Maintenance activities include removal of debris and sediment, periodic flushing of pipes and the use of high-pressure water sprays for periodic cleaning.

Another significant component of wetland maintenance relates to the control of nuisance pests, especially mosquitoes. Wetlands are known to be ideal breeding ground for mosquitoes, which can transmit diseases to humans. Scientific research has shown that mosquito problems associated with treatment wetlands are rare (Interstate Technology & Regulatory Council (ITRC), 2003). However, mosquito abatement will be a critical maintenance element of the Vista Grande Wetland. An effective mosquito abatement strategy consists of introducing mosquitofish into the wetland. Mosquito abatement strategies will be coordinated with the mosquito abatement programs implemented by San Francisco and San Mateo County Mosquito Abatement Districts. An O&M plan will likely be required by the regulatory agencies as part of the permitting process.

Monitoring

Monitoring is needed to ensure proper performance of the wetland. It is recommended that a monitoring plan be developed and maintained throughout the wetland life. The monitoring plan will likely include recording of water quality parameters listed in the San Francisco Bay Basin Plan (Basin Plan), water flows, rainfall, and plant cover for dominant species (RWQCB, 1995). A monitoring plan is likely to be required by the regulatory agencies as part of the permitting process.

5.3.8 Preliminary Capital Costs

The preliminary capital cost estimates for the wetland is provided in Table 5-13. Two Vista Grande Wetland alternatives were evaluated for the Vista Grande Watershed Study. Alternative A is the recommended alternative, described earlier in this section. Alternative A is estimated to cost approximately $8.6 million (December 2005 dollars). Escalating costs to the assumed midpoint of construction at a rate of 5% per year increases the cost estimate to $11.2 million (2012 dollars)[1]. For informational purposes, the cost estimate for Alternative B is provided in Appendix F. Information on cost escalation is provided in Appendix G.

It is important to note that Alternative A cost only includes the cost to divert stormwater and construct the treatment wetland. Costs for upgrading recycled water facilities to provide nitrification and for distributing the recycled water to the wetland are not included. Also, the cost estimates provided in Table 5-13 do not include the cost for a pump station to pump water from Lake Merced to the wetland headwaters, in case Lake Merced water is used. Last, the cost estimate presented above assumes that the existing Lake Merced overflow structure is used as an outlet into South Lake, and that no pump station is needed to discharge the wetland effluent into South Lake.

[1] Note that this escalation does not include financing costs associated with obtaining a bond measure, such as a debt service reserve fund.

Table 5-13: Vista Grande Wetland Alternative A Planning Level Capital Cost Estimate

Description	Units	Unit Cost	Quantity	Total Cost
SITE PREPARATION / MOBILIZATION				
Clear and grub brush including stumps	acre	$10,000	6.5	$65,000
Removal of heritage oaks	-	-	-	$50,000
Relocate Olympic GC Sewer Pipeline	lf	$96	3600	$346,000
Relocate 30" Sewer Pipeline	lf	$360	3600	$1,296,000
Demolition 18" Sewer Pipeline	lf	$20	3600	$72,000
Relocate Above-ground Structures	Allowance	$500,000	-	$500,000
Mobilization/Demobilization	each	10%	-	$435,000
CONSTRUCTION				
Mass excavation and hauling	cy	$38	15,000	$570,000
Grading, compacting, and transporting fill	day	$10,000	10	$100,000
Traffic Barrier	lf	$50.50	3,600	$182,000
Embankment Construction	cy	$32	1,300	$42,000
Roadways / trains (maintenance access)	sf	$5	48,000	$240,000
Pump Station	Allowance	$150,000	1	$150,000
Inlet structure	Allowance	-	1	$50,000
Flow Control Facilities	Allowance	-	1	$50,000
Outlet Basin	Allowance	-	1	$50,000
Standard Piping	lf	$40	850	$34,000
Draining Piping	lf	$40	3,600	$144,000
Draining Valving	Allowance	$20,000	1	$20,000
Wetland planting - propagation / harvesting / installation	acre	$30,000	5.5	$165,000
Replanting during wetland establishment	acre	$30,000	5.5	$165,000
Landscaping	acre	$30,000	2.0	$60,000
Subtotal:[a]				$4,800,000
Contingency (30%)[a]:				$1,400,000
Construction Cost Estimate[a]:				$6,200,000
Implementation (30% Allowance)[a]:				$1,900,000
Environmental Compliance[a]:				$500,000
Capital Cost Estimate (December 2005 dollars)[a]:				$8,600,000
Cost Escalated to the Midpoint of Construction[a, b]:				$11,200,000

a. Costs are rounded to the closest $100,000.
b. Costs have been escalated to the midpoint of construction (2012) at a rate of 5% per year. See Appendix G for more information.

5.3.9 Benefits

Lake Merced Lake Level Augmentation

Beneficial uses for Lake Merced are set forth in the San Francisco Bay Basin Plan (Basin Plan) (RWQCB, 1995). The Basin Plan lists Lake Merced as a potential municipal water source, as both a water-contact and non-water contact recreational source, as a warm and cold fresh water habitat, and as wildlife and fish spawning habitat. Maintaining appropriate water levels is a critical factor to preserve Lake Merced beneficial uses. However, Lake Merced water levels declined from the late 1980's to the early 2000's, as reported in a series of reports (EDAW, September 2004a, b). To mitigate those declining water levels the SFPUC has been evaluating a range of target lake levels and supplemental water sources. Several water supplies were looked at in order to achieve the various water levels. Water supplies that were evaluated include: 1) stormwater from Vista Grande canal; 2) recycled water; 3) SFPUC system water, and groundwater. Currently, SFPUC system water is used periodically for lake level enhancement. However, the Vista Grande Wetland could provide an alternative water supply in lieu of SFPUC system water.

The variability of the water supply and the wetland treatment capacity will dictate the additional volume to Lake Merced and resulting lake level enhancement. Previous model runs and field data show that lake level enhancement is also affected by hydrologic conditions (i.e. dry year versus wet year) (EDAW, September 2004a). Three water supply scenarios to the Vista Grande Wetland were considered. Scenario #1 assumes a constant water supply addition (wetland-treated stormwater) of 1.0 mgd throughout the year. Scenario #2 assumes a winter supply addition (wetland-treated stormwater) of 1.9 mgd, and a summer supply of recycled water of 0.85 mgd. Scenario #3 assumes a winter supply addition (wetland-treated stormwater) of 1.9 mgd, and assumes that water from Lake Merced would be recirculated to the wetland in summer time to sustain the wetland ecosystem. The three scenarios and their impacts on lake levels are captured in Table 5-14. As shown in Table 5-14, the year-round addition of 1.0 mgd (Scenario #1) would sustain a lake level of less than 8.0 feet SF city datum during average years. Scenario #2 would result in lake level of 8.0 feet during average years. Similarly, Scenario #3 would result in lake level fluctuating between 5-6 feet and 8.0 ft during average years. Dry year water requirements to maintain similar lake levels as discussed above will be higher but have not been quantified.

Table 5-14: Scenarios for Providing Supplemental Water to Lake Merced and Effect on Lake Water Level

Water Source Combination	Season	Flow (mgd)	Volume Added to South Lake (AF)	Effect on Water Level at Lake Merced (ft)
Scenario #1				
Stormwater	**Year-round**	**1.0**	**1,120**	<8.0 ft (average year)
Scenario #2				
Stormwater	Winter (6 months)	1.9	1,050	8.0 ft (average year)
Recycled Water	Summer (6 months)	0.85	470	
Stormwater + Recycled Water	**Year-round**	**1.38 (annual average)**	**1,520**	
Scenario #3				
Storm water	Winter (6-months)	1.9	1,050	5-6 ft - 8.0ft (average year)
Water Recirculation from Lake Merced	Summer (6 months)	-	-	
Stormwater + Lake Merced	**Year-round**	**0.95 (annual average)**	**1,050**	

Habitat

The area northeast of the Vista Grande canal is part of San Francisco Significant Natural Resource Areas (EIP Associates, 2005). The Natural Areas Program was developed in the late 1990s to preserve, restore, and enhance remnant Natural Areas and promote environmental stewardship of these areas. Because of its proximity to South Lake and Impound Lake, it is likely that the Vista Grande Wetland will provide an extension of the nearby wetland habitat for local and migratory bird populations.

Figure 5-26: Impound Lake Fringe Habitat

Recreation

Lake Merced and the area around the Vista Grande canal is an important habitat area for migrating birds from August through November. As such, it is also heavily used for bird watching during that time. The Vista Grande Wetland will incorporate an access road for maintenance purposes, which could be used as a public trail, thus providing an area for bird watchers to enjoy this resources without trespassing or disturbing golfers. Therefore, there are opportunities to use the Vista Grande Wetland for recreational and educational purposes through a public trail and educational signage documenting the wetland purpose and function of constructed wetlands.

5.3.10 Implementation Issues

Environmental Considerations

Constructed treatment wetlands are considered appropriate technology for treating stormwater and are generally looked upon favorably by regulatory agencies. Although stormwater wetlands are considered to be ecologically sound solutions to stormwater treatment, they are designed specifically to treat the contaminants most commonly found in stormwater, so they generally do not replicate the extensive diversity and productivity of natural wetlands. As a result, they are not suitable and will not qualify as a replacement habitat wetland.

Construction for the wetland could create some erosion and additional runoff into Lake Merced. It will require clearing all vegetation from the site, which could disturb some existing habitat. However, the area will be replanted for the wetland, creating additional, suitable quality habitat for birds and wildlife.

After treatment in the wetland, water that is discharged into South Lake will contain low concentrations of nitrate, phosphorus, and other nutrients. Nutrients are one of the driving forces in the eutrophication process but the concentrations in the wetland effluent are expected to have a minimal impact on the lake. Pathogens and other microorganisms in the stormwater will be significantly reduced through treatment in the wetland. For “first flush” stormwater entering the wetland, which may have high concentrations of total coliform, the wetland effluent and the localized concentration near the discharge area in South Lake may exceed the action level for total coliform concentrations. In this situation, all stormwater flows could be sent through the new tunnel and flow into the wetland could be temporarily suspended, limiting water quality impacts to the lake.

Construction of the wetland would result in the removal of the plants and trees located along the existing Vista Grande canal, including two large oak trees. The trees in this area are a valuable component of a small habitat that supports many birds all year and is a significant stopover point for many migrating landbirds. The potential loss of these trees could be mitigated by planting new trees in the vicinity and relocating the large oak trees, if feasible. In addition, the grasses and other plants along the Vista Grande canal form a weedy area that sparrows and finches use for feeding from late summer through mid-spring. Planting some of the open uplands around Lake Merced with Native grasses, lupine, coyote bush, or other appropriate vegetation could help replace this habitat.

Overall, the Vista Grande Wetland is expected to be an environmental enhancement project since it will create habitat and increase water levels in Lake Merced.

Permitting Requirements

The Vista Grande Watershed is expected to trigger regulatory involvement from several State and Federal agencies. Table 5-15 summarizes the permitting requirements that have been identified for this preliminary program component. Chapter 6 provides a more detailed discussion of the regulatory requirements for the Vista Grande Watershed Study.

Table 5-15: Summary of Permit Requirements for the Vista Grande Wetland

Agency	Permit or Requirement	Authority	Cause for Permitting Action	Time Frame
US Army Corps of Engineers (the Corps)	§404 Permit	Clean Water Act	The Vista Grande Wetland requires filling and abandoning the Vista Grande canal. If the Vista Grande canal is deemed part of the "waters of the United States", the wetland will require a §404 permit from the Corps. Any work along the bank of Lake Merced may also trigger this permit and could require a §10 permit as well.	4-6 months – Individual Permit 45-60 days - Nationwide Permit An additional year or more if a biological opinion is required
	§10 Permit	River and Harbors Act		
US Fish and Wildlife Service	§7 Consultation	Endangered Species Act	The area around the Vista Grande Wetland may contain the appropriate habitat for endangered species. The Corps will consult with USFWS during the permit process. If endangered species or their habitat are believed to be affected, USFWS will prepare a biological opinion under a §7 Consultation.	1-3 years
San Francisco Regional Water Quality Control Board (RWQCB)	§401 Permit - Water Quality Certification	Clean Water Act §401	Under §401 of the Clean Water Act, any activity subject to a permit from a Federal agency must be by the appropriate State that the activity meets all State water quality standards.	60 days after application is deemed complete. Up to one year of additional time may be requested from the Corps.

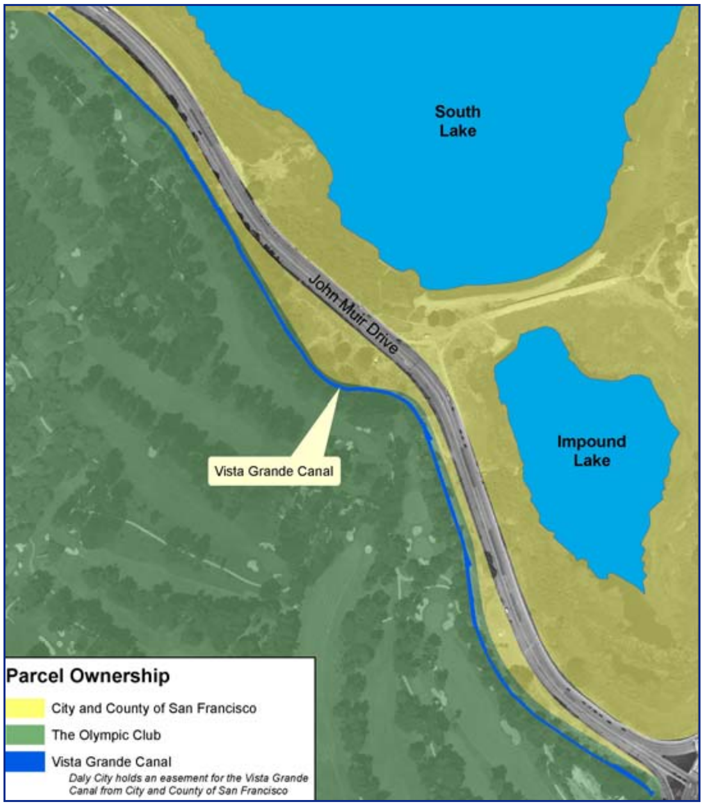
Agency	Permit or Requirement	Authority	Cause for Permitting Action	Time Frame
	§402 Permit - NPDES: General Construction Activity Stormwater Permit	Clean Water Act §402	Required for any construction activity that disturbs more than five acres of land, or if the overall program disturbs more than five acres of land.	Approximately six months
	Waste Discharge Requirements	Porter-Cologne Water Quality Control Act	Required for any activity that generates dredged material, fill or any other discharge that may directly or indirectly impacts the "waters of the State". Waived if §401 Permit required.	Approximately three months
California Department of Fish and Game (CDFG)	Streambed Alteration Agreement (§1602 permit)	Fish and Game Code §1602	Required before undertaking any activity that will significantly change any river, stream, or lake. The jurisdiction of CDFG includes the Vista Grande canal.	30 days after application submittal to evaluate completeness; 60 days after application is deemed complete.
California Coastal Commission (CCC) and/or Local Coastal Programs (LCPs)	Coastal Development Permit or Public Works Plan	California Coastal Act of 1976; Federal Coastal Zone Management Act	Required for any development in the coastal zone. The coastal zone begins at the shoreline and extends from 500 yards to 5 miles inland. The coastal zone extends around Lake Merced and includes the Vista Grande Canal area.	Six months to two years
California State Lands Commission	General Lease – Right-of-Way	California Public Resources Code - Division 6 Public Lands	Required for any project within the California State Lands Commission's jurisdiction. Any work below the ordinary low-water mark on Lake Merced would be within their jurisdiction. It would need to be determined if other project areas, such as the canal are within their jurisdiction.	1-3 years

Property

Securing the rights to the land along the existing Vista Grande canal is essential to the success of the wetland. Currently, the Olympic Club owns the property where the canal is located, and Daly City has an easement from CCSF for the canal, as shown in Figure 5-27. The land between the canal and the road is owned by the CCSF. In order to build the wetland, the land owned by the Olympic Club will need to be acquired. Negotiation with the Olympic Club will be necessary to secure this land.

In addition, John Muir Drive will need to be narrowed to allow for the buffer zone between the road and the wetland. The current conceptual design assumes that five feet of the road will be available for this buffer. Narrowing the road may provide for enhanced recreational opportunities along the wetland area, but the traffic impacts of this modification should be evaluated during the design stage of the wetland, and coordination with SF DPW will be required.

Figure 5-27 Property Ownership around the Vista Grande Canal



Dry-Weather Flow Monitoring

Constructed wetlands must have a source of water throughout the year so that the wetland plants and other organisms within the wetland ecosystem can continue to grow and thrive. Summertime flows have been observed in the Vista Grande canal year-round. However, these flows have not been quantified. An essential step in the implementation of the wetland project will be to monitor flows in the Vista Grande canal year-round to assess whether an alternative water supply such as recycled water will be necessary to support the wetland ecosystem during summer months (May to November). Monitoring should begin during the next dry season (summer 2006) so that quantity and quality of available flows are known before design of the wetland begins.

Alternative Water Sources

Depending on the results of the summertime flow monitoring, an alternate water supply may be necessary to support the wetland during dry periods. Recycled water could be used as an alternative source of water for wetland maintenance and lake-level augmentation. Prior to using recycled water, nitrification will need to be added to the recycled water facility to lower ammonia to protect mosquitofish in the wetland. If the water quality of the recycled water effluent is still not compatible with Lake Merced water quality objectives, additional treatment (i.e. denitrification and phosphate removal processes) would be required to lower nitrate and phosphorus concentrations in the recycled water.

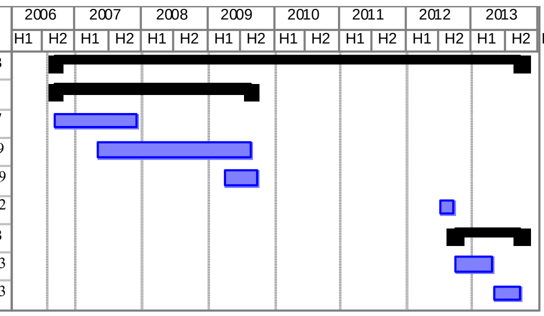
Re-circulation from Lake Merced is another option for year-round wetland maintenance. This option would require installing a pump station to transport water from Lake Merced into the wetland. This alternative would not provide any lake-level augmentation benefit during the re-circulation period since the water would be extracted directly from the lake. However, re-circulation from Lake Merced may provide a viable alternative to maintain the wetland ecosystem during the dry season if flows are shown to be insufficient to support wetland life and recycled water use is determined infeasible.

5.3.11 Implementation Schedule

The Vista Grande canal will be removed during the construction of the Vista Grande Wetland. Since the canal is still an essential stormwater conveyance structure, construction on the wetland cannot begin until construction of the new Tunnel South of County Line is complete and the tunnel is operational. However permitting and design for the wetland can be conducted concurrently with the permitting and design of the tunnel. Overall, the permitting, environmental documentation, and design phases of the Vista Grande Wetland are expected to take approximately three years. Construction is estimated to take an additional nine months. If construction of the wetland starts when construction of the tunnel is complete, wetland operations could begin by mid-2013. An implementation schedule for the Vista Grande Wetland is shown in Figure 5-28. This implementation schedule includes only permitting, design and construction phases and is dependent on funding availability and the proposed schedule for the Tunnel South of County Line.

Figure 5-28 Vista Grande Wetland Implementation Schedule

ID	Task Name	Duration	Start	Finish
1	**Wetland**	**1848 days**	**Fri 9/1/06**	**Tue 10/1/13**
2	**Permitting**	**780 days**	**Fri 9/1/06**	**Thu 8/27/09**
3	Applications	327 days	Fri 9/1/06	Mon 12/3/07
4	Approval	608 days	Tue 5/1/07	Thu 8/27/09
5	Design	130 days	Wed 4/1/09	Tue 9/29/09
6	Bid & Award	66 days	Fri 6/29/12	Fri 9/28/12
7	**Construction & Monitoring**	**262 days**	**Mon 10/1/12**	**Tue 10/1/13**
8	Construction	152 days	Mon 10/1/12	Tue 4/30/13
9	Wetland Monitoring	110 days	Wed 5/1/13	Tue 10/1/13



5.3.12 Recommendation and Next Steps

It is recommended to construct the Vista Grande Wetland alternative discussed in this section (Alternative A). The Vista Grande Wetland is an effective way to supply additional water to Lake Merced to raise water levels and enhance habitat around Lake Merced. The wetland described in this section would maximize the area available for treatment and enhance recreational and educational opportunities. The benefits of the use of the stormwater from the Vista Grande Wetland should also be examined as part of an alternatives analysis report looking at the different options for raising Lake Merced water levels. Three scenarios are available to operate the Vista Grande Wetland year-round, as shown in Table 5-16. Water supply scenarios include: 1) stormwater supply year-round; 2) stormwater supply in winter and recycled water supply during summer; and, 3) stormwater supply during winter and water pumped from Lake Merced during summer.

Table 5-16: Possible Combinations of Water Supplies for Operation of the Vista Grande Wetland

Scenario	Season	Flow (mgd)	Estimated Chlorophyll in Lake Merced (mg/L) [a]		Coliform bacteria in L. Merced (MPN/100 mL) [b]		Water Level change in Lake Merced (ft) [c]		Recommendation
			With wetland	Ambient	With wetland	Ambient	With wetland	Ambient	
Scenario #1									
Stormwater	Year-round	1.0	0.024	0.029	1,468	1,250	<8.0 (average year)	0	Preferred
Scenario #2									
Stormwater	Winter	1.9	0.029	0.029	2,113	1,250			
Recycled Water	Summer	0.85	0.027	0.029	NA [d]	1,250			
Stormwater + Recycled Water	Year-round	1.38	0.028	0.029	≤ 2,113	1,250	8 (average year)	0	Preferred
Scenario #3									
Storm water	Winter	1.9	0.029	0.029	2,113	1,250			
Recirculated Lake Merced Water	Summer	-	-	-	-	-			
Stormwater + Lake Merced		.95	0.029	0.029	≤ 2,113	1,250	5-6 ft - 8.0 ft (average year)	0	Less preferred due to reduced benefit to lake level enhancement and potential impacts to Lake Merced

a. Chlorophyll "a" levels based on the limiting nutrient. Nitrogen appears to be the limiting element for plant growth in Lake Merced based on the bioavailable N:P ratio of 0.5 where < 10 = N-limiting, > 15 = P-limiting (see Table *). If P becomes the limiting nutrient, then water volumes would need to be reduced by about two-thirds to half.
b. The coliform standard for non-contact recreation is 2,000 MPN/mL. Values are based on a simple die-off model but wetlands would actually remove more pathogens.
c. Long-term average value after initial groundwater demand is met.
d. NA = Not applicable, water source is disinfected at the WWTP prior to entry to the wetland.

The first step in implementing the Vista Grande Wetland is to perform flow monitoring in the Vista Grande canal year-round to determine the seasonal availability of stormwater. If the flow monitoring confirms the availability of storm water flows year-round, it is recommended to pursue Scenario #1. Scenario #1 is the preferred alternative as it would reduce dry-weather flow discharges through the Tunnel South of County Line outlet structure; it is also the least costly alternative. If stormwater is not available during summer, it is recommended to treat up to 0.85 mgd of recycled water, as illustrated in Scenario #2. Issues surrounding emerging contaminants and pharmaceuticals in recycled water would need to be considered when investigating the overall feasibility of Scenario #2. If Scenario #2 is not pursued, then Scenario #3 could be implemented. Scenario #2 is preferred over Scenario #3, as it would reduce the wastewater effluent discharge to the beach during summer and would enhance South Lake level. Scenario #3 identifies Lake Merced water as a potential water supply to the wetland during summer if no other source of water is available.

If there is public and political support for the Vista Grande Wetland, the critical step for project implementation would be to secure funding. Securing funding could occur concurrently with the wetland monitoring phase and construction of the tunnel. After funding is secured, the project design and construction phases could occur as described earlier.