Chapter 3 Previous Studies

The Vista Grande stormwater conveyance system and watershed area has been evaluated in a number of reports and studies for the CCSF, the Daly City and San Mateo County over the last twenty years. This chapter summarizes key studies conducted on the Vista Grande stormwater conveyance system and watershed area. Many of the alternatives developed through these previous studies have been used as the technical basis for development and analysis of the alternatives included in the Vista Grande Watershed Study.

3.1 Vista Grande Storm Sewer Project Draft Report (Kennedy/Jenks Engineers, 1983)

In 1983, Kennedy/Jenks Engineers (Kennedy/Jenks) prepared a report for Daly City on the Vista Grande Storm Sewer System. The purpose of the study was to analyze the capacity of the Vista Grande stormwater conveyance system, present findings of deficiencies, and identify potential implementation alternatives to reduce flooding. As part of this study, Kennedy/Jenks:

- Evaluated the capacity of the existing stormwater conveyance system for three design storms (5-year, 4-hour storm; 10-year, 4-hour storm; 25-year, 4-hour storm).
- Estimated the probable collection system flows generated by each design storm.
- Developed and evaluated solutions for capacity limitations at the tunnel.
- Identified recommended system improvements to increase storm flow capacity.

The stormwater conveyance system analyses identified surcharging throughout Vista Grande drainage basin. Modeling results demonstrated the peak volumes of surcharge at the Vista Grande tunnel caused by the 5- and 10-year (4-hour) storms to be 24 million gallons (MG) and 26 MG, respectively, with 12 to14 MG of flooding demonstrated in other areas of the system. As a result, Kennedy/Jenks identified a number of collection system conditions that contribute to inadequate conveyance capacity and made recommendations to alleviate these issues.

The study analysis focused on eight alternatives to increase downstream conveyance capacity for the Vista Grande watershed as summarized in Table 3-1.

Table 3-1 Alternatives Analyzed in the Vista Grande Storm Sewer Report (Kennedy/Jenks, 1983.)

Alternative	Description
Alternative 1: New Parallel Tunnel	Construction of a 3,500 feet long tunnel parallel to the existing tunnel location, passing under Olympic Club to a new Fort Funston outfall.
Alternative 1A: New Tunnel at County Line	Construction of a new 1,000 feet long box culvert under Olympic Club (bypassing the existing canal) and new 3,500 feet long Tunnel at County Line. This option would construct needed infrastructure within San Mateo County only.
Alternative 2: Tunnel Pressurization	Utilization of a new pump station at the tunnel to pump stormwater through the tunnel; or installation of a pressurized pipeline within tunnel. (Alternative deemed not technically or practically feasible.)
Alternative 3: Storage Basin at Lake Merced	Construction of a 38 MG concrete rectangular storage basin/channel adjacent to Vista Grande canal along John Muir Drive
Alternative 4: Storage Basin at Westlake Park	Construction of a 38 MG underground storage basin under Westlake Park. Pumps would be required to drain the basin to the existing canal. (Since development of the study, the Daly City wastewater treatment plant has been constructed at this location.)
Alternative 5: Multiple Storage Basin Sites	Construction of five surface or underground detention basins throughout City at or near localized flooding sites including the southeast corner of the Olympic club, Westlake Park, the northwest corner of Lake Merced Golf Club (LMGC), the southwest corner of LMGC, and Benjamin Franklin Middle School.
Alternative 6: Disposal to Other Storm Drain Systems	Disposal of stormwater to other conveyance systems including San Francisco and Colma Creek collection systems. (Alternative deemed not feasible due to institutional and practical constraints)
Alternative 7: Overflow Structures at Lake Merced	Construction of five to eleven smaller overflow structures across John Muir Drive to divert flows in excess of tunnel capacity to Lake Merced.

After evaluating the alternatives based on engineering feasibility, risk analyses, and cost, Kennedy/Jenks recommended Alternative 7, Overflow Structures at Lake Merced, for implementation since it was the least costly alternative. However, if environmental approvals for this alternative could not be gained, Kennedy/Jenks recommended implementing the one of the new tunnel improvements (Alternative 1 or 1A). It was noted that implementation of one of these alternatives would also require environmental and discharge approvals, as well as detailed site investigation, surveying, geotechnical investigation, tunnel and box culvert design, property acquisition, and financial consulting services for project financing.

3.2 Vista Grande Diversion Feasibility Evaluation, Lake Merced Technical Memorandum No.2 (CH2M Hill, 2001)

In 2001, CH2M Hill completed the Vista Grande Diversion Feasibility Evaluation Project for the City of Daly City, San Mateo County, and the CCSF. This project evaluated the feasibility of, and options for, diverting treated stormwater from Vista Grande canal to Lake Merced. The goals were to reduce flooding problems at the canal and implement water supply delivery to Lake Merced for lake level increase. The study examined the hydraulic and water quality issues associated with the diversions and potential water quality treatment options for the diversions.

From the evaluations, a suite of eight alternatives was developed, and the advantages and disadvantages of each were investigated. The alternatives are summarized in Table 3-2.

Table 3-2 Alternatives Evaluated in the Vista Grande Diversion Feasibility Evaluation (CH2M Hill, 2002)

Alternative	Description
Alternative1: Direct Discharge	Diversion of flows from the canal to South and Impound Lakes through series of overflow structures with trash gates. This alternative was based on that originally developed by Kennedy/Jenks (1983). The alternative was dropped for consideration due to water quality and regulatory constraints.
Alternative 2: Structural Control Measures	Installation of overflows structures and three 150 cfs continuous deflection system (CDS) units for limited water quality treatment before diversion to Lake Merced.
Alternative 3: Constructed Wetlands	Construction of surface flow treatment wetlands to treat stormwater before diversion to Lake Merced.
Alternative 4A: Vista Grande Detention Basin	Construction of a 38 MG concrete storage basin adjacent to Vista Grande canal along John Muir Drive. This alternative was originally developed by Kennedy/Jenks (1983).
Alternative 4B: Impound Lake Detention Basin	Diversion of stormwater flows into Impound Lake for storage. This alternative considered the storage available below hydraulic connection with South Lake.
Alternative 5: Depth Filters	Utilization of sedimentation/filter basin and chambers that treat stormwater; would be constructed in combination with storage for peak flows.
Alternative 6: Grassy Swales	Utilization of densely vegetated areas that intercept sheet flow.
Alternative 7: Infiltration Basins	Utilization of basins designed for infiltration and percolation of captured flow to groundwater.
Alternative 8: Other Technologies	This alternative considered three other types of technologies including membrane filtration, chemical precipitation, and disinfection.

These alternatives were analyzed and ranked based on environmental, financial, real estate, construction, and operation and maintenance issues and feasibility. The evaluation revealed that no single alternative would address all objectives. Therefore, implementation of the two highest ranked alternatives, Structural Control Measures and Constructed Wetlands, was determined to be the preferred alternative. As developed for the study, the preferred alternative would include diversion of up to 330 cfs to Lake Merced through CDS units, followed by treatment wetlands. Approximately 23 acres of treatment wetlands would be developed along the southern shoreline of South Lake and the entire shoreline of Impound Lake. The preferred alternative assumed that coliform levels in Vista Grande stormwater would be lowered to 20,000 MPN/100 mL. This preferred alternative was the basis for the Lake Merced Pilot Stormwater Enhancement Project conducted by SFPUC and Daly City in 2004 and 2005 (CH2M Hill, 2004; NSMCSD, October 2005.) The study did not develop cost estimates for the alternatives analyzed or the recommended alternative.

3.3 Vista Grande Stormwater Drainage Basin Hydraulic Capacity Evaluation (CH2M Hill, 2002)

In 2001/2002, CH2M Hill performed a hydraulic capacity evaluation of the Vista Grande watershed stormwater conveyance system for the Daly City and San Mateo County. This evaluation was conducted in support of the Vista Grande Diversion Feasibility Evaluation (CH2M Hill, 2001). The study examined the stormwater system performance under the 10-year, 4-hour design storm conditions, estimated the benefit of flow diversion to Lake Merced, and provided potential system improvements to correct system deficiencies. The focus of the improvements was implementation of large upstream detention basins in Daly City.

To examine system performance for the design storm, a computer stormwater management model (SWMM) was developed. This effort involved compiling existing collection system data, such as system configuration, pipe diameters, length, elevations, slope, and other physical parameters, as well as understanding known system constraints and areas of flooding, and determining land use and percent impervious area system-wide. As part of the calibration of the model, flow monitoring at Vista Grande canal was conducted by TRS Consultants during the 1998-1999 wet weather season. The report noted that this stormwater model was designed specifically for the Vista Grande canal. As a result, calibration of the model was only performed at one point in the canal, and the variables that defined the storm drain collection system upstream of the canal were not fine-tuned. Such uncertainties in this modeling effort supported the recommendation that further flow monitoring, collection system data verification, and calibration be completed for future efforts related to the stormwater collection system. The hydraulic capacity modeling of the existing stormwater system demonstrated localized flooding beyond those noted by City staff, and identified specific surcharging pipe segments deficient in capacity.

The hydraulic evaluation of potential recommendations to correct Vista Grande drainage system deficiencies involved modeling several scenarios developed as potential solutions to the localized flooding upstream and canal overflows downstream. It was noted that the Vista Grande tunnel was the existing limitation of the system, and that modifying or replacing it was currently cost prohibitive, and therefore, upstream stormwater detention basins were investigated as a potential solutions for flooding in the Vista Grande drainage basin. The eight proposed alternatives and findings of the models are summarized in Table 3-3. It is important to note that all upstream detention scenarios modeled (Scenarios 5 through 8) assumed that Scenario 4, which included diversion of 330 cfs from the canal to Lake Merced, would be implemented.

Table 3-3 Scenarios Analyzed in the Stormwater Drainage Basin Hydraulic Capacity Evaluation (CH2M Hill, 2002)

Scenario	Description
Scenario 1: Divert of Mission Street Flow to Colma Creek Drainage Basin	Scenario 1, which is already being implemented, included diversion of flows from Mission Street into the Colma Creek drainage basin.
Scenario 2: Sliplining of the Lake Merced Blvd. 60-inch Storm Pipe	This scenario involved sliplining of large pipe south of treatment plant to address structural integrity of the pipe; sliplining of the pipe would reduce the pipe diameter to approximately 48 inches.
Scenario 3: Flow diversion from the Vista Grande canal to Lake Merced	This alternative would include the diversion of approximately 330 cfs from Vista Grande canal to Lake Merced.
Scenario 4: System Following Implementation of Scenarios 1, 2, and 3	This model scenario included implementation of Scenarios 1, 2, and 3. This scenario served as the baseline scenario from which scenarios 5, 6, 7, and 8 were modeled.
Scenario 5: Detention Basin at Junipero Serra Freeway (I-280) Cloverleaf	Involved installation of 1.6 MG detention basin at the southwest portion of John Daly Blvd. and I-280 cloverleaf. (This basin location was dropped due to site constraints and limited hydraulic benefit.)
Scenario 6: Lake Merced Golf Club (LMGC) Detention Basins	This scenario involved installation of 3 detention basins at LMGC, resulting in 4.3 MG of detention storage.
Scenario 7: Westlake Shopping Center Detention Basin	This scenario involved installation of one 36 MG detention storage basin under Westlake Shopping Center.
Scenario 8: Park Plaza Drive Detention Basins	This scenario involved installation of two detention basins: a 7.5 MG basin at Franklin Middle School and a 6.3 MG basin at Garden Village Elementary School. (The Garden Village basin was dropped due to constructability issues and limited hydraulic benefit.)

The study found the Westlake Shopping Center Detention Basin was the only basin that provided significant hydraulic system benefit. The other detention basin locations, (LMGC, and Franklin Middle School) provided benefit to localized flooding and potential for groundwater recharge. Although not thoroughly analyzed, the study also suggested that retention of stormwater at the Olympic Club could provide some groundwater recharge and stormwater benefit. As a result, the study recommended development of detention basins at Westlake Shopping Center and the two golf courses. The study recommended two approaches to implementation – developing an official stormwater management plan or initiating discussions with property owners to learn their receptiveness to the recommended on-site stormwater retention alternatives. The study did not develop cost estimates for the recommended alternatives.

In conjunction with detention basin implementation planning, CH2M Hill recommended that the City obtain the data needed to further calibrate the SWMM model. This would aid in the proper quantification of detention basin benefits and would help to prioritize additional storm drain system improvements necessary to alleviate upstream flooding.

3.4 Initiative to Raise and Maintain Lake Level and Improve Water Quality (EDAW, September 2004a, b) – Task 3 and 4 Technical Memorandums

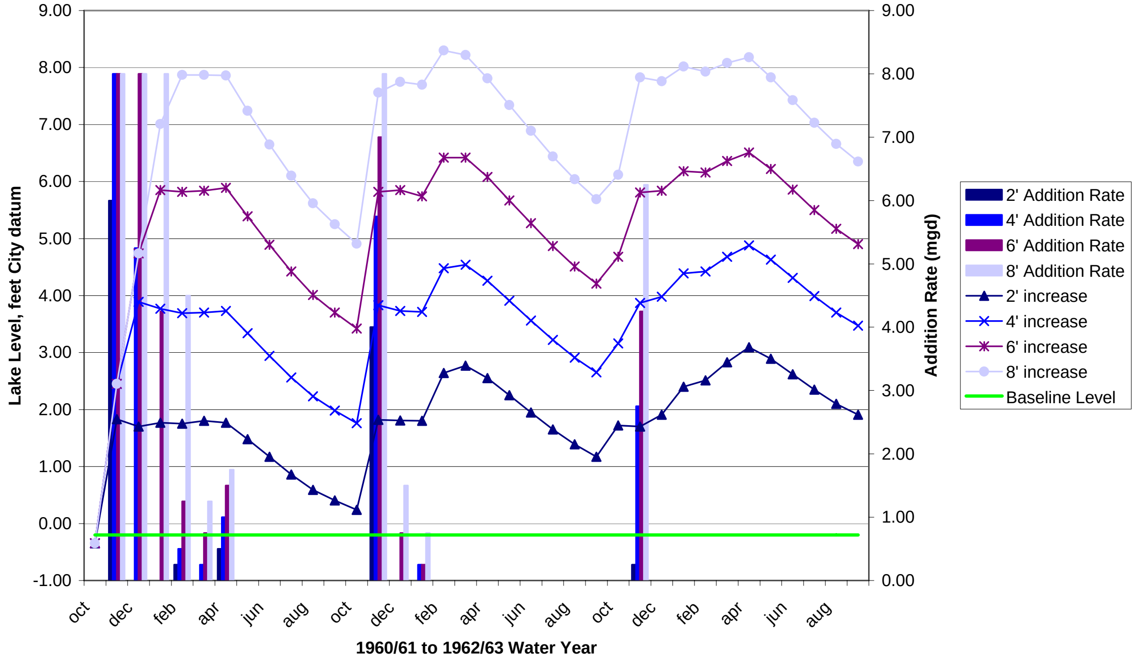
These technical memoranda (TMs) were completed as part of a series of TMs to gain understanding on the lake ecosystem, lake and groundwater interactions, and to provide information in support of maintaining and augmenting water levels and water quality improvement in Lake Merced. Four water augmentation sources for Lake Merced – SFPUC System Supply Water, Vista Grande Stormwater, Recycled Water from SFPUC or Daly City, and Westside Basin Groundwater - were evaluated for impacts to existing beneficial uses, water quality, infrastructure, vegetation, and fisheries and wildlife. Task 4 TM focused on the water quality of these different sources; and found that the water quality of Vista Grande stormwater flows shows levels of nutrients and coliform that would require treatment before supplied to Lake Merced. A pilot study to investigate the treatment of stormwater flows through CDS units and riparian buffers was recently conducted by SFPUC and Daly City to evaluate the effectiveness of nutrient and coliform removal by vegetation and wetlands before supplied to Lake Merced (NSMCSD, 2005).

The volume of water needed to raise and maintain lake levels is discussed in detail in recent years. Two water augmentation alternatives were developed – a seasonal input with fluctuating lake levels, and a year-round supply maintaining a constant lake level. Assuming seasonal water supply additions, it is estimated that in a year of average hydrologic conditions, about 500 AF will be needed to maintain the lake in a range between 3 and 5 feet (SF city datum) after the initial water requirement to bring the lake level to this level is met. Under average hydrologic conditions, a multiple year hydrograph of managed lake levels could be expected to be as illustrated in Figure 3-1. This figure is based on 1960/1961 through 1962/1963 hydrologic condition (average precipitation of 20.13 inch), in which the initial supplemental water to raise the lake level would vary depending on the desired level increase. For example, assuming an existing lake level of 0 feet (SF city datum), the initial supplemental water requirement to raise the lake level by +4 feet would be about 1,400 AF. After reaching the +4 feet increase, the lake would decline about 2 feet through the spring, summer and early fall as a result of seepage and evaporation. Seasonal additions of precipitation and supplemental water would then restore the desired lake level through the winter followed by repeat cycle of decline and subsequent seasonal addition.

As illustrated in Figure 3-2, after the initial water requirement to raise Lake Merced is met, the volume of water required to maintain the lake level in the following water year (1961/1962) is only about 600 AF. In water year 1962/1963, which was only slightly wetter than average, the volume of water to maintain lake level is close to 250 AF. Therefore, between 250 AFY and about 600 AFY of additional supply is required to maintain the lake at the desired interim lake level range average between 3 to 5 feet (SF city datum), during average hydrologic conditions. It is important to note that water requirements to sustain a target lake level will be impacted by hydrologic conditions, and will be more significant during dry year conditions.

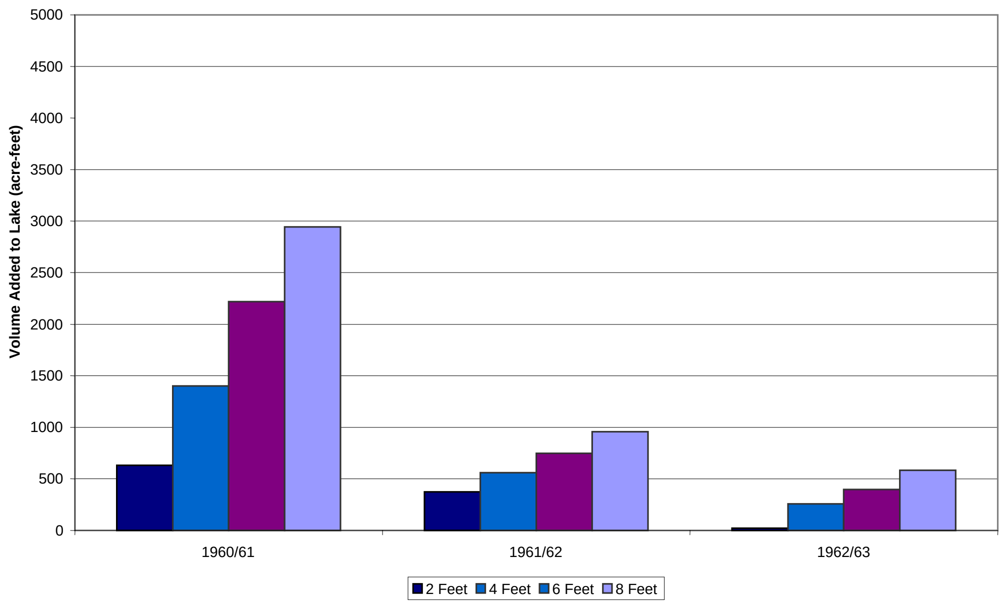
The TMs stated that existing lake water quality was determined to be eutrophic for a majority of the year with high nutrient levels and that these conditions may or may not be attributed to natural physical parameters of the lake, and can also be hastened by nutrients in other inputs, such as stormwater.

Figure 3-1: Simulated Lake Level and Water Addition Rates: Seasonal Additions, Multiple-Year Average Hydrologic Conditions [a]



a. Figure 4-5 from Task 3 Technical Memorandum-(EDAW, September 2004a).

Figure 3-2: Supplemental Water Requirements for Alternative Lake Levels: Seasonal Additions, Multiple-Year Average Hydrologic Conditions [a]



a. Figure 4-6 from Task 3 Technical Memorandum (EDAW, September 2004a).