Storm Drain Master Plan

San Mateo, California

April 2004

Schaaf & Wheeler
CONSULTING CIVIL ENGINEERS

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CITY OF SAN MATEO
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CHAPTER 1
MASTER PLAN OVERVIEW

Master planning has been undertaken to help guide the City of San Mateo establish a prioritized capital improvement program to mitigate the impacts of storm runoff. This report presents the results of San Mateo's first comprehensive storm drainage master planning effort since 1966.

OBJECTIVES

The basic objective of this master plan document is to provide an examination of flood risks within San Mateo, and identify needed projects that mitigate risks to an appropriate level. Specifically, this study identifies capital improvements needed to provide a level of flood protection consistent with the policies of the Federal Emergency Management Agency (FEMA) as administered through the National Flood Insurance Program (NFIP) and policies established by the City through this master planning process. Several objectives have been accomplished:

1. A geographical information system (GIS) based storm drain model for the entire city has been built; allowing City staff, other engineers, and developers to easily locate relevant data on a computer screen.

2. Storm drainage criteria for various system elements are presented. These criteria will govern future infrastructure design; and are used to evaluate the performance of existing facilities, and plan remedial improvements.

3. The capacities of existing storm drain facilities throughout San Mateo to meet these criteria have been evaluated. System deficiencies are categorized in terms of the risk to public safety.

4. Projects that can improve storm drain operations are identified.

5. A prioritized Capital Improvement Program (CIP) is outlined.

6. Maintenance guidelines and replacement schedules are presented.

7. Projected capital improvement costs and funding requirements are summarized.

BACKGROUND

Detailed study background including hydrologic and environmental settings, flood protection facilities, historic flooding and regulatory floodplain mapping efforts within the city are described in Chapter 2 of this report. A brief synopsis of the history behind this master plan is provided below.

Hydrologic and Environmental Settings

San Mateo encompasses six major drainages (both artificial and natural) between the Santa Cruz Mountains and San Francisco Bay along the eastern side of the San Francisco Peninsula. Major watersheds include the North Shoreview District, San Mateo Creek, East Third Avenue, 16th Avenue Drain, 19th Avenue Drain, and Laurel Creek; with the latter three draining to Marina Lagoon, a large storage and pumping facility created from the antecedent Seal Slough.

The local Mediterranean climate is mild, although winter storms between November and March can be very intense. Varied geologic settings throughout the city affect the type of flood risks presented by these intense winter storms. Stream erosion and landslides are more prevalent in the upper watersheds near the foothills, while the center core of the city is more prone to riverine flooding and the bay front area is also subject to tidal flooding. All areas within the City could experience local flooding that is a nuisance or worse, depending upon the condition of the neighborhood storm drain systems.

As a relatively mature city, San Mateo's land uses are well established and not anticipated to significantly change in the future. This Master Plan has been set up for land uses built-out to current zoning limits.

1966 Storm Drain Master Plan

In 1966 San Mateo's first comprehensive storm drain master plan divided the City into several major drainage areas, which with minor adjustments are used throughout this master plan. This document provided recommendations for the major drainage facilities within each tributary, generally leaving the design of local storm drains to developers as "lands are improved within the watershed area."[1]

Developers and the Public Works Department have improved the drainage system over the subsequent years. However, a study of the drainage system's performance as a whole has not been undertaken until now.

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[1] Bezzant, Robert G, "Drainage Phase: Public Services and Facilities Element of San Mateo General Plan," 1966.

San Mateo's Participation in the NFIP

The National Flood Insurance Act of 1968 allows FEMA to make flood insurance available only where the community has adopted adequate floodplain management regulations. The City of San Mateo joined the NFIP at the end of 1974 and has been a regular member of the program since 1981.

Historically, San Mateo was not designated as flood-prone. Studies completed in the 1980s, however, indicated that portions of San Mateo might be prone to flooding after all. In 1988 FEMA adopted new policies that changed the assessment of flood risks to those areas protected by levees.

With new rules for levee evaluation, FEMA prepared a Flood Insurance Study (FIS) for San Mateo north of Highway 92 beginning in 1996. The FIS concentrated on flooding from San Mateo Creek, and indicated that the creek levees and the Bay levee at the north end of Coyote Point were not adequate and assumed to fail during a 100-year event. The Flood Insurance Rate Map became effective on October 19, 2001 (Figure 1-1). Efforts are under way to change this map through FEMA's Letter of Map Revision (LOMR) process, and a 2002 study identified regulatory flood risks south of Highway 92 also shown on Figure 1-1.[2]

SOURCES OF FLOODING

San Mateo faces two distinct but interrelated sources of flooding: San Francisco Bay and interior runoff. Tidal flooding is addressed in *Flood Management Strategies in San Mateo, California* (Schaaf & Wheeler, 2002); while this master plan focuses on interior runoff, and in particular how that runoff is conveyed to major drainage facilities.

San Francisco Bay

High tides can cause or exacerbate flooding in the low-lying areas between El Camino Real and the Bay. Without adequate levee protection, these areas would be directly exposed to saltwater inundation. Furthermore, interior flood protection systems discharge to the Bay, so high tides also serve to limit their effectiveness. That is, it is more difficult to discharge a given flowrate against a higher tide than a lower tide.

Interior Runoff

This master plan examines how storm runoff from throughout the City of San Mateo drains into major conveyance facilities including North Shoreview pumping facilities, San Mateo Creek, the Marina Lagoon system, and directly to San Francisco Bay.

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[2] Schaaf & Wheeler, *Flood Management Strategies in San Mateo, California*, June 2002.

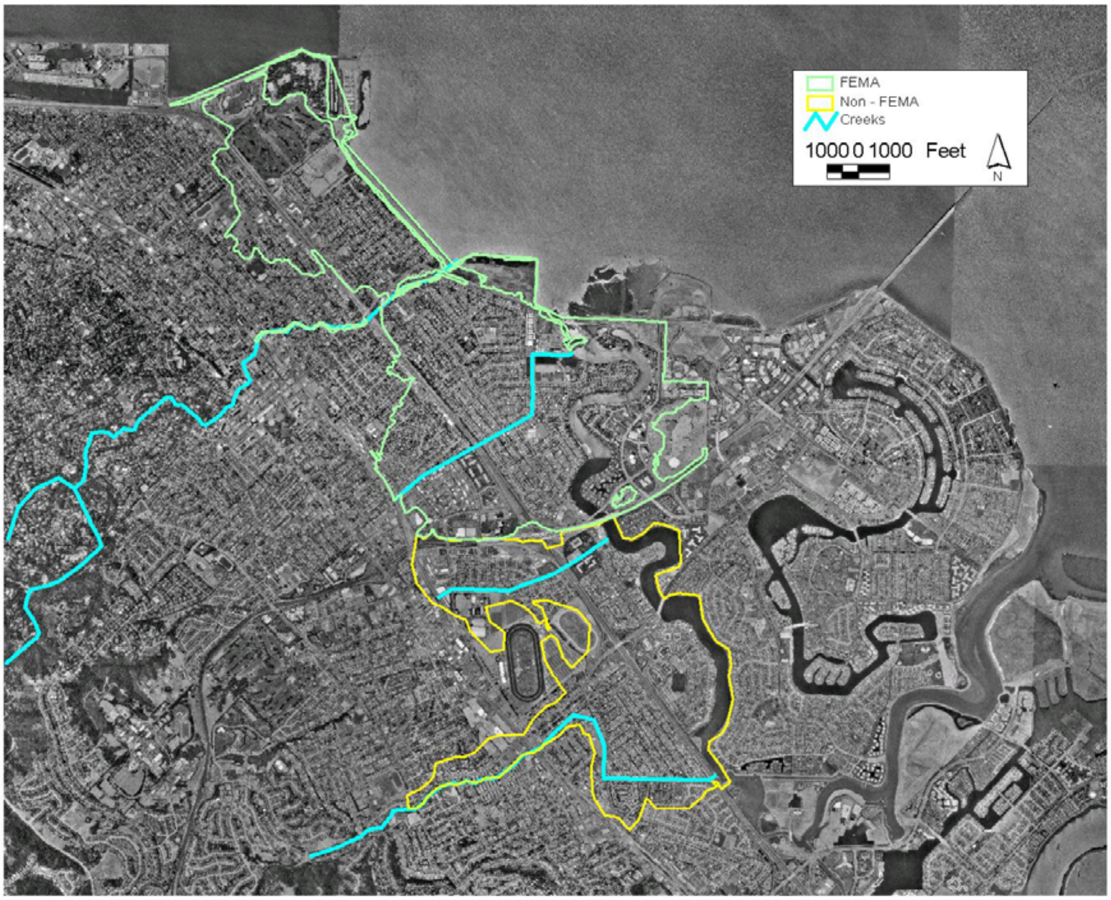


Figure 1-1: Regulatory Flood Hazards in San Mateo

Local Drainage

After tidal inundation and residual interior runoff are eliminated for the base flood, the possibility of flood risk due to inadequate storm drainage facilities may remain. The primary objective of the Storm Drain Master Plan is to address this risk.

WORK PRODUCTS

This master plan is intended to function at several levels. City planners and engineers responsible for capital improvements should find that this document contains sufficient background information and data to serve as a basis for CIP implementation and/or modification. For those city staff and other parties interested in a more in-depth examination of storm drain facilities within San Mateo, the companion ARCVIEW GIS based MOUSE model is available. MOUSE is a program designed by the Danish Hydraulic Institute (DHI) to model hydrology, hydraulics, water quality and sediment transport in urban drainage and sewer systems. As discussed in supporting reports and documents, the following information is available via the GIS:

1. ***Inventory of Drainage Facilities.*** All City-owned drainage pipes greater than 12 inches in diameter have been input into the storm drain model. Information pertaining to each system component may be accessed graphically or through database spreadsheets.

2. ***Tributary Drainage Areas.*** Land areas used to generate local runoff are also available graphically in the storm drain model, which catalogs tributary area, land use, soil conditions and other basin morphology.

3. ***Storm Drain Capacity Evaluation.*** Storm drain capacities are documented in the model. For each drainage system component, peak discharge, full pipe capacity and discharge as a percentage of capacity, and maximum hydraulic grade line are computed. Based on hydraulic grade calculations, the degree of surcharge and depth of water in the street are also determined. This determination is then used to assign priorities for system remediation.

4. ***Drainage System Profiles.*** The main purpose of a GIS system is to eliminate the need for large quantities of paper documents. Since there are over 4,600 separate storm drain lines and channel reaches that have been modeled, those interested in viewing drainage system profiles may do so graphically using software features specifically designed for this purpose.

FINDINGS

Several conclusions have been reached regarding San Mateo's storm drainage systems, and methods to improve their performance so as to reduce the risk of property damage:

1. Most storm drain problems occur between Alameda de las Pulgas and Highway 101. Alameda de las Pulgas marks a general slope break where fairly steep drainages feed into underground pipe systems. Many of the pipes are undersized and cause local flooding.

2. Problem areas are fairly evenly spread geographically from north to south San Mateo.

3. Pump stations are generally adequate and do not require substantial remediation.

4. Channel improvements will greatly improve drainage throughout the city. These improvements include increasing capacity at road crossings and adding floodwalls.

5. There are relatively few areas where the storm system is gravely undersized. Most of the flooding problems do not pose high risks to human life; though many are a threat to property.

6. The quality of available storm drain infrastructure data is relatively poor. Obtaining better data will greatly improve the numerical models and increase confidence in their results. New City-wide topographic information would be highly beneficial.

MASTER PLAN COSTS AND BENEFITS

Capital projects are needed to provide the benefits of reduced flood risk and relief from economic impacts during heavy storm water runoff events. Failure to provide capital improvements or maintain the storm drain systems could interrupt daily commerce throughout the city, so all residents receive a benefit from a functional storm drain system regardless of whether their property is directly affected by said improvements and maintenance.

The requisite nexus between master plan implementation and parcel assessment is that each property should be assessed in direct proportion to the amount of runoff it generates, which in aggregate is the sole reason for the City's storm drain capital and maintenance budgets. To maintain all property owners on an equal footing with regard to benefit calculation, this master plan recommends capital improvements that provide a certain level of service city-wide. Storm drain improvement benefits are proportioned on the basis of equivalent tributary area for each parcel as described in Chapter 10.

Table 1-1 summarizes recommended storm drain capital improvement costs maintenance and long-term replacement programs for storm drains, providing as well an approximate annual breakdown of drainage fees based on the concept of "effective acre," which is based on how much runoff is generated by various land uses. Capital costs are amortized over twenty years at six percent interest.

TABLE 1-1: SUMMARY OF MASTER PLAN COSTS

Master Plan Improvements	Capital Cost	Amortized Cost	Annual Cost per Effective Acre
High Priority CIP Projects	$20,000,000	$1,744,000	$400
Medium Priority CIP Projects	$10,000,000	$872,000	$200
Low Priority CIP Projects	$5,000,000	$436,000	$100
Total CIP Projects	$35,000,000	$3,052,000	$700

FUNDING SOURCES

The City is operating under political and legal constraints to the raising of monies for public works projects. Residents in public forums have voiced their political concerns, and the City's attorney must work through the legal aspects of each type of potential funding mechanism. This study does not attempt to promulgate a detailed financing plan; rather, it provides a menu of possible capital sources for City leaders and residents to consider in Chapter 10 including:

- General funds
- Loans
- Grants
- Outside agency programs
- Special legislation
- Redevelopment agency money
- Taxation (Mello-Roos)
- Benefit-assessment districts
- Storm drain utility user fees

City proposals to spread the burden of flood risk remediation throughout all of San Mateo are appealing because the entire city generates runoff, and thus contributes to the flood hazards.

RECOMMENDATIONS

Reducing local flood risks by improving the City's storm drainage systems is a worthy goal that justifies the costs of said improvements presented in this report. City officials have laid out a comprehensive long-term plan to address regulatory flood risks associated with extreme event runoff. This Master Plan provides an additional tool to reduce local flood risks not covered by FEMA mapping. Substantial reductions in local flood hazard — whether nuisance flooding or real hazards to property — can be achieved by completing the identified capital improvement projects.

ACKNOWLEDGEMENTS

Several individuals have provided invaluable assistance in the collection of data for and review of the master plan documents. In particular, the assistance of Mmes. Susanna Chan, P.E.; Darla Reams, P.E. and Amy de la Salle; and Messrs. Otis Chan; Andrew Wang; Bob Hulsmann and Chip Short, LS are appreciated.

CHAPTER 2
BACKGROUND

This chapter provides a general background of flood management issues currently affecting the City of San Mateo. Hydrologic and environmental settings are described, along with flood protection and storm drain facilities. Historic flooding, a summary timeline of regulatory floodplain mapping efforts within the city, and Master Plan objectives are discussed herein.

HYDROLOGIC AND ENVIRONMENTAL SETTINGS

San Mateo is situated between the Santa Cruz Mountains and San Francisco Bay along the eastern side of the San Francisco Peninsula approximately 12 miles south of San Francisco. Cities that border San Mateo include Burlingame to the north, Belmont to the south, Foster City to the east, and the Town of Hillsborough to the west. Figure 2-1 places San Mateo in its regional context.

Climate

San Mateo's climate is moderate — some would say ideal — with an average summertime high temperature of 78°F, dropping to an average winter nighttime low temperature of 42°F. Mean average precipitation at City Hall is roughly 22 inches, with about 90 percent of that precipitation falling from November through March. Precipitation occurs entirely as rainfall. Snowmelt is not a hydrologic process that significantly affects runoff in the city.

Geology

Much of San Mateo was built over alluvium deposited from streams discharging from the Santa Cruz Mountain foothills to the west, and tidal flats adjacent to San Francisco Bay. The varied geologic settings affect the types of flood risk experienced throughout the city.

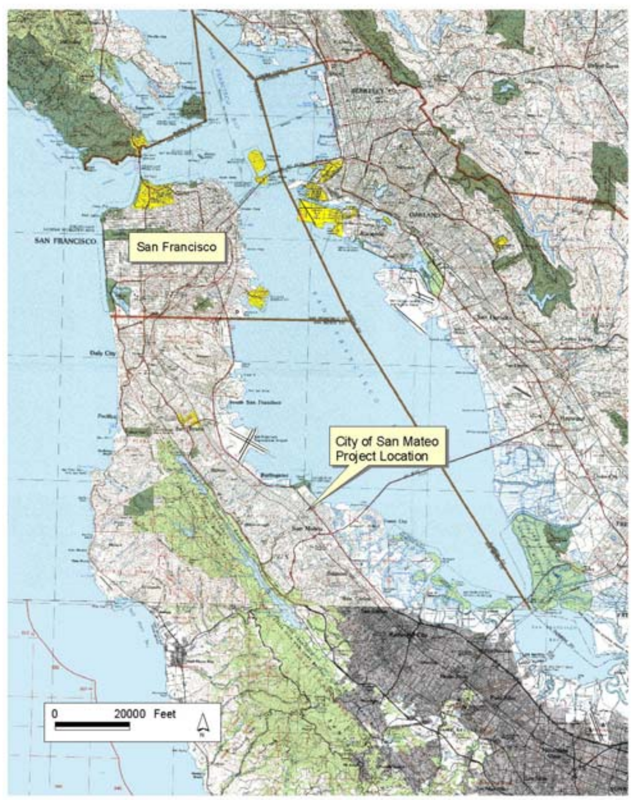


Figure 2-1: Vicinity Map

Stream erosion and landslides are more prevalent in the upper watershed near the foothills. The center core of the city is more at risk from riverine flooding, and the bay front area is also prone to tidal flooding.

Figure 2-2 delineates the City's seven major watersheds, with the first three draining directly to San Francisco Bay, either by gravity or pumping, and the latter four draining to the Marina Lagoon, whose water is pumped into the bay:

1. North Shoreview Pump Stations
2. San Mateo Creek
3. East 3rd Avenue and Detroit Drive Pump Station
4. 16th Avenue Drain
5. 19th Avenue Drain
6. Laurel Creek
7. Direct Drainage to Marina Lagoon

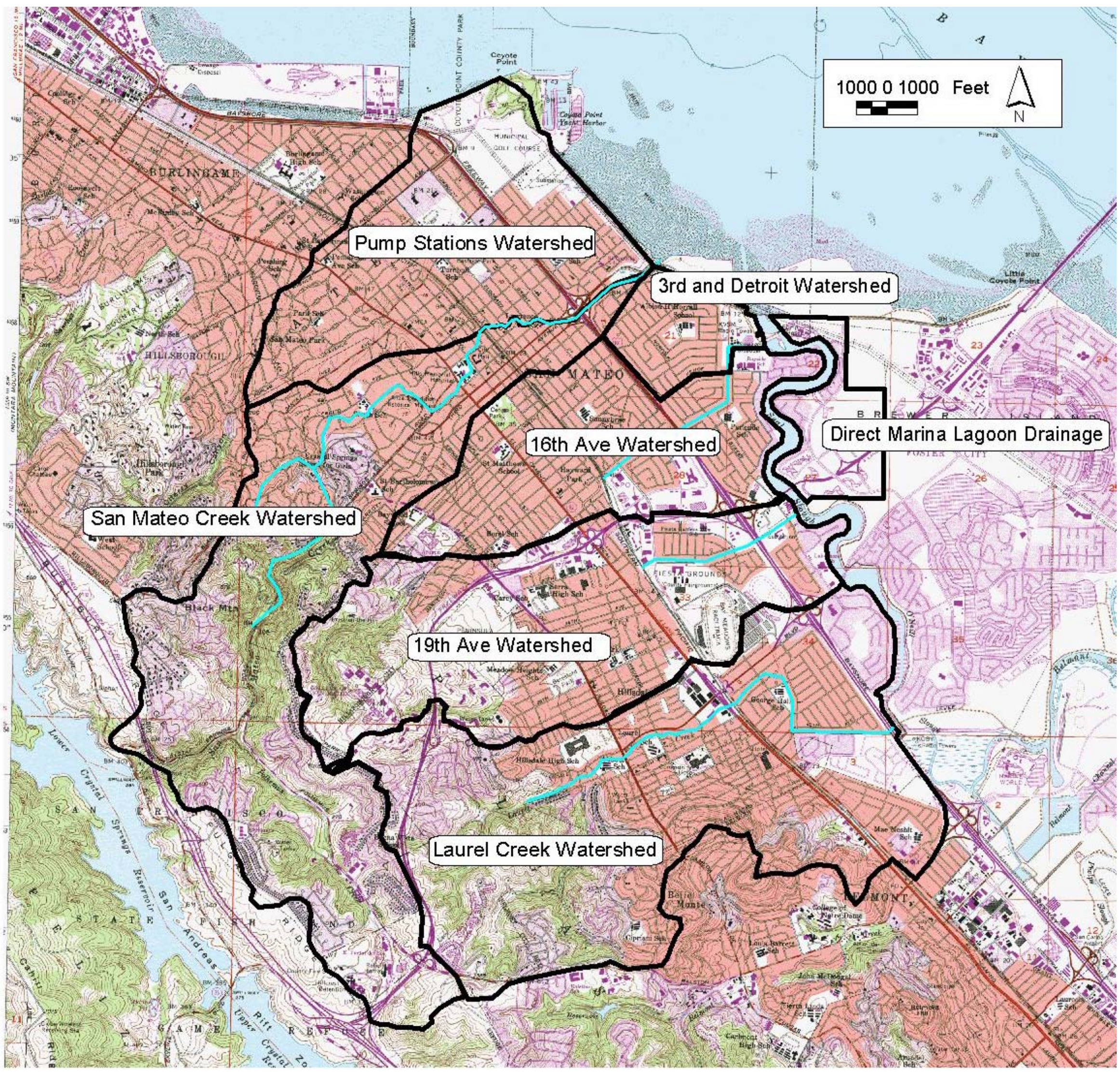


Figure 2-2: San Mateo Watersheds

Land Use

Although open space is scattered throughout the city, particularly in the foothills, the vast majority of San Mateo has been urbanized. The city has matured to the point where urban redevelopment and small-scale infill are the predominate forms of new development within established zoning. For the most part, existing development is revitalized rather than having open space converted to more intense urban uses. Zoning within the city also appears to be stable, so with few exceptions land uses are not changing over time.

A fairly wide mix of land uses characterizes San Mateo. From protected watersheds and open space areas in the foothills, creeks flow through lower-density hillside residential areas through increasingly dense residential areas mixed with commercial and industrial uses. The city has been developed to the shores of San Francisco Bay. Most residential areas retain some open space in the form of lawns and gardens, and public parks are scattered throughout the city. Large open space areas include the Sugarloaf Mountain Open Space, Laurelwood Park, Peninsula Golf and Country Club, Beresford Park, Bay Meadows Race Course, Los Prados Park, Central Park, Joinville Park, Shoreline Park, and Coyote Point County Recreation Area and the Municipal Golf Course. The training facility associated with Bay Meadows was recently converted to high density residential and commercial use.

FLOOD PROTECTION FACILITIES

Flood protection is provided to developed portions of San Mateo by a series of levees that keep San Francisco Bay out, while storm drains and creeks convey storm-generated runoff into the bay. These are distinct flood protection systems whose functions affect each other, particularly near the Bay.

Outboard Levee System

San Mateo is protected from San Francisco Bay tidal flooding by a system of levees located within San Mateo, Foster City, and Belmont. Figure 2-3 shows the “outboard,” or “bayfront,” levee system that prevents tidal inundation from the bay.

Interior Flood Protection Facilities

Precipitation that falls on land from the Santa Cruz Mountain foothills to the bayland area generates storm water runoff. This runoff flows downhill toward the bay and is conveyed in a number of natural and manmade flood protection systems. These systems interact with one another, and potential improvements to one system may impact the performance of other systems, either positively or negatively.

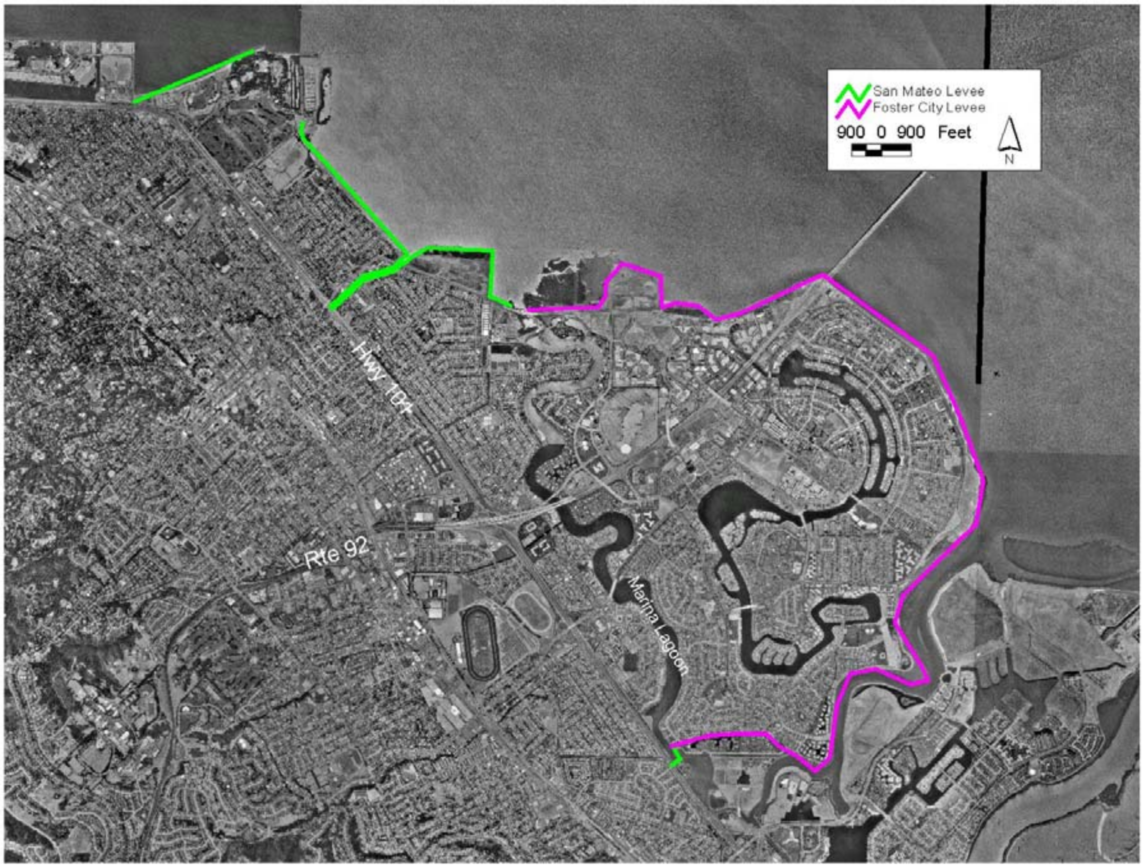


Figure 2-3: Outboard Levees

On the north end of San Mateo, pumping systems provide flood protection to low-lying areas in the North Shoreview Neighborhood and to the South Shoreview local drainage system at East Third Avenue. With the tidal floodplains walled off from San Francisco Bay by the outboard levee system, pump stations are required to discharge runoff that collects behind the levee. The Coyote Point and Poplar Avenue Pump Stations were evaluated in *Flood Management Strategies for San Mateo* (Schaaf & Wheeler, 2002). Storm drain master planning described herein assumes that recommended pump station improvements will be made.

San Mateo Creek in the northern half of the city and Laurel Creek to the south represent natural channels that have been improved in various reaches to provide enhanced flood flow conveyance from more urbanized areas served by storm drain systems. The 16th Avenue Drainage Channel and 19th Avenue Drainage Channel are excavated channels collecting local runoff from storm drains and conveying that runoff through fully urbanized areas to the Marina Lagoon, which is an artificial tidal lagoon that provides flood protection and other benefits described in Chapter 5.

Storm runoff is delivered to the major flood protection facilities through a system of street gutters, pipes, ditches and pump stations. The Storm Drain Master Plan provides a numeric model of the City's local storm drains and ties them into the major flood protection facilities to analyze their combined performance during selected storm events. This effort represents the first comprehensive storm drain planning study in San Mateo since 1966.

As improvements are made to the major flood protection facilities throughout the city, the Storm Drain Master Plan will be crucial to identify further potential for residual flooding caused by inadequacies in local drainage systems, and evaluate alternative remediation projects to mitigate that flood risk.

HISTORY OF FLOODING WITHIN SAN MATEO

Not every flooding event is recorded. However, it is useful to recount both published and anecdotal information about previous flooding episodes. Historic information can be valuable in highlighting areas of recurring problems, and gauging the relative severity of various flood events. Streamflow records at the nearest USGS gage (San Francisquito Creek at Stanford, which is about ten miles to the south of San Mateo's City Hall) have been examined for the ten largest runoff events on record (Table 2-1). The gage has recorded stream flows since 1932, with data missing from 1942 to 1950.

TABLE 2-1: TEN LARGEST RUNOFF EVENTS ON RECORD

San Francisquito Creek at Stanford		
Event Date	**Maximum Discharge (cfs)**	**Flood Frequency (years)**
February 1998	7,200	80
December 1955	5,560	25
January 1982	5,220	20
April 1958	4,460	15
January 1967	4,000	10
February 2000	3,930	9
November 1950	3,650	8
February 1986	3,480	8
January 1983	3,420	7
January 1973	3,400	7

A sampling of published and anecdotal recollections of several storm events is presented below for historical perspective on storm events in San Mateo. Recorded flood severity, unfortunately, often reflects individual newspaper reporters' writing styles as much as unbiased and reliable data. Individual storm events are recounted in chronological order.

February 1940

Heavy rainfall and high winds combined to cause extensive damage throughout San Mateo County, primarily from overblown trees and landslides. Power outages and road damage was common. San Mateo Creek threatened to overflow its banks, but there is no record that it did.

December 1955

The Christmas 1955 storm is considered to be the "storm of record" for Northern California by the Army Corps of Engineers, and the maximum 24 hours of its 72-hour rainfall pattern is used within this study as a basis for storm drain system evaluation. Two days of heavy rainfall lead swollen creeks to overtop their banks throughout the Peninsula. Until the 1998 El Niño, the 1955 event represented the flood of record for San Francisquito Creek.

San Mateo City officials called the flooding a "one in a hundred year" event, but subsequent years of streamflow records have reduced the estimated magnitude of peak December 1955 runoff to the equivalent of a 25-year event. San Mateo Creek, Laurel Creek, and what is now the 19th Avenue Drain were reported to have overtopped their respective banks. San Mateo Creek flooded the basements of Mills Hospital, downtown businesses and the Shoreview neighborhood. Laurel Creek spills flooded El Camino Real from 25th Avenue south to Belmont. "Knee-deep" flooding resulted from spills from the 19th Avenue Drain. Storm drain inadequacies were blamed for the flooding of ground floor apartments at West 3rd Avenue and Eaton Road.

The worst reported flooding was in the South Shoreview neighborhood, where Norfolk, Newbridge, and Ocean View Avenues were full of water to the doorsteps of homes. Many homes were damaged, and evacuation was contemplated. Local flooding would have been much worse, but was at least partially mitigated by sandbagging efforts along the bayfront levee and San Mateo Bridge.

April 1958

San Mateo and Laurel Creeks overflowed their banks primarily due to debris blocking bridges and culverts. Blocked storm drains also caused some local flooding. San Mateo Creek flooded the City of Paris department store and damaged merchandise. The City Library was also threatened but not flooded. In the Shoreview area and San Mateo Village, flooding was blamed on Laurel Creek blockages. Creek overflows flooded Santa Clara Street, Otay Circle, Branson Drive, 39th Avenue, 40th Avenue and Gatos Way, among others. Shoreview flooding was concentrated on Royal Avenue. Businesses along El Camino Real, Hillsdale Boulevard, and 25th Avenue also sustained damage.

January 1967

Minor street flooding due to the rains and a high tide was reported for low-lying areas along the bay. Serious flood damage was not reported.

January 1973

San Mateo County was hit by two combined storms and high tides within three days in the winter of 1973. The San Mateo Times reported high tides of 8.7 feet at the San Mateo Bridge for January 18, on what is believed to be the MLLW datum. (The 100-year tide at the bridge is 10.7 feet MLLW or 7.1 feet NGVD.) During this storm event, however, San Mateo City officials were pleased with the operation of the levees and the Marina Lagoon. On January 16, when rainfall was most intense, only minor intersection flooding was reported. On January 18, when the tides were highest, two feet of water was reported flowing over East 3rd Avenue. As an aside, tides overtopped a levee along Belmont Slough in Foster City, and Beach Park Boulevard was closed from Shell Street to Foster City Boulevard. Apparently, no homes were damaged during this incident, however. A break in another Foster City levee threatened Redwood Shores.

January 1982

Record rainfall — nearly six inches in 24 hours at San Francisco International Airport — forced evacuations throughout the Peninsula during the January 4 storm. Most of the damage throughout the County was attributed to mudslides, but flooding in low-lying areas also contributed to the total damage figure. Damage was heavy and widespread, prompting Governor Jerry Brown and President Reagan to declare San Mateo County a disaster area on January 7. Four people lost their lives county-wide, and damages topped $30 million. The City contributed $300,000 in private property damage to that total, and $250,000 in public property damage. More than 100 homes were flooded with two to three feet of water in the Shoreview, San Mateo Village, and San Mateo Park areas.

January 1983

Reported high tides of 7 to 9 feet and a week of storms combined to cause widespread flooding along San Mateo County's bay front. Power outages, flooding, mudslides and road closures led County officials to declare a state of emergency on January 27. Areas along the bay shore suffered heavy damage caused by tidewaters, and high tides reduced storm drainage systems' abilities to handle high local runoff and overflowing creeks.

In San Mateo, nine-foot bay tides (MLLW, or about 5.5 feet NGVD) flooded intersections west of Bayshore Freeway near the Burlingame border. Saltwater lapped against East 3rd Avenue, and San Mateo Creek overflowed on January 28, also flooding 3rd Avenue. At the south end of the city, Highway 92 was nearly closed by floodwaters, and the El Camino Real underpasses at Hillsdale Boulevard and the Southern Pacific Railroad were closed because of hubcap-deep water.

February 1986

Ten days of steady rain and flooding in Northern California prompted a state of emergency for most of the region. By February 21, the storm system had produced as much as fifty percent of the average annual precipitation in some areas. While spared the severity of flooding along the Napa and Russian Rivers to the north, or in the Sacramento area, homes and businesses were flooded in several Peninsula cities, as high tides combined with heavy runoff to cause localized flooding. In San Mateo, high tides caused sewer backups in the Shoreview area and southern San Mateo. Storm drain backups also flooded street intersections throughout the city. Marina Lagoon served the city well by storing excess storm runoff and relieving surcharged storm drain systems.

February 1998

Saturated ground conditions and heavy rainfall over a two-day period produced the flood of record on San Francisquito Creek coincident with high tides in San Francisco Bay. San Mateo was spared the heavy flood damage experienced by Palo Alto and East Palo Alto, but the storm forced uncontrolled releases from Crystal Springs Reservoir into San Mateo Creek. Spills from Crystal Springs caused some damage due to erosion and landslides, but the creek was never at “flood stage”. San Mateo County was declared a federal disaster area, with over $40 million in losses countywide.

REGULATORY FLOOD HAZARDS

Typical insurance policies do not cover the potentially devastating consequences of flooding. Even after a catastrophic event wherein houses and businesses are completely destroyed, property owners remain liable for their mortgage balances without the equity to cover them. National flood insurance was created in 1968 for the expressed purpose of providing flood coverage even in the absence of a Presidential declaration of disaster. The intent of flood insurance is to proactively prepare for future flood damages on an equitable basis nation-wide.

National Flood Insurance Program

The National Flood Insurance Program (NFIP) as administered by the Federal Emergency Management Agency (FEMA) allows property owners within participating communities to purchase insurance that protects against losses from flooding. Damages to structures and contents are covered by the flood insurance, which may be purchased through residential and commercial insurance agents. For San Mateo to participate in the NFIP, the City must adopt and enforce a floodplain management ordinance to reduce future flood risks to new construction in Special Flood Hazard Areas. In return, the Federal Government will make flood insurance available in the city.

San Mateo's Participation in the NFIP

The National Flood Insurance Act of 1968 allows FEMA to make flood insurance available only where the community has adopted adequate floodplain management regulations. The City of San Mateo joined the NFIP at the end of 1974, and has been a regular member of the program since 1981.

The first Special Flood Hazard Area map was produced in 1975 and rescinded in March 1981. At that time the entire city was mapped as a Special Hazard "Zone C," which essentially meant that the city was designated as non-floodprone. Lenders therefore would not have required flood insurance coverage on mortgages and business loans, although residents and businesses could have purchased optional flood insurance at fairly reasonable rates.

Further studies in the 1980s indicated that portions of San Mateo might be prone to flooding after all. Also, FEMA adopted new policies in 1988 that changed the assessment of flood risks to those areas protected by levees.

Ensign & Buckley, a Sacramento consulting engineering firm, prepared a Flood Insurance Study (FIS) for San Mateo (north of Highway 92) under contract to FEMA beginning in 1996. Ensign & Buckley's study concentrated on riverine flooding from San Mateo Creek, and indicated that the creek levees and the Bay levee at the north end of Coyote Point were not adequate and assumed to fail during a 100-year event.

After considering the City's technical appeal to its FIS, and several City requests for delays to address outstanding issues, FEMA issued a Letter of Final Determination on April 19, 2001 and ended the statutory 90-day appeal period. The final FIRM and base flood elevations become effective on October 19, 2001. In 2002 Schaaf & Wheeler prepared a comprehensive flood management study for San Mateo that generally confirmed FEMA's mapping of special flood hazard areas within San Mateo, and identified other flood risks south of Highway 92 (Figure 2-4).

Current Regulatory Activity

The City is actively pursuing projects that will reduce regulatory flood hazards from the areas highlighted in blue on Figure 2-4 to the areas shaded in green:

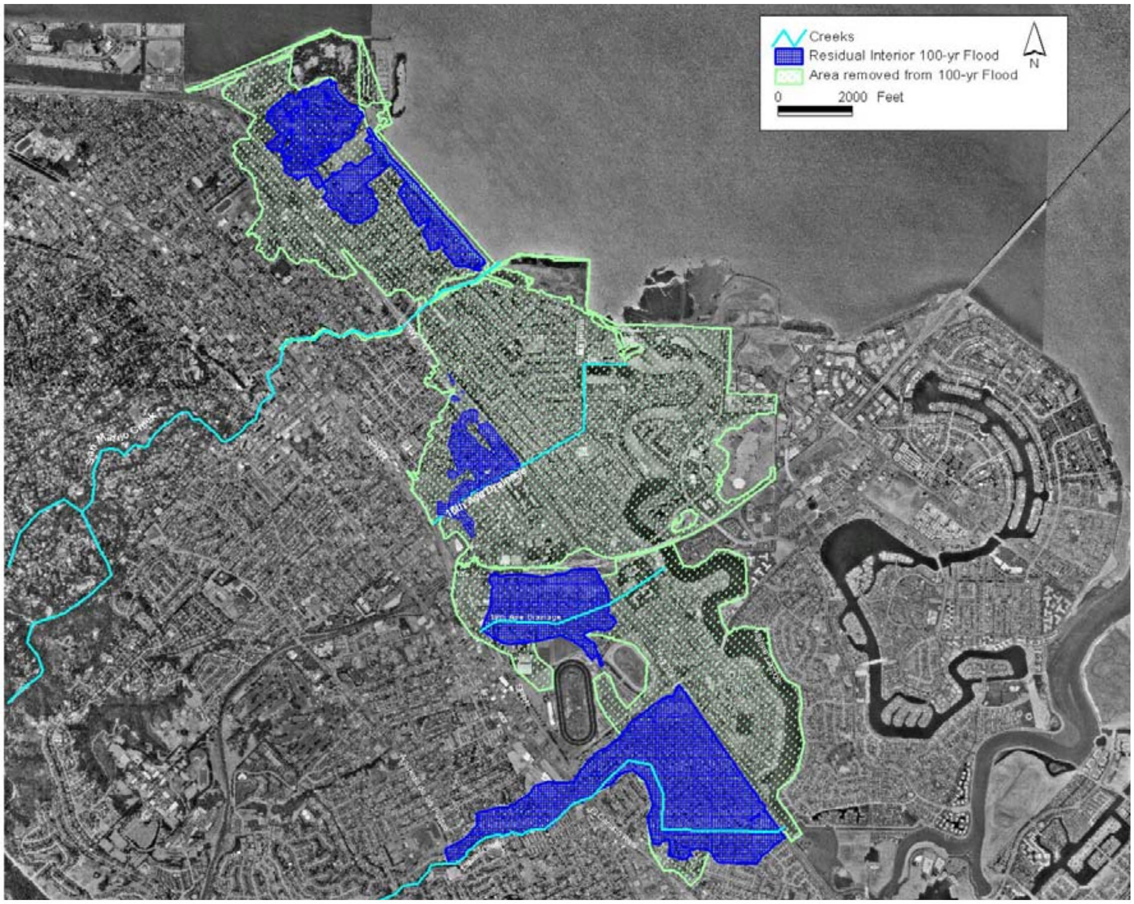


Figure 2-4: Proposed Reductions in Regulatory Flood Hazards

1. San Mateo Creek. The City obtained a Conditional Letter of Map Revision (CLOMR) from FEMA stating that City floodwall improvement between J. Hart Clinton Drive and Highway 101; its replacement of the Norfolk Avenue Bridge; and Caltrans' improvement of the Highway 101 culvert and associated on- and off-ramp bridges would meet national standards for 100-year flood protection established by the NFIP.

2. Outboard (coastal) levees. At the beginning of 2004, the City's CLOMR submittal for proposed projects to provide flood protection from San Francisco Bay tide was under review by FEMA's Technical Evaluation Contractor, and the City had begun final plans to rehabilitate the O'Neill Slough Tide Gate.

3. Crystal Springs Reservoir Flood Pool. The City has reached an agreement with the San Francisco Public Utilities Commission to reserve a two billion gallon winter flood pool in Crystal Springs Reservoir. This flood pool eliminates a regulatory one-percent spill from San Mateo Creek near Mills Hospital.

MASTER PLAN OBJECTIVES

The basic objectives of this master plan are to evaluate existing storm drainage conveyance, storage and pumping facilities and identify capital improvements needed to provide a level of flood protection consistent with the policies of the Federal Emergency Management Agency (FEMA) as administered through the National Flood Insurance Program (NFIP) and City policies.

NFIP regulations define the "base flood" as a flood magnitude having a one percent chance of being equaled or exceeded in any given year. Often this is referred to as a "one-percent" or "100-year" flood. This level of risk, however, should not be confused with a flood that *will* occur once every one hundred years, but one that might occur once every one hundred years or so *on the average* over a very long period of time. In fact, over the life of a 30-year mortgage, there is a 26 percent chance of experiencing a flood equal or greater in magnitude than the base flood as demonstrated by Table 2-2, which provides an interesting perspective on flood risk.

TABLE 2-2: RELATIVE RISK OF VARIOUS FLOOD EVENTS

	10-year	25-year	100-year
Annual risk of event	10%	4%	1%
Risk of at least one event in 5 years	41%	18%	5%
Risk of at least one event in 10 years	65%	34%	10%
Risk of at least one event in 30 years	96%	71%	26%
Risk of at least one event in 50 years	99%	87%	39%
Risk of at least one event in 100 years	99.997%	98%	63%

Based on the statistics presented above, this Master Plan establishes level-of-service criteria for the design of new drainage systems and the evaluation of existing systems. The Master Plan seeks to:

- Assess the performance of storm drainage systems against those criteria;
- Identify capital improvements to reduce flood risk and meet those criteria;
- Prioritize said capital improvements based on risk reduction; and
- Describe alternative funding mechanisms to implement necessary capital projects.

CHAPTER 3
METHODOLOGIES

The criteria used to design storm drain systems and evaluate their performance must be defensible yet simple to understand and apply. Ideally, the same criteria used to analyze system performance will also continue to be used for future infrastructure design. As discussed in this chapter and the next, storm drain design criteria set forth in City of San Mateo Standard Specifications is used in this master plan, with some additional provisions as discussed herein.

SYSTEM MODELING

MOUSE is a package of software programs designed for the analysis, design and management of urban drainage systems, including storm water sewers and sanitary sewers. The MOUSE model works with add-on modules to ArcView GIS and can simulate runoff, open channel flow, pipe flow, water quality and sediment transport. This program has been chosen to model the San Mateo storm drain system because of its capabilities with overland flow, pumps, and open channel flow; the incorporation of the SCS hydrology method; and the overall stability of the model. The City's modeling package consists of three interrelated products:

1. MOUSE is a group of hydrologic, hydraulic, water quality and sediment transport modeling modules which can be used together or independently. The modules used in the San Mateo Storm Drain model include the Surface Runoff Module, which computes surface runoff using one of five computational methods and one of three hydrological parameters; and the Hydrodynamic Pipe Flow Module, which calculates an implicit finite-difference numerical solution of the St. Venant flow equations for the modeled pipe network.

2. MOUSE GM is an ArcView3.3-based program which includes tools specifically designed to develop urban drainage models. MOUSE GM provides a graphical user interface for data input and editing and serves as a bridge between ArcView GIS and the MOUSE modeling program. Capabilities of MOUSE GM include import and export of model data, network editing and gap-filling, catchment delineation, network simplification, and importation and presentation of model results.

3. MIKEVIEW is a graphical tool used for viewing and presentation of MOUSE results. Capabilities include plan, longitudinal, and cross-section views; animation of results; presentation of flooding including water depth and pressure; and overlay of results on background graphics such as maps or aerial photos.

Data Sources

Most data used in this master plan are obtained from AutoCAD plans provided by the City of San Mateo. Street improvement plans have been consulted in some cases to fill in missing or conflicting information. Some previously gathered cross-section information and open channel measurements taken on-site are also used to supplement information from the City in certain areas. All elevations have been converted to City of San Mateo Datum minus 100 feet, to match the AutoCAD records obtained from the City of San Mateo. Conversion from City Datum to the National Geodetic Vertical Datum of 1929 (NGVD) can be achieved using the following equation:

Master Plan Datum + 2.36 feet = NGVD 1929

Information regarding pump station operation has been obtained from conversations with city operations and maintenance staff and available records.

Data Inadequacies

AutoCAD plans provided by the city are missing a large quantity of information critical to accurately modeling the storm drain system. Routinely encountered examples include:

- two conflicting pipe sizes given for a single pipe;
- no manhole indicated at the intersection of two or more pipes;
- catch-basins represented as manholes;
- sections of the system not included with the plans;
- entire channels (notably San Mateo Creek) left off the plans; and
- rim and/or invert elevations missing from manholes and catch-basins (nodes).

Out of a total of 5754 nodes originally determined to be in the system, 1646 are missing rim information and 1375 are missing invert information. Of these, 1267 nodes (22 percent of the total) are missing both rim and invert information. Once manhole nodes are added where necessary due to pipe size changes or pipe intersections, approximately 38 percent of all nodes in the system are still missing both rim and invert elevations.

To develop a working model of the storm drain system, missing information in the model has been filled in using several methods. USGS quadrangle maps, aerial photography of the City of San Mateo, and field work have been used to approximate the location and alignment of missing open channels and ditches. Missing rim elevations are assigned using a combination of DEM information and interpolation of ground elevations between labeled rim elevations in the City AutoCAD plans.

Missing invert elevations have been checked and adjusted based on longitudinal profiles of the modeled pipe network and assumed gravity flow throughout the system. Pipe sizes initially assigned based on the AutoCAD layering convention of the City plans (each pipe diameter size is drawn on a unique AutoCAD layer) have been verified and adjusted as required by visually inspecting the entire San Mateo system on the AutoCAD plans to locate the numerous instances in which the AutoCAD text conflicted with the assigned layer. Figure 3-1 represents the process of this data collection, verification, and adjustment.

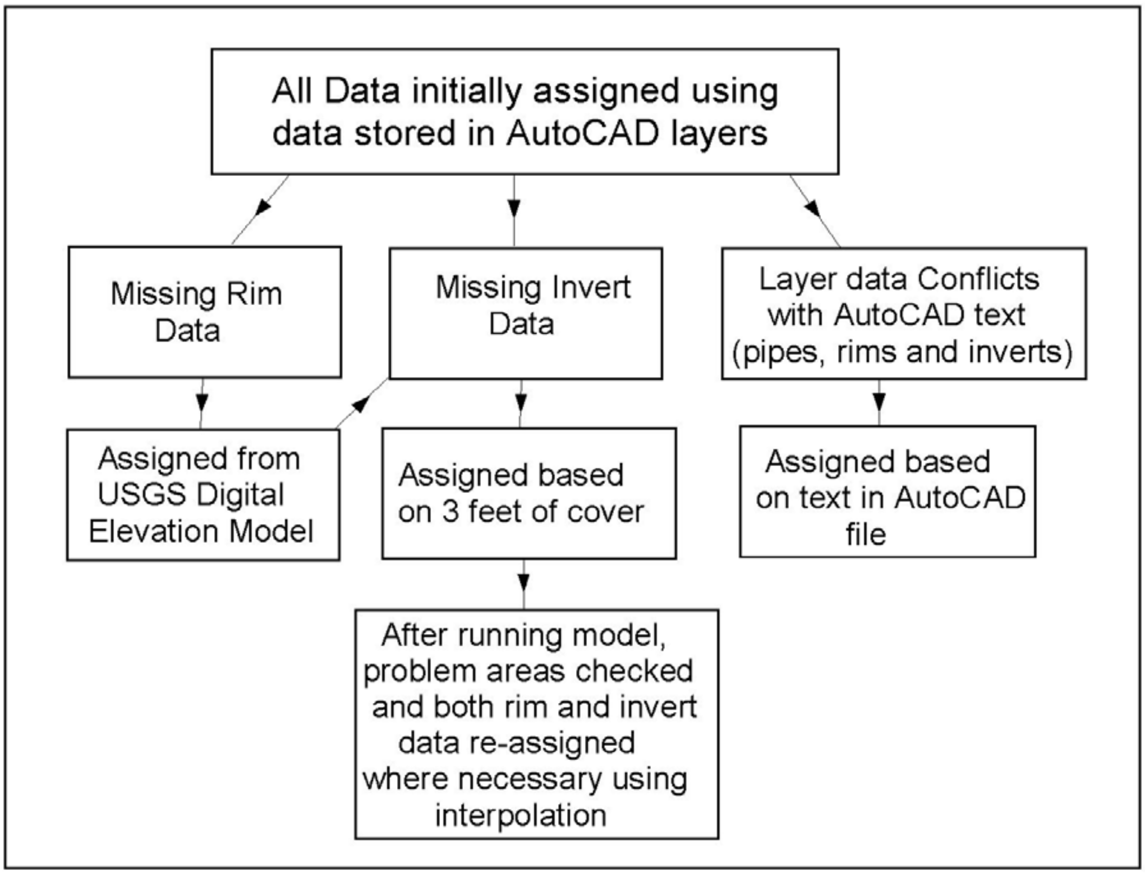


Figure 3-1: Data Collection, Verification and Adjustment Process

Recommendations to Improve Data Accuracy

Ideally, invert and rim elevations of all manholes and catch-basins should be field verified and recorded along with all pipe sizes. If a full review of the system is not feasible for the City to undertake, the acquisition of accurate city-wide topography would greatly increase the veracity of the model results. Additional data to be incorporated into model in the future should be entered directly into MOUSE, MOUSE GM, or ArcView, rather than into AutoCAD.

MOUSE MODEL

The City of San Mateo storm drain system is modeled as six independent urban drainage systems based on outlet points and major drainage for each area: North Shoreview, San Mateo Creek, East 3rd Avenue Pump Station (Detroit Drive), 16th Avenue drainage, 19th Avenue drainage, Laurel Creek, and the Marina Lagoon. Each drainage system model is composed of a pipe network (pipes, manholes, catch basins, etc.), and localized urban catchments which the network drains.

Operation

Two separate calculations are performed by MOUSE for the San Mateo model: a runoff calculation estimating the amount of water entering the storm drain system during a design rainfall event; and the pipe flow calculation which replicates how the storm drain system will convey flows to outlet locations. Flows resulting from the runoff calculation are used as inflows for the subsequent pipe flow calculation.

The MOUSE runoff model offers a choice of five runoff routing descriptions: Time-Area routing, Kinematic wave/Non-linear reservoir, Model C1, Model C2, and the Unit Hydrograph Method (UHM). The San Mateo storm drain model uses the UHM model with the SCS dimensionless hydrograph and SCS Curve Number loss method to calculate surface runoff. A simulation can be started at any point during the chosen design storm to assess surface runoff for any period of the design storm, with computations made based on a user-specified time step.

The MOUSE pipe flow model offers a choice of three flow description approximations: Dynamic Wave, Diffusive Wave, and Kinematic Wave; distinguished by the set of forces each takes into account. The San Mateo storm drain model uses most comprehensive flow description, Dynamic Wave, which incorporates the effects of gravitational, friction, pressure gradient and inertial forces. Because it accounts for all major forces affecting flow conditions, this equation allows the model to accurately simulate fast transients and backwater profiles. Transition to supercritical flow conditions is simulated by a gradual decrease in the inertial force effects calculated as the Froude number of the flow increases. The simulation of flooding at a node is accommodated by the insertion of an artificial basin above the node which will store water when the water level rises above the ground level. The surface area of the basin gradually increases (up to a maximum of 1000 times the node surface area) with rising water levels at the node; replicating the effects of flooding. Water stored in the basin begins to reenter the system when the outflow from the node becomes greater than the inflow. The pipe flow simulation can be executed using either a constant or variable time step, and can be run for any portion of the time interval specified by the input rainfall time series and corresponding calculated runoff hydrograph.

Input and Output

MOUSE surface runoff calculations require two types of input data: boundary data and urban catchment data. Boundary data for the run-off computation consists of an input rainfall time series representing the design storm event for the model. Urban catchment data includes the boundaries of each drainage catchment, along with relevant physical and hydrologic parameters including surface area and basin lag time. The runoff calculation output is a runoff hydrograph that corresponds to the input rainfall time series.

MOUSE pipe flow calculations require network data, operational data, and boundary data as input. Network data consists of the pipe network elements including nodes (manholes, basins, outlets, and storage nodes) and links (pipes, culverts, and open channels). Parameters required to describe nodes include the x and y coordinates of the node, unique name, node type, diameter for manholes, geometry for basins, ground and invert levels, and water level in outlets. Parameters required to describe links include name of upstream and downstream nodes, cross-sectional shape and dimensions, material, and upstream and downstream inverts. Structural system elements including gates, weirs, pumps and orifices are all modeled as functional relationships connecting two nodes in the system, or associated with one node in the case of free flow out of the system. Operational data consists of parameters which describe how these elements function in the network. Boundary data for the pipe flow computation can include any external loading, inflow discharges, water levels at interaction points with receiving waters; as well as the results of a runoff calculation. Figure 3-2 displays several of these input parameters.

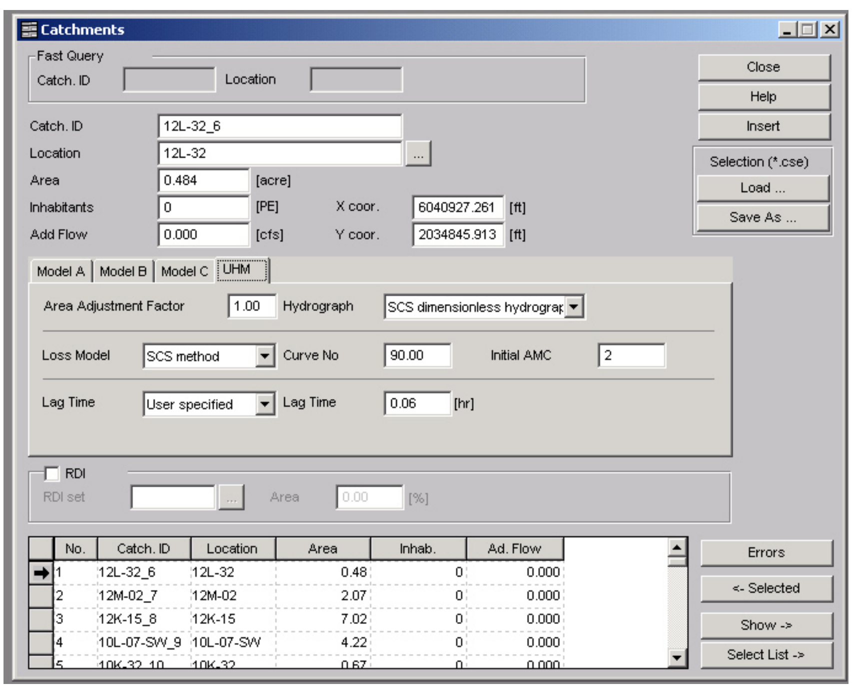


Figure 3-2: MOUSE Input

Output from the pipe flow computation includes the calculated water level at each node, pump discharges, weir discharges, water level in network branches, discharge in network branches, water velocity in network branches, water volume in the system, and time step data. Output is viewed using the MIKE View program. Results may be displayed in plan view or as a profile for a selected network section, and may be viewed as a temporal animation or at maximum or minimum values. Additional outputs which can be derived from MOUSE pipe flow results using MIKE View include water depth, flooding, pressure in closed conduits, percentage pipe filling, the flow (Q) calculated from Manning's equation for each link, and model instability.

RUNOFF ESTIMATION

Methods used in this master plan to estimate peak storm water flow rates and volumes require the input of precipitation data. Since it is impossible to anticipate the effect of every conceivable storm, precipitation frequency analyses are often used to design facilities that control storm runoff. A common practice is to construct a design storm, which is a rainfall pattern used in hydrologic models to estimate surface runoff.

Precipitation frequency analyses are based on concepts of probability and statistics. Engineers generally assume that the frequency (probability) of a rainfall event is coincident with the frequency of direct storm water runoff, although runoff is determined by a number of factors (particularly antecedent moisture conditions in the basin) not necessarily dependent upon the precipitation event. For the purpose of evaluating storm drain performance for this master plan, relevant frequencies of occurrence for precipitation (and by assumption, runoff) are ten years and 100 years.

Design Storm

The distribution of rainfall that creates the design storms used in the San Mateo storm drain model is based on the U.S. Army Corps of Engineers (USACE) three-day December 1955 Northern California rainfall event (Figure 3-3). This storm is considered to be the "storm of record" for Northern California by the USACE, and its 72-hour rainfall pattern is used within this Master Plan as a basis for hydrologic analysis.

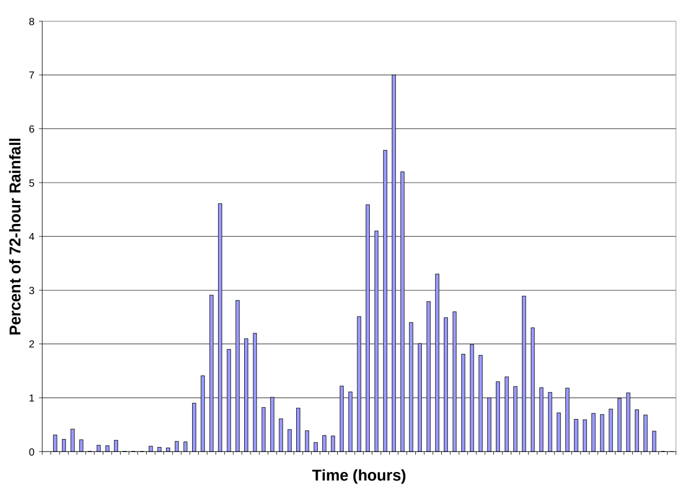


Figure 3-3: USACE 72-hour Storm Pattern

From the original 72 hour pattern, the 24-hour period giving the most rainfall is selected as the basis of the 24-hour storm pattern used in the MOUSE model. The pattern has been balanced to match local depth-duration-frequency statistics using the Santa Clara Valley Water District's Return of Period Specific Data (TDS) to obtain rainfall depths based on the mean annual precipitation found in San Mateo for the ten-year and one hundred-year return periods.

Total storm precipitation is calculated using the following regression equation:

$$x_{T,D} = A_{T,D} + B_{T,D}\, MAP$$

where $x_{T,D}$ is the precipitation depth (inches) for a given return period T (years) and storm duration D(hours), and MAP is the mean annual precipitation at the watershed centroid. Coefficients A and B for the return period and storm duration of interest are interpolated from values in the Santa Clara Valley Water District *Hydrology Procedures Manual*. The mean annual precipitation is determined using an area averaged calculation based on isohyets obtained from the City of San Mateo. The average MAP for San Mateo is 22.3 inches. Five-minute incremental rainfall intensities for the peak hour of the storm are calculated using the following equations:

$$d_{T,D} = x_{T,D} - x_{T,D\text{-}5min}$$

$$i_{T,D} = d_{T,D} / (5/60 \text{ hours})$$

where $d_{T,D}$ is the incremental depth, $x_{T,D\text{-}5min}$ is the precipitation depth for a storm of duration 5 minutes less than the duration D, and $i_{T,D}$ is the incremental intensity. Five-minute incremental rainfall intensities for the remaining hours of the storm are calculated using the following equations:

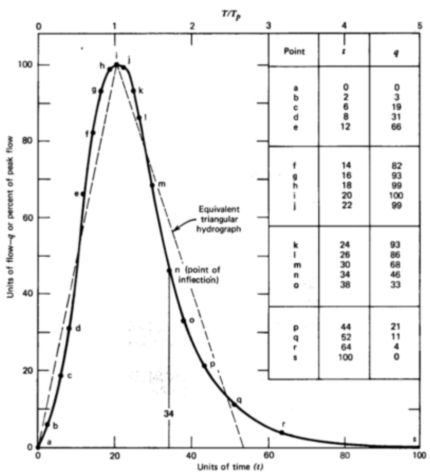
$$d_{T,D} = x_{T,D} - x_{T,D\text{-}1hour}$$

$$i_{T,D} = d_{T,D} / (1 \text{ hour})$$

where $d_{T,D}$ is the incremental depth, $x_{T,D\text{-}1hour}$ is the precipitation depth for a storm of duration one hour less than the duration D, and $i_{T,D}$ is the incremental intensity. The final 24-hour design storms are constructed by placing the calculated five-minute incremental intensities in the same order as the USACE storm event.

Unit Hydrographs

A unit hydrograph is a numerical representation of the time response of catchment runoff caused by one inch of excess rainfall applied uniformly over a unit of time. Many different techniques are available to estimate unit hydrographs. The SCS-dimensionless unit hydrograph is used in the San Mateo storm drain model, as shown in Figure 3-4. The SCS lag time equation provides an estimate of basin lag, which is defined as the time from the center of the unit rainfall event to the runoff peak. The SCS equation for basin lag is:



$$T_{LAG} = L^{0.8} \frac{(S+1)^{0.7}}{1900\sqrt{Y}} \qquad S = \frac{1000}{CN} - 10$$

where T_{LAG} is lag time in hours, L is the hydraulic length of watershed in feet, S is the maximum retention in the watershed in inches, Y is the average basin slope in percent, and CN is the SCS curve number for the watershed.

Figure 3-4: SCS Dimensionless Unit Hydrograph

Infiltration and Other Losses

Direct runoff is estimated by subtracting soil infiltration and other losses from the rate of rainfall. The Curve Number (CN) Method is an empirical methodology derived by the Soil Conservation Service (SCS) to estimate direct runoff. The method assumes an initial amount of rainfall is absorbed by tree cover, stored in depressions, and infiltrates soil before any direct overland runoff will occur. The CN represents the stormwater runoff potential in a drainage basin. Curve numbers vary from 0 to 100; with 0 equating to no runoff from a basin and 100 indicating that all precipitation will run off. The CN is estimated as a function of hydrologic soil group, land use/cover, and antecedent moisture condition (AMC), with AMC defined as the moisture content of a soil prior to any precipitation event. AMC is characterized by the SCS as:

AMC I	soils are dry
AMC II	average conditions
AMC III	heavy rainfall, or light rainfall with low temperatures; saturated soil

Curve numbers used in the San Mateo storm drain model are based on CN tables published in the Santa Clara Valley Water District Hydrology Manual; SCS maps of established Hydrologic Soil Groups; zoning information from the City of San Mateo, City of Burlingame, and County of San Mateo; and aerial photographs. Curve Numbers used in the model are presented in Table 3-1.

TABLE 3-1: CURVE NUMBERS BASED ON LAND USE AND HYDROLOGIC SOIL GROUP

Land Use/Zoning	Hydrologic Soil Group			
	A	B	C	D
Single family dwellings	57	72	81	86
Two family dwellings	61	75	83	87
Medium density family dwellings	77	85	90	92
High density family dwellings	77	85	90	92
Commercial/Manufacturing/Office	89	92	94	95
Open Space	49	69	79	84
Transportation Corridor	98	98	98	98
Industrial	81	88	91	93
Shoreline	49	69	79	84

Calibration of Antecedent Moisture Conditions

To improve estimates of discharge, the following procedure has been used to calibrate watershed Antecedent Moisture Conditions using a flood frequency analysis of recorded stream flow gage data for nearby San Francisquito Creek.

1. Perform a statistical analysis of streamflow data at the USGS gage on San Francisquito Creek at Stanford. The San Francisquito Creek gage is used because it has the longest runoff record of any creek in the San Mateo area.

2. Prepare a rainfall-runoff model for the watershed tributary to the San Francisquito Creek gage, which is hydrologically similar to San Mateo.

3. Using the 100-year and 10-year design storm rainfall patterns described herein, calibrate the San Francisquito Creek model AMC to replicate 100-year and 10-year flood frequencies for peak discharge and runoff volume.

Table 3-2 summarizes AMC calibration. A full description of the calibration methodology may be found in *Flood Management Strategies in San Mateo, California*. (Schaaf & Wheeler, 2001) The AMC used in the San Mateo model is the closest AMC available in MOUSE to the calibrated AMC calibrated to the results of flood frequency analyses of San Francisquito Creek.

TABLE 3-2: ANTECEDENT MOISTURE CALIBRATION

Return Period	Peak Discharge (cfs)	Calibrated AMC	MOUSE AMC Used
10-year (10%)	4,000	2.0	2
100-year (1%)	7,800	2.2	2

Correlation with San Mateo Watershed Models

Because the MOUSE model is calibrated to frequency analyses for San Francisquito Creek and by extension the watershed models prepared for San Mateo's FEMA processing, MOUSE results compare favorably to the bases for revised flood hazard mapping.

DRAINAGE SYSTEM ANALYSES

Detailed analyses of peak stormwater discharge are performed with the MOUSE program, which also determines the flow condition in each drainage system element.

Closed conduits

Pipes are modeled as one-dimensional closed conduit links which connect two nodes in the model. The conduit link is described by a constant cross-section along its length, constant bottom slope, and straight alignment. The unsteady flow in closed conduits is calculated using conservation of continuity and momentum equations, distinguishing between pipes flowing partially full (free surface flow), and those flowing full (pressurized flow). MOUSE deals with pressurized flow conditions by introducing a fictitious slot in the top of the conduit cross section, essentially replacing the closed conduit with an open channel. The cross section of the slot is shaped so that flow in the channel will approximate the hydraulic behavior of the pressurized pipe.

Open Channels

The MOUSE program models open channels as one-dimensional links which connect two nodes in the model. Each channel reach is modeled as a separate link. The open channel link is described by a constant cross-section along the channel reach, constant bottom slope, and straight alignment. Cross sections for each channel reach are specified individually.

Storage Facilities

Often storm drain collection systems terminate in a storage facility where runoff is pumped into a receiving creek, or metered out to downstream conveyance facilities. The Marina Lagoon and Laurel Creek Dams are examples of this type of facility in San Mateo. Storage facilities on Laurel Creek and East Laurel Creek are modeled by MOUSE.

Combining the ten square miles of Marina Lagoon drainage in the MOUSE model proved to be cumbersome and numerically unstable, so its operation is modeled with HEC-1, and the resulting stage hydrographs become boundary conditions in the MOUSE model.

Pumping Facilities

Pumps are modeled in MOUSE as a functional relation between two nodes. Pumps are characterized by starting and stopping water levels, an offset, and a capacity curve of head vs. flow data for the pump.

CHAPTER 4
DRAINAGE STANDARDS

Public works construction in the City of San Mateo follows design criteria set forth by the most current edition of Associated General Contractors of California Joint Cooperative Committee's (APWA-AGC) "Standard Specifications for Public Works Construction". Criteria used throughout the Master Plan to evaluate how well individual storm drainage systems are functioning, and how best to improve that function, are expanded from storm drain criteria in those standards. Other guidance is provided by the City of San Mateo Standard Drawings.

NEW SYSTEM DESIGN

Any proposed storm drainage system, whether to serve new development, extend existing facilities, or to remedy problem areas, should be designed in conformance with the following standards:

With 10-year Design Discharge	Hydraulic grade shall be no higher than two (2) feet below top of curb elevation at any manhole or inlet.
With 100-year Design Discharge	Hydraulic grade shall not exceed top of curb elevation.

Parts of San Mateo's existing collection system do not strictly meet these criteria; so when new systems are tied into existing systems, it may not be possible to provide a design that meets the desired standard. The design and evaluation of new systems, particularly extensions of existing systems, must be done on a case-by-case basis and these exceptions to the listed criteria for new systems are suggested where new collection systems discharge to existing systems:

With 10-year Design Discharge	Pipes shall be sized to carry the 10-year discharge without surcharging the pipe. When downstream surcharge effects are included, upstream hydraulic grades shall be no higher than the top of curb elevation at any manhole or inlet.
With 100-year Design Discharge	Hydraulic grade shall not exceed the street right-of-way elevation at any location.

Manholes should be no farther than 500 feet apart, and catch basins are to be spaced so that the maximum width of gutter flow does not exceed eight feet from the face of curb during a ten-year design storm; or 600 feet, whichever is less.

Evaluation of Existing Systems

This master plan recognizes that it may not be cost effective to replace facilities simply so that all areas within the city meet standards set for new systems. Instead, less restrictive criteria have been established in consultation with city staff to balance system performance and public safety against limited capital improvement funds. Collection system improvements are prioritized per Table 4-1.

TABLE 4-1: STORM SYSTEM IMPROVEMENT PRIORITIES

Improvements Not Required	10-year design discharge is carried in the street no deeper than the top of curb, and 100-year design discharge is carried within the street right-of-way without adjacent property damage.
High Priority	City reports recurring flooding problems and frequent citizen complaints; or a condition exists that creates a significant annual risk of flood damage; or the 10-year design discharge is not carried within the street right-of-way and would tend to cause property damage.
Medium Priority	Ten-year (10%) design discharge is carried within the street right-of-way, but the 100-year (1%) design discharge is not. Adjacent areas are prone to flooding in the most extreme runoff events.
Low Priority	Projects under this category correct the presence of nuisance flooding where the 10-year flow depth in the street is over the top-of-curb, but contained within the street right-of-way. Flooding causing significant property damage is not expected. This category also includes those areas where 100-year flows are not contained within the street-right-of-way, but would not endanger property.

Low priority are optional because they essentially alleviate nuisance flooding (with minimal risk to life and property) that has not been considered a problem in the past. Such projects would likely be funded through additional local development or as ancillary projects to street or other utility redevelopment. However, repeated flooding that disrupts residents or businesses could force these projects to receive a higher priority.

Outfalls

Where storm drain collection systems discharge to receiving waters, analyses assume that the peak of local runoff coincides with the 10-year peak stage at the collection system outfall. Under ten-year design conditions for which the collection systems are designed, this provides for a conservative analysis. For 100-year conditions, however, it is generally unrealistic to expect the collection system to discharge against a coincident peak stage within a creek with a much larger tributary area, since the smaller local basins will likely peak earlier than the receiving creek.

Where storm drain systems discharge into a pumping or detention facility, however, coincident peaks are assumed for both ten- and 100-year analyses. Outfalls to major drainage facilities shall be equipped with flap gates or other devices to prevent creek water from flowing into the storm drains.

STORAGE FACILITIES

There are two basic categories of stormwater storage: detention and retention. Some facilities in fact blur the distinction, but detention generally refers to the temporary storage of incoming runoff that exceeds the permissible release. After the storm event, the facility empties and returns to its natural function; such as a parking lot, rooftop, or park. Retention facilities, on the other hand, hold on to the excess runoff for an indefinite period. Natural ponds and lakes exemplify retention facilities where water levels change only through evaporation, infiltration and additional storm runoff. Several storage facilities in San Mateo serve a dual role for both stormwater detention and retention. For instance, pumps are used to move attenuated flood waves through the facility, but a permanent pool of water remains behind for aesthetic (or perhaps recreational) purposes.

Design Reliability

Properly designed, constructed, and maintained, stormwater storage facilities can reduce peak flows, thereby better utilizing the capacity of downstream conveyance facilities. Such facilities can also potentially mitigate the need for system upgrades. The efficacy of any detention facility, as well as ancillary improvements in the quality of storm runoff to receiving waters, needs to be evaluated on a case-by-case basis. However, some general design criteria should be applied to every basin:

1. Basins should be sized so that their output does not exceed the design capacity of downstream facilities.

2. There must be an emergency overflow section capable of safely discharging the 100-year peak inflow (should outlet works become clogged), without causing property damage.

3. At least one foot of freeboard over the maximum 100-year water surface elevation should be provided for excavated basins. Three feet of freeboard (minimum) must be provided where basins are created by berms or levees.

4. Infiltration capacity shall not be considered when designing basins, unless percolation rates are determined by on-site soils testing certified by a Civil or Geotechnical Engineer.

5. Debris and sediment loading must be considered in design (see below).

6. Ponds and basins need to be designed with shallow side slopes (5:1 minimum) so that people and animals may extricate themselves from the water should the need arise. A safety shelf may also be considered. Facilities that pose an inordinate risk to the public should be fenced off. Inlet and outlet openings larger than six inches in diameter must be screened to protect children and animals.

7. A mechanism for draining the basin should be provided. If the basin also serves as a pumping forebay, the pumping facilities must be capable of fully dewatering the basin.

8. Facilities designed for the permanent (or semi-permanent) retention of water should be deep enough to avoid eutrophication and breeding insects. Pond surface areas should be at least one-half acre, with a minimum depth of ten feet over at least a quarter of the area. The average depth over the rest of the pond needs to be at least five feet. Basin outlets should be positioned opposite from the inlet to promote circulation. Stocking permanent ponds with fish also promotes good water quality.

9. Underdrain systems to minimize wetness should be considered for detention facilities not intended as permanent water features. This helps to prevent the facility from encouraging insect populations, and also provides for a quicker return to its dry weather function.

10. Basin bottoms and sides should be stabilized with vegetation to withstand periodic flooding and prevent erosion. Basin outlets need to be provided with erosion protection such as riprap.

Debris Loading

Detention and retention basins will eventually fill up with sediment and other debris, reducing their storage capacity to the point where they will not operate as designed. Therefore, some consideration of debris loading should be made for each basin. Based on work by Schaaf & Wheeler for the Santa

Clara Valley Water District and others, the following empirical relationships (debris load per unit drainage area) can be used to evaluate debris loading:

Highly urban areas	0.1acre-foot/mi^2/year
Hillside open space	0.4 acre-foot/mi^2/year

Depending upon the desired frequency of maintenance, some allowance for dead storage should be made to handle sediment and debris using the loading rates given above.

PUMPING FACILITIES

Without a safe gravity release for runoff, stormwater pumping facilities shall be designed to discharge the one-percent (100-year) design flow without endangering property. Associated storage facilities may be used to meet this criterion. Chapter 7 provides additional general pump station design and operating guidelines.

Reliability

Pump stations shall be designed to provide reliable, automatic service. Provisions must be made in facility design to promote the maintenance of pumping equipment and mechanical appurtenances (Chapter 9). Economics generally preclude the practicality of providing redundant standby pumps in a stormwater facility since full station capacity is utilized so rarely.

Standby Power

Where the primary source of pump power is electric motors, provisions for generating power during PG&E service outages shall be provided. The manual transfer of power to emergency generators is only acceptable if the pump station is configured so maintenance crews can safely connect a portable generator power plug to the switchgear. Otherwise, and for critical installations, a standby generator (or generators) shall be permanently installed on-site, capable of starting the largest pump motor with all other motors and ancillary demand already under load.

Stations with permanent generators shall be provided with automatic transfer switches that sense the loss of PG&E power, switch pump station control to the engine-generator, sense normal phase balance from the power utility, and provide a time-delayed retransfer to normal utility power. Provisions to maintain continuous power to all control, alarm, and telemetry systems through battery backup or other means shall also be made.

Diesel is the fuel of choice due to its non flammability, availability, and ease of transportation. Natural gas engines may be considered with City approval, but natural gas is susceptible to interruption during earthquakes or other disasters. Propane and gasoline engines shall not be used.

Tailwater Conditions

Pumps shall be designed for peak discharge to receiving waters assuming a one-percent (100-year) coincident tailwater.

CHAPTER 5
MAJOR INTERIOR DRAINAGE FACILITIES

This chapter examines the major watersheds within San Mateo, and their associated facilities. The recommendations made in this chapter refer to channel and watershed facility improvements. Storm drain network improvements are outlined in Chapter 6.

San Mateo's storm drainage collection systems drain into six major conveyance facilities: the North Shoreview pumping facilities, San Mateo Creek, East Third Avenue pump station, 16th Avenue Drain, 19th Avenue Drain, and Laurel Creek. These facilities discharge into the San Francisco Bay, either directly or via the Marina Lagoon. Figure 5-1 delineates the major drainage facilities and Marina Lagoon.

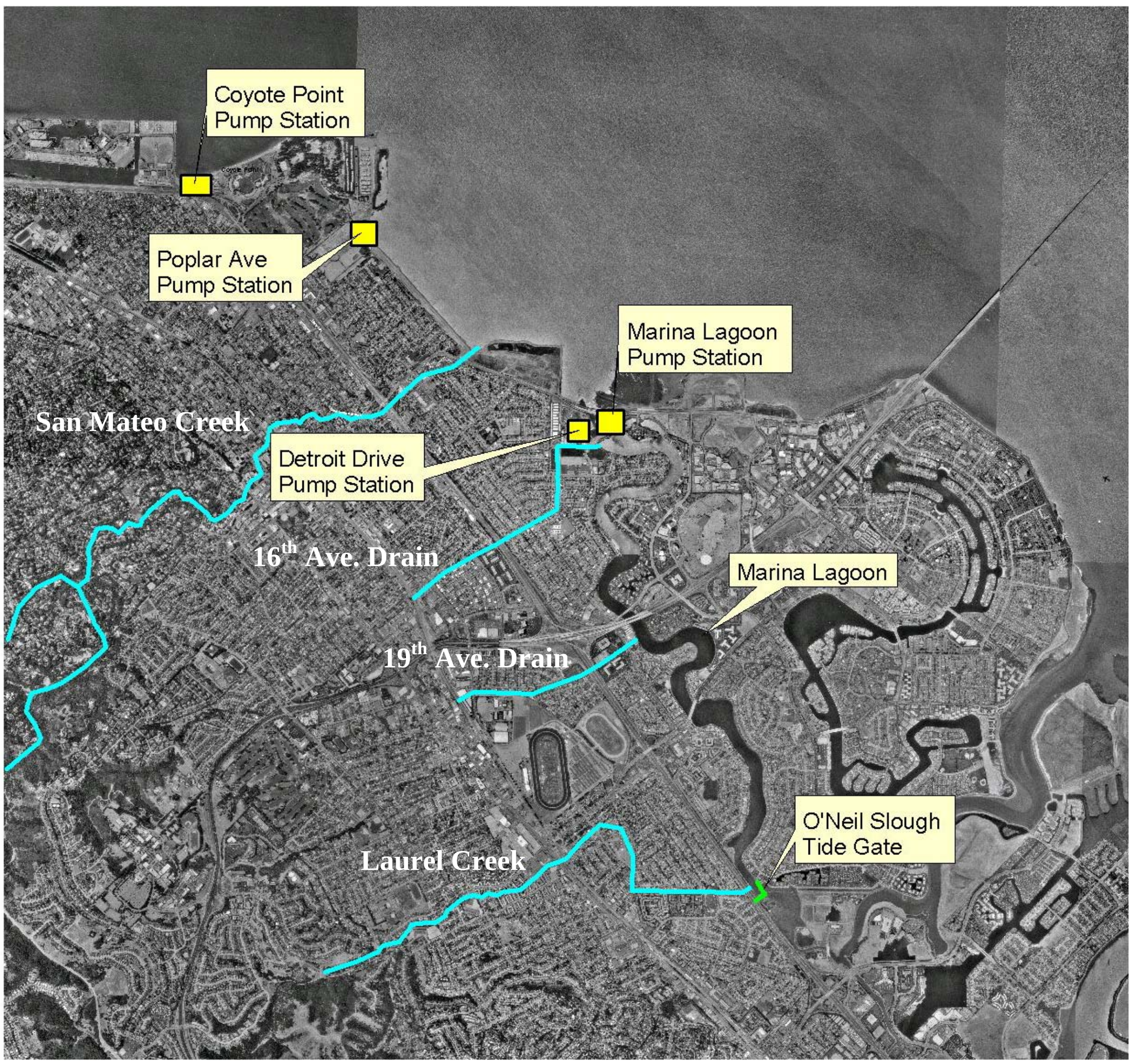


Figure 5-1: Major Drainage Facilities in San Mateo

NORTH SHOREVIEW FACILITIES

San Mateo's outboard levee flood protection system prevents stormwater from running off directly into the San Francisco Bay in the North Shoreview area; necessitating that runoff which collects behind the levee be pumped out into the Bay. Runoff from approximately 2.4 square miles drains into the North Shoreview area from the west and southwest and is conveyed through a series of ditches to pumping facilities at the Coyote Point and Poplar Avenue pump stations. Figure 5-1 also shows the North Shoreview area facilities.

Shoreline Park

Shoreline Park encompasses both storage and conveyance facilities in the form of wetlands and a series of feeder channels which convey runoff from a watershed that extends above El Camino Real through Shoreline Park to the Poplar Avenue pump station. The Shoreline Park Master Plan proposes improvements to create additional wetlands and increase tidal flows into the flood-control channels and thereby provide a more natural slough habitat.

Pump Stations

The Poplar Avenue Pump Station is located adjacent to the Bay Front Levee, and pumps directly from the Shoreline Park storage area into San Francisco Bay through three 30-inch diameter steel pipes, which are badly corroded and missing flap gates. Total nominal station capacity is 72,400 gallons per minute (gpm), or about 160 cubic feet per second (cfs). Standby power is supplied from a portable engine-generator using a manual transfer switch with mechanical interlock (Kirk key).

The Coyote Point Pump Station is situated next to the Coyote Point Levee near the Burlingame city limit. The station pumps water from an open ditch that parallels Airport Boulevard into the San Francisco Bay through two 20-inch and two 36-inch diameter outfalls onto a concrete apron. Total nominal station capacity is 70,000 gpm, or about 155 cfs. Standby power provisions are similar to those at the Poplar Avenue pump station (Chapter 7).

Schaaf & Wheeler's *Flood Management Strategies* (June 2002) recommends full rehabilitation of both pump stations to 230 cfs capacity each, new outfalls to San Francisco Bay, provisions for fully automatic standby power, and a new underground overflow connection along Airport Boulevard from Coyote Point Pump Station to the municipal golf course and Poplar Avenue Pump Station.

The report also recommends a floodwall/inboard levee system from J. Hart Clinton Drive along San Mateo Creek to Shoreline Park, extending parallel to the SF Bay Shore for 3500 feet, along Shoreline Park Master Plan Area edge to property line north of Cavanaugh Street, to Poplar Avenue, connecting in to high ground at Bayshore Freeway. This project has been reconsidered due to right-of-way and environmental complexities and doubt over its true efficacy in reducing flood risk.

SAN MATEO CREEK

San Mateo Creek serves as the outlet to Lower Crystal Springs Reservoir, which has a large tributary area that includes the San Andreas Reservoir and Upper Crystal Springs Reservoir. San Mateo Creek (Figure 5-1) drains another four square miles below Crystal Springs Dam, including areas tributary to Polhemus Creek. From the Lower Crystal Springs Reservoir outlet, San Mateo Creek parallels Crystal Springs Road in a relatively deep and narrow canyon for about two miles to the base of the foothills, where the canyon opens out into an alluvial fan. The creek remains in a natural state downstream to El Camino Real, where it enters an underground culvert at Mills Hospital. The creek is confined to the culvert through downtown, re-emerging as a natural urban channel at B Street near the Caltrain Depot, and continuing to San Francisco Bay in various states of improvement. A concrete floodwall on the south bank serves to contain floodwaters during extreme runoff events from Highway 101 to J. Hart Clinton Drive; and a similar wall for the north bank is currently in final design. Caltrans is also constructing improvements to the bridges and culvert at Bayshore Freeway to allow for full design flow capacity downstream of the downtown culvert.

In general San Mateo Creek does not back up into its tributary drainage systems and cause significant local flooding problems.

EAST THIRD AVENUE PUMP STATION

This facility is located at the mouth of Seal Slough on the Bay side of the Marina Lagoon Pumping Station on the south side of East Third Avenue (J Hart Clinton Drive) near Detroit Drive. Figure 5-1 shows its location. The pump station drains 0.5 square mile east of Highway 101 between San Mateo Creek and the 16th Avenue Drainage Channel.

Two 20,000 gpm diesel engine driven pumps deliver stormwater runoff directly to San Francisco Bay through 36-inch diameter flapgated outfalls. As indicated in Chapter 7, even with only one engine-driven pump in operation, available storage in the drainage system and pump forebay limits the maximum ponding elevation to 0.4 foot NGVD (98.1 feet City Datum). Available topography shows that the lowest natural ground in the area (wetlands) is at least elevation 98 feet City Datum, so pump station operation does not adversely impact local flooding conditions in this watershed.

16th AVENUE DRAIN

Urban stormwater runoff generated between Crystal Springs Road and Highway 92 east of Alameda de las Pulgas is collected in the 16th Avenue Drainage Channel at the Union Pacific Railroad. The channel is a fairly uniform prismatic channel that conveys runoff into storage in the Marina Lagoon or to pumping facilities which discharge to the San Francisco Bay. Analysis shows that hydraulic constrictions from major crossings at Delaware Street, U.S. Highway 101, and the Union Pacific Railroad force water out of the channel during extreme runoff events.

Proposed Projects to Mitigate 16th Avenue Flooding

The 2002 *Flood Management Strategies* report recommends the following capital projects to mitigate 16th Avenue flooding, as shown on Figure 5-2:

1. Removal and replacement of Delaware street culvert with clear span bridge
2. Addition of two new 8' x 5' concrete box culverts at Highway 101 crossing
3. Construction of floodwalls from Highway 101 to Delaware Street
4. Cleanout of the channel between 101 and Union Pacific Railroad

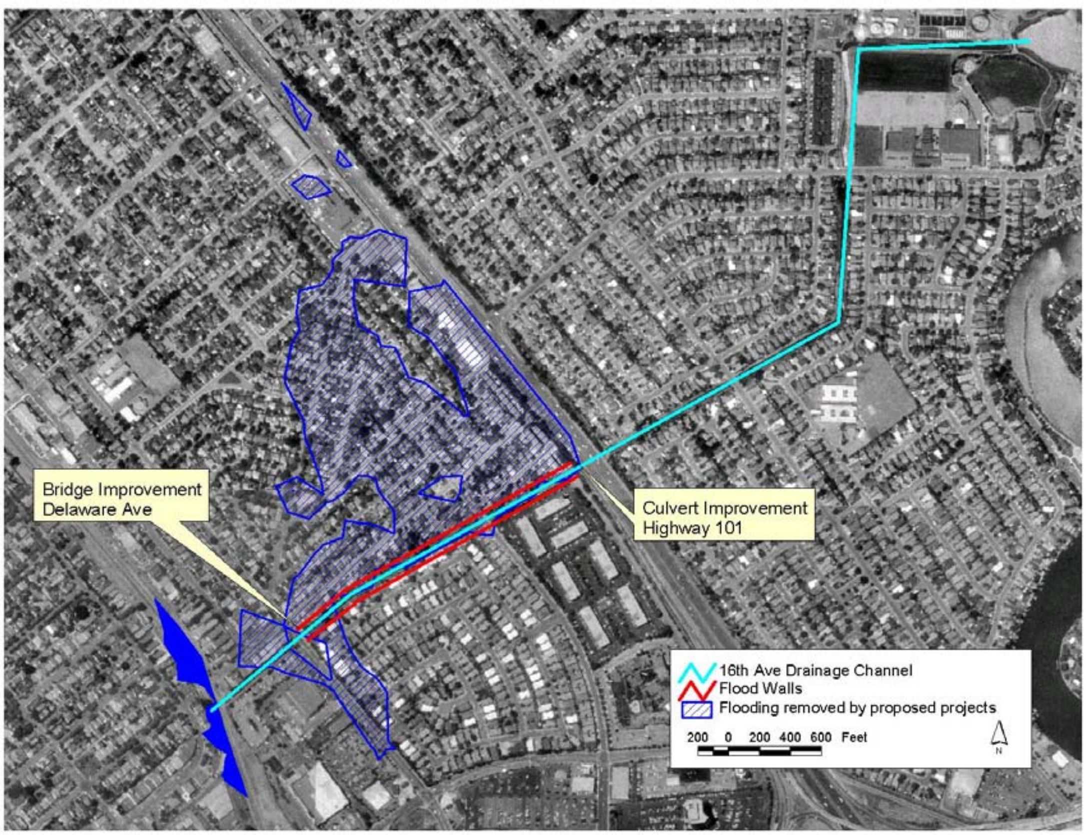


Figure 5-2: Recommended 16th Avenue Drain Projects (Flood hazard reduction in blue.)

Impact on Local Storm Drainage

Proposed projects will improve local drainage along the 16th Avenue Drain. Lowering water surfaces in the channel will provide better and faster drainage for the storm drain system. Many nuisance flooding areas may be fixed with these improvements.

19th AVENUE DRAIN

The 19th Avenue Drainage conveys runoff from an area of approximately 3 square miles, as well as being fed by several tributaries. It is similar to the 16th Avenue channel, with major crossings including the Union Pacific Railroad, Delaware Street, Bermuda Drive, Highway 101, and Norfolk Street. Channel constrictions at Delaware Street and Bermuda Drive force floodwaters out of the channel during the 100-yr storm event.

Proposed Projects to Mitigate 19th Avenue Flooding

The *Flood Management Strategies* report recommends capital projects to mitigate 19th Avenue flooding as shown on Figure 5-3:

1. Replacement of the double 13.5’ x 5.4’ RCB culvert with new clear-span bridge at Delaware Street
2. Channel cleanout and bank repair between Delaware Street and Bermuda Drive
3. Removal and replacement of bridge at Norfolk Street with new clear-span bridge
4. Relocation of utilities at Norfolk Street
5. Construction of concrete floodwalls between Bermuda Drive and the Union Pacific Railroad

Impact on Local Storm Drainage

Proposed projects will improve local drainage along the 19th Avenue Drain downstream of Delaware Street. Most of the interior flooding problems in this basin occur above the upstream end of the open channel.

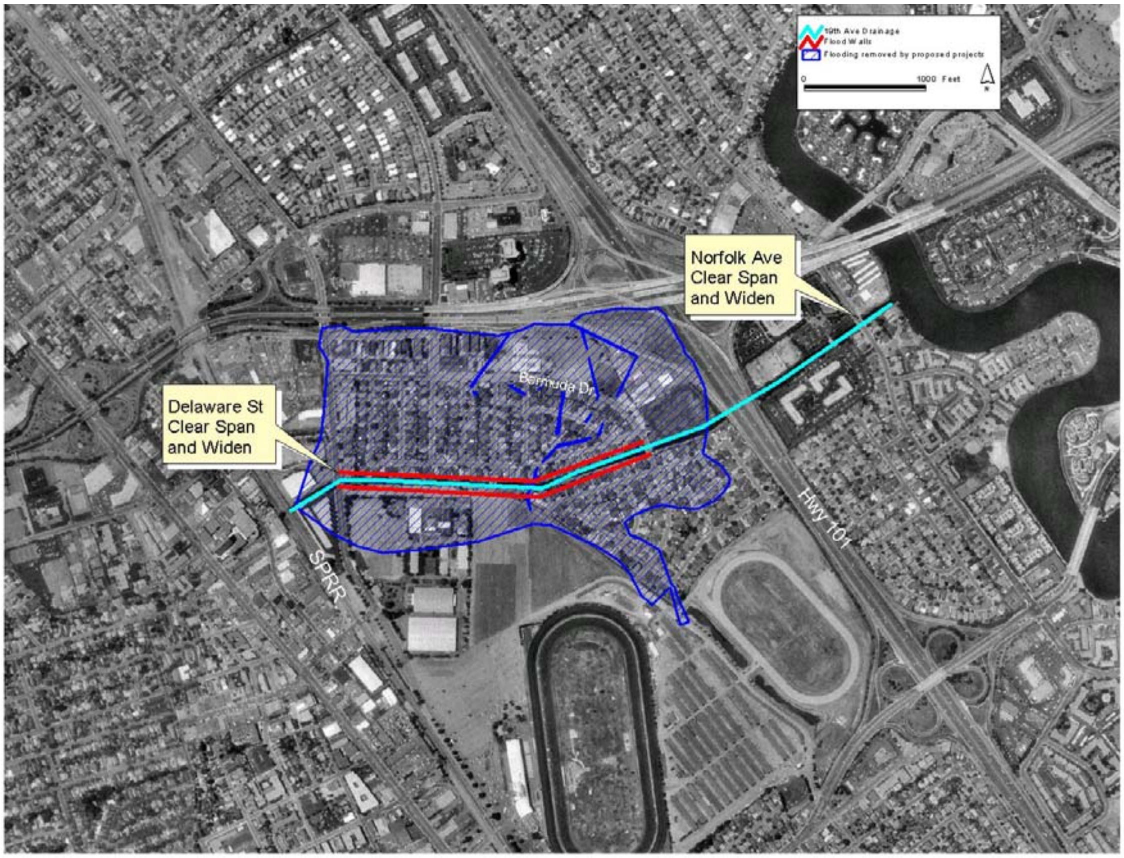


Figure 5-3: Recommended 19th Avenue Drain Projects (Flood hazard reduction in blue.)

LAUREL CREEK

Laurel Creek drains the southern-most part of San Mateo (Figure 5-1). The creek flows from the outlet of Laurel Creek Dam in a quasi-natural state on a relatively steep slope, enters an underground culvert at Edison Street, and travels in an engineered open channel alongside Hillsdale Shopping Center to El Camino Real. The creek continues through various reaches of channel improvements and a number of inadequately-sized culverts to its discharge point at the Marina Lagoon.

Problem Areas

Inadequately-sized culverts produce problem areas at Laurel Creek crossings including Alameda de las Pulgas, Hacienda Street, Edison Street, El Camino Real, SPRR, Pacific Boulevard, Curtiss Street, Otay Avenue, and the George Hall School. A restricted and encroached-upon right-of-way between Laurel Creek Dam and Edison Street forces floodwaters out of the creek during severe storm events. Vegetation growth and slumping banks have lessened bank-full channel capacity downstream of Otay Avenue and in other reaches. The channel is additionally very difficult to access in many reaches along its length; making maintenance activities such as vegetation removal and slope bank repairs nearly impossible.

Projects to Mitigate Laurel Creek Flooding

Schaaf & Wheeler's *Flood Management Strategies* (June 2002) recommends these capital projects to mitigate Laurel Creek flooding, as shown on Figure 5-4:

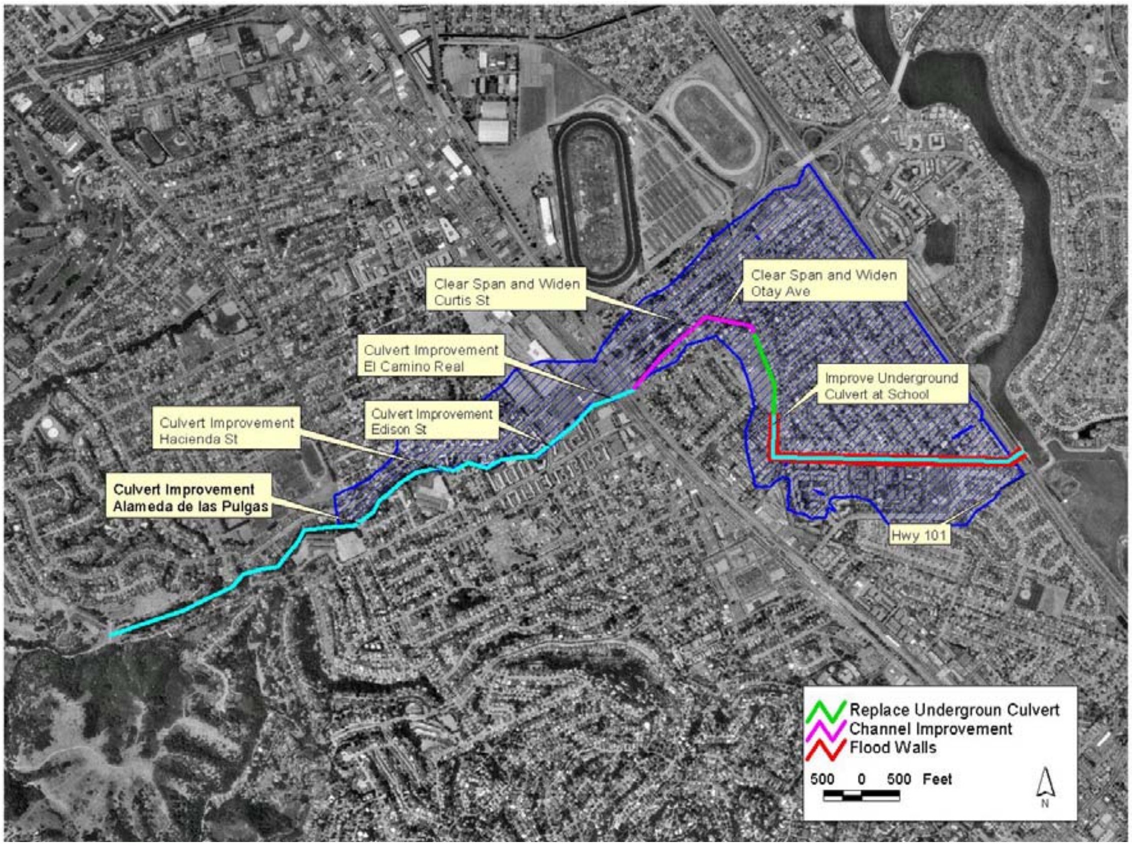


Figure 5-4: Recommended Laurel Creek Improvements (Flood hazard reduction in blue.)

1. Replacement of double 8' x 4' RCB with triple 9' x 4' RCB at Alameda de las Pulgas
2. Replacement of 10' x 6' RCB with double 10' x 6' RCB at Hacienda Street
3. Construction of parallel 10' x 6' culvert under Edison Street
4. Construction of new 12' x 5' concrete culvert bypass between El Camino Real and Pacific Boulevard
5. Enlargement of channel between Pacific Blvd ad George Hall School
6. Replacement of 10' x 5' culvert with 25' x 6' clear-span bridge at Curtiss Street
7. Replacement of double 7/5' x 4' RCB with 25' x 6' clear-span bridge at Otay Avenue
8. Replacement of multi-pipe culvert with new 30' x 7' box culvert at George Hall School
9. Replacement of triple 12' x 5.5' RCB with new 40' x 6' clear-span bridge
10. Construction of concrete floodwalls from George Hall School to Hwy 101

Impact on Local Storm Drainage

Proposed projects on Laurel Creek will greatly improve local drainage. The greatest impact will be near El Camino Real; lowering the channel water-level will provide greater drainage to the pipe systems along El Camino Real. The computer models show this area to be very sensitive to creek water levels. Many of the storm drain deficiencies upstream of El Camino, in the hillier region, are not caused by channel capacity.

MARINA LAGOON FACILITIES

The Marina Lagoon is a 1,400 acre-foot storage facility created by dredging the former O'Neil Slough and Seal Slough and constructing levees along the new lagoon banks. The 16th Avenue Drain, 19th Avenue Drain, and Laurel Creek all discharge to the Lagoon and provide a source of fresh water runoff during the winter. Runoff stored in the Lagoon is pumped to San Francisco Bay by five 150,000 gpm diesel engine pumps at the Marina Lagoon Pump Station. During the summer an average of 52 million gallons per day of water from Belmont Slough enters the lagoon and is pumped into the Bay to improve circulation and water quality.

Lagoon Operation

Water levels in the Lagoon are regulated by controlling inflows through the O'Neill Slough intake gates and discharges through the Marina Lagoon pump station. Levels are adjusted seasonally to optimize flood control, recreation, aesthetics, and ecological benefits provided by the Lagoon. The winter operation level is currently set at elevation 94.5 feet (San Mateo datum) to provide for flood storage during the rainy months; while summertime water levels are maintained at 96.7 feet to provide good conditions for swimming, boating, and other recreational uses. The water level is lowered to 93 feet from January 15th to February 15th each year to facilitate pier work on houses and docs, as well as City maintenance of the facility. In 2004 construction will begin to raise the earthen levee and headwall of the O'Neill Slough Tide Gate, and replace the tide gate structure itself.

Statistical analyses indicate that the lagoon may safely be operated at the summertime level from April through October. Maximum one-percent flood levels in Marina Lagoon reach elevation 98.0 (City Datum) when the normal winter operating level of the lagoon is 94.5 feet. All storm drain evaluations and recommended improvements are based on this winter operating level and these pump settings (City Datum):

Lead Pump On	94.5 feet	Lag 3 Pump On	95.2 feet
Lag 1 Pump On	94.6 feet	Lag 4 Pump On	95.8 feet
Lag 2 Pump On	94.8 feet	Pumps Off	94.0 feet

CHAPTER 6
STORM DRAIN COLLECTION SYSTEMS

Analyzing San Mateo's storm drain collection system performance forms the essential core of this master plan. To better track and report results from the MOUSE model, collection system components are named according to their geographic location. Nodes-labeling within the model follows the convention used by the City in the storm drain system AutoCAD plans; with the first three alphanumeric characters of the name representing a block on the map grid, and the subsequent being a random unique number. Pipes, culverts, and other system components can be identified by the nodes they link. An index map of showing the grid blocks for the City node-naming convention and more detailed maps providing individual model nodes are available as Appendix E.

For each basin, this chapter describes major storm drain facilities and outfalls, historic problem areas (and known reasons for the problems), pumping and storage facilities (if applicable), and other known flood hazards. Within each basin, areas meeting storm drain system evaluation criteria from Chapter 4 are delineated, as are those areas that do not meet the criteria, but require some form of remediation. Furthermore, relative flood risks to neighboring properties are discussed, as are individual improvement projects and their prioritization.

EVALUATION OF STORM DRAIN CAPACITIES

Each collection system is analyzed to determine its flow condition during the design storms and compared to the performance-based priority criteria discussed in Chapter 4. Table 6-1 provides the decision tree used to assess storm drain system performance. Master plan improvements are designed to provide flood protection meeting the "satisfactory" criteria in the table.

TABLE 6-1: STORM DRAIN SYSTEM PERFORMANCE CRITERIA[1]

<table>
<tr><td colspan="5">Is d_{10} < Top of Curb (T/C)?</td></tr>
<tr><td colspan="2">YES
Is d_{100} < Street Right-of-Way (R/W)?</td><td colspan="3">NO
Is d_{10} < Street Right-of-Way (R/W)?</td></tr>
<tr><td>YES</td><td>NO</td><td colspan="2">YES</td><td>NO</td></tr>
<tr><td rowspan="3">Satisfactory</td><td rowspan="3">Improve at
Medium Priority</td><td colspan="2">Is d_{100} < Street Right-of-Way (R/W)?</td><td rowspan="3">Improve at
High Priority</td></tr>
<tr><td>YES</td><td>NO</td></tr>
<tr><td>Improve at
Low Priority</td><td>Improve at
Medium Priority</td></tr>
</table>

[1] d_{10} and d_{100} are depths of street flooding in the 10- and 100-year design runoff events respectively

Implementing high priority projects is critical to the perceived success of master plan improvements, even when those projects address nuisance flooding. While nuisance conditions may not always cause substantial property loss, they are often a source of frequent citizen complaints. It is also important to recognize that during the most intense rainfall events, streets are counted on to convey runoff. Eliminating the flow of water within street rights-of-way would require a great deal of public expenditure and is not considered a beneficial investment.

This chapter is broken into seven drainage areas, generally progressing from east to west, and from south to north following natural drainage patterns. The basins are organized around the major drainage facilities within the city. It should be noted that neither private drainage systems nor site-specific drainage characteristics are analyzed.

Each basin analysis contains a schematic representation of the local stormwater collection systems, showing problem areas under existing conditions and recommended master plan improvements.

SYSTEMS DRAINING TO NORTH SHOREVIEW

The North Shoreview drainage area is approximately 1.94 square miles, and is bounded roughly to the north, east, and west by the City of Burlingame, the San Francisco Bay, and Town of Hillsborough respectively; and to the south by the San Mateo Creek drainage area. The North Shoreview tributary collection systems consist of 516 nodes, 71,000 linear feet (13.4 miles) of connecting storm drain pipes, and 14,500 linear feet (2.8 miles) of channel which discharge to the Coyote Point and Poplar Avenue pump stations.

Historic Problem Areas

Information from the City of San Mateo indicates historical flooding problems in the areas of Third Avenue and Norfolk Street; Coyote Point and Airport Boulevard; Idaho and Indian Streets; Tilton and Delaware Streets; S. El Dorado and E. Santa Inez; Lindberg and Second; Greenwood Avenue and driveway flooding from undersized French drains along the eastern edge of the drainage area.

Identified Deficiencies and Required Improvements

MOUSE analysis of the North Shoreview systems shows flooding occurring at 196 of the 516 system nodes. Depths of less than one-foot occur at 93 of these, while depths between one and two feet occur at 76 nodes, with the remaining 27 nodes experiencing flooding depths of greater than two feet. A map of the watershed identifying historic problem areas, system segments not meeting performance criteria, and proposed master plan improvements is presented as Figure 6-1. Master plan analysis includes new Caltrans facilities crossing Highway 101 at Howard, Poplar and Dore.

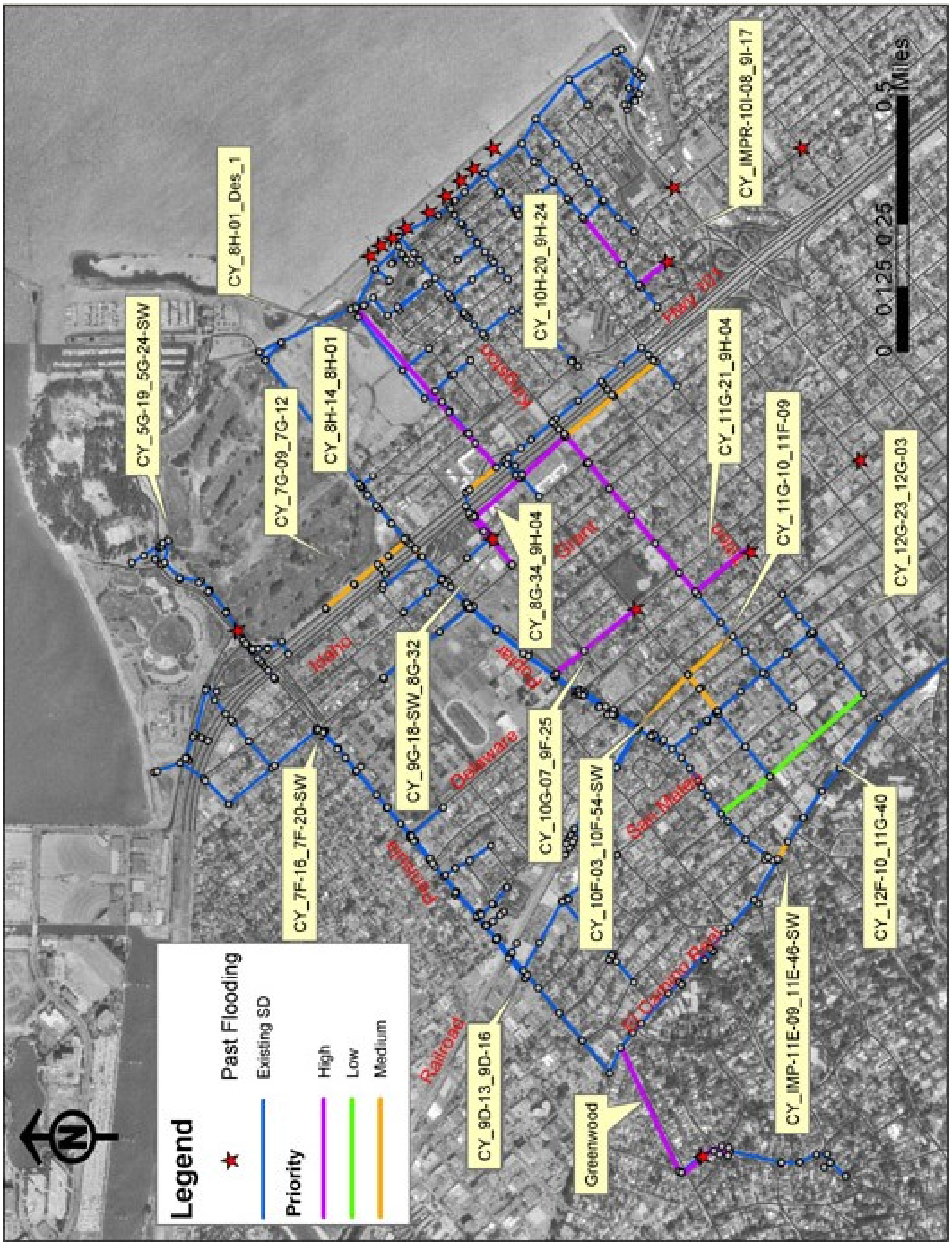


Figure 6-1: North Shoreview Drainage Master Plan

SYSTEMS DRAINING TO SAN MATEO CREEK

The San Mateo Creek drainage area is approximately 4 square miles; 1.3 square miles of which is drained by City of San Mateo storm drain systems, and the remainder of which drains directly to the creek. The drainage area consists of two separate tributary storm drain areas, one centered on the intersection of State Highway 92 and Polhemus Road, and the other bounded roughly by the North Shoreview drainage area to the north, Town of Hillsborough to the west, San Francisco Bay to the east, and the 16th Avenue drainage area to the south. Various smaller storm drain systems discharge into the San Mateo Creek channel, comprising approximately 330 nodes connecting 39,150 linear feet (6.9 miles) of storm drain pipe.

Historic Problem Areas

The City of San Mateo has identified the intersection of 2nd Avenue and Delaware Street as having recurrent historical flooding problems.

Identified Deficiencies

MOUSE analysis shows that flooding occurs at 64 nodes in the San Mateo Creek tributary drainage area. Depths at 21 of these nodes are less than one foot, depths between one and two feet are found at 20 nodes, and the remaining 23 nodes flood at depths greater than 2 feet. Maps of the watershed identifying historic problem areas, system segments not meeting performance criteria, and proposed master plan improvements are presented as Figure 6-2 for the upper watershed and Figure 6-3 for the lower watershed closer to downtown.

SYSTEMS DRAINING TO EAST THIRD AVENUE

The East Third Avenue drainage area is approximately 0.35 square miles, and is located on the east side of Bayshore Freeway, just south of the North Shoreview drainage basin. The tributary storm drain system consists of approximately nodes and linear feet (miles) of pipe draining by gravity to the East Third Avenue and Detroit Drive Pump Station (Chapter 7).

Historic Problem Areas

According to the City of San Mateo, flooding has historically occurred near the intersections of Dakota and Patricia, and Cottage Grove and Nash.

Identified Deficiencies

MOUSE analysis shows that flooding occurs at 35 nodes in this drainage area requiring 2.3 miles of new storm drains. A map of the watershed identifying historic problem areas, system segments not meeting performance criteria, and proposed master plan improvements is presented as Figure 6-4.

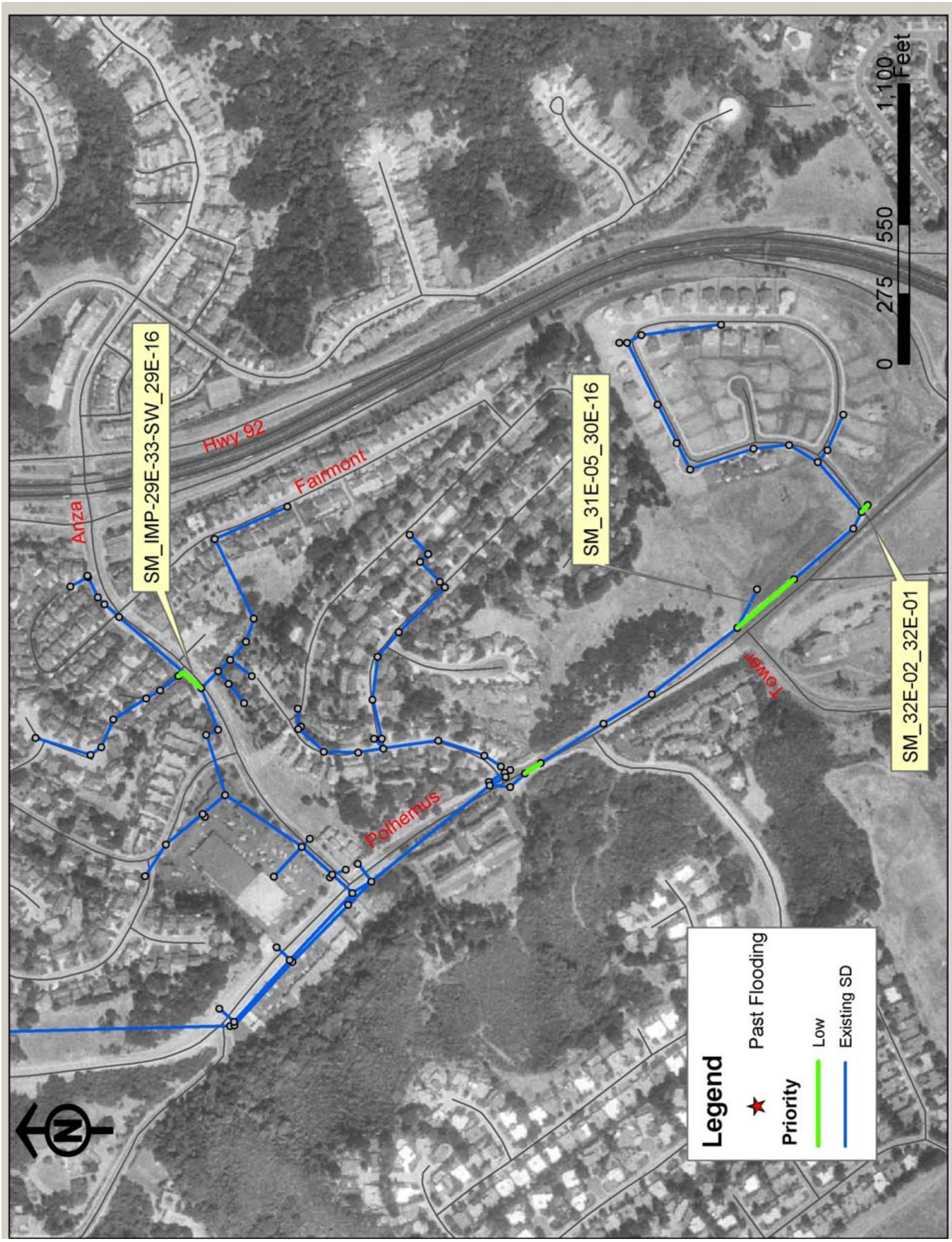


Figure 6-2: Master Plan for Upper San Mateo Creek Watershed

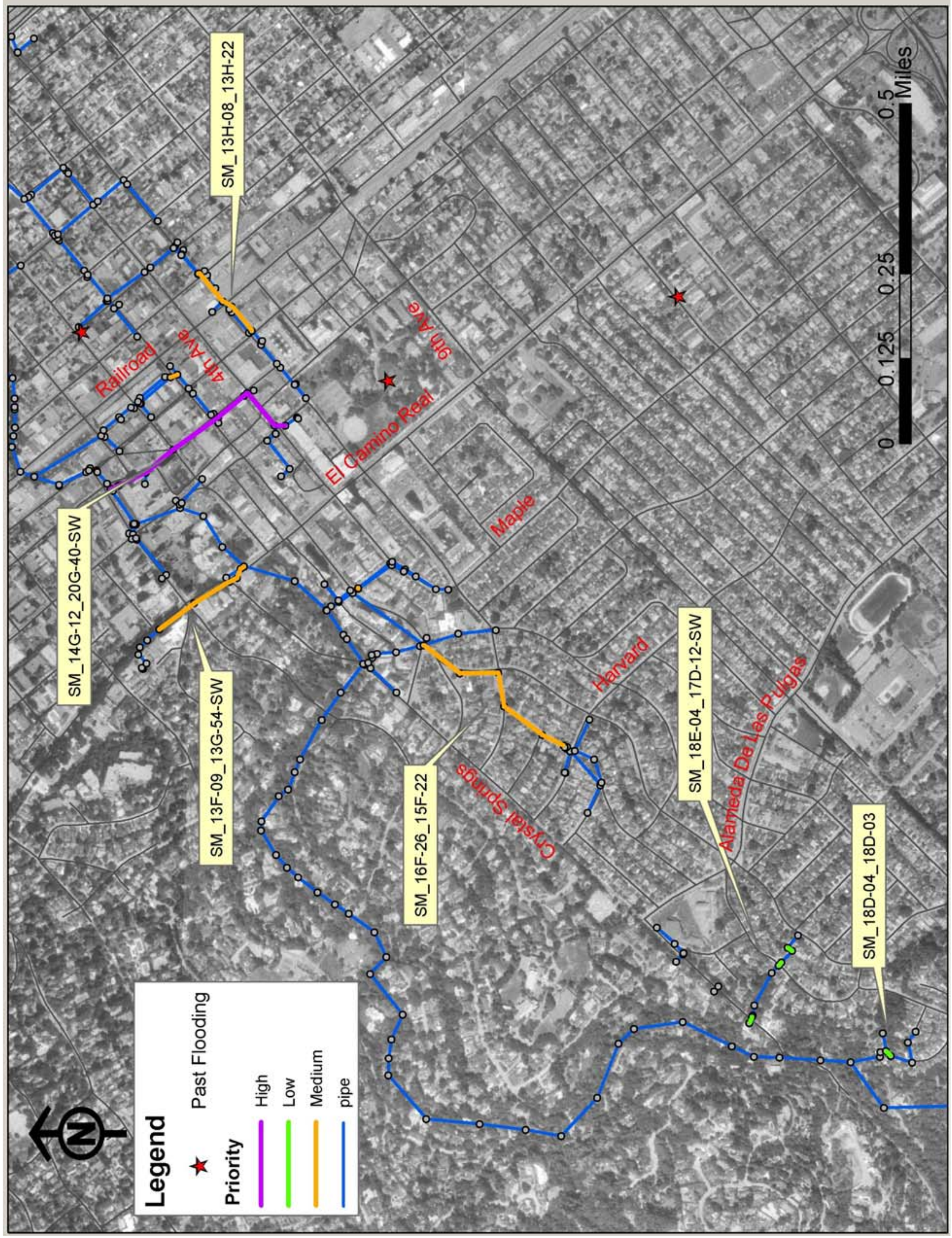


Figure 6-3: Master Plan for Lower San Mateo Creek Watershed

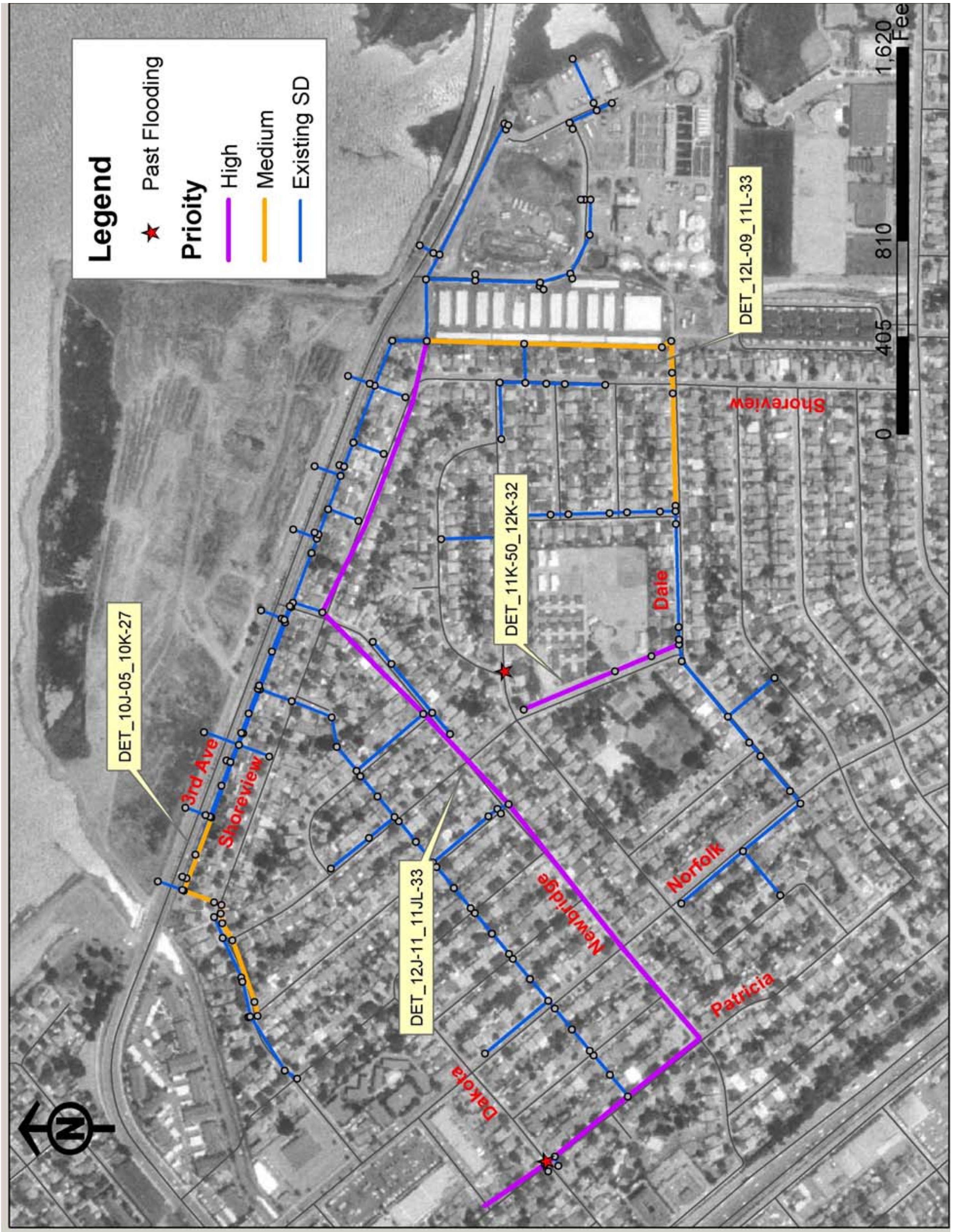


Figure 6-4: Master Plan for East Third Avenue Watershed

SYSTEMS TRIBUTARY TO 16TH AVENUE DRAIN

The 16th Avenue drainage area is approximately 2.1 square miles, and is bounded to the north and west by the San Mateo Creek drainage basin, to the east by the Marina Lagoon, and to the south by the 19th Avenue drainage basin. The 16th Avenue Drainage tributary collection systems consist of 869 nodes, 101,380 linear feet (19.2 miles) of connecting storm drain pipes, and 12,600 linear feet (2.4 miles) of channel.

Historic Problem Areas

Flooding in the 16th Avenue watershed has historically occurred in the following areas: Hobart between Maple and El Camino Real; 17th and Railroad; Pershing and Taylor; Idaho, Sunnybrae, and Birch; and San Mateo Central Park.

Identified Deficiencies

MOUSE analysis of the 16th Avenue systems shows that flooding occurs at 294 nodes. Depths of flooding are less than one foot at 98 nodes. Flooding depths are between one and two feet at 117 nodes, and greater than two feet at 79 nodes. A map of the watershed identifying historic problem areas, system segments not meeting performance criteria, and proposed master plan improvements is presented as Figure 6-5.

SYSTEMS TRIBUTARY TO 19TH AVENUE DRAIN

The 19th Avenue tributary storm drain system consists of 827 nodes, 82,230 linear feet (15.6 miles) of pipes and culverts, and 26,480 linear feet (5.0 miles) of channel. The basin is bounded to the north by the 16th Avenue basin, to the west by the San Mateo Creek basin, to the south by the Laurel Creek basin, and to the east by the Marina Lagoon.

Historic Problem Areas

According to the City of San Mateo, areas with problem flooding are: Alameda de Las Pulgas between 21st and 31st; 340 Sylvan Avenue; 20th and Railroad; Palm and Railroad; and the Fiesta Gardens area.

Identified Deficiencies

MOUSE analysis of the 19th Avenue storm drain system identified flooding at 338 nodes. Flooding depths of less than on foot were found at 143 nodes. Depths between one and two feet were found at 114 nodes. Depths of greater than two feet were found at 81 nodes. A map of the watershed identifying historic problem areas, system segments not meeting performance criteria, and proposed master plan improvements is presented as Figure 6-6.

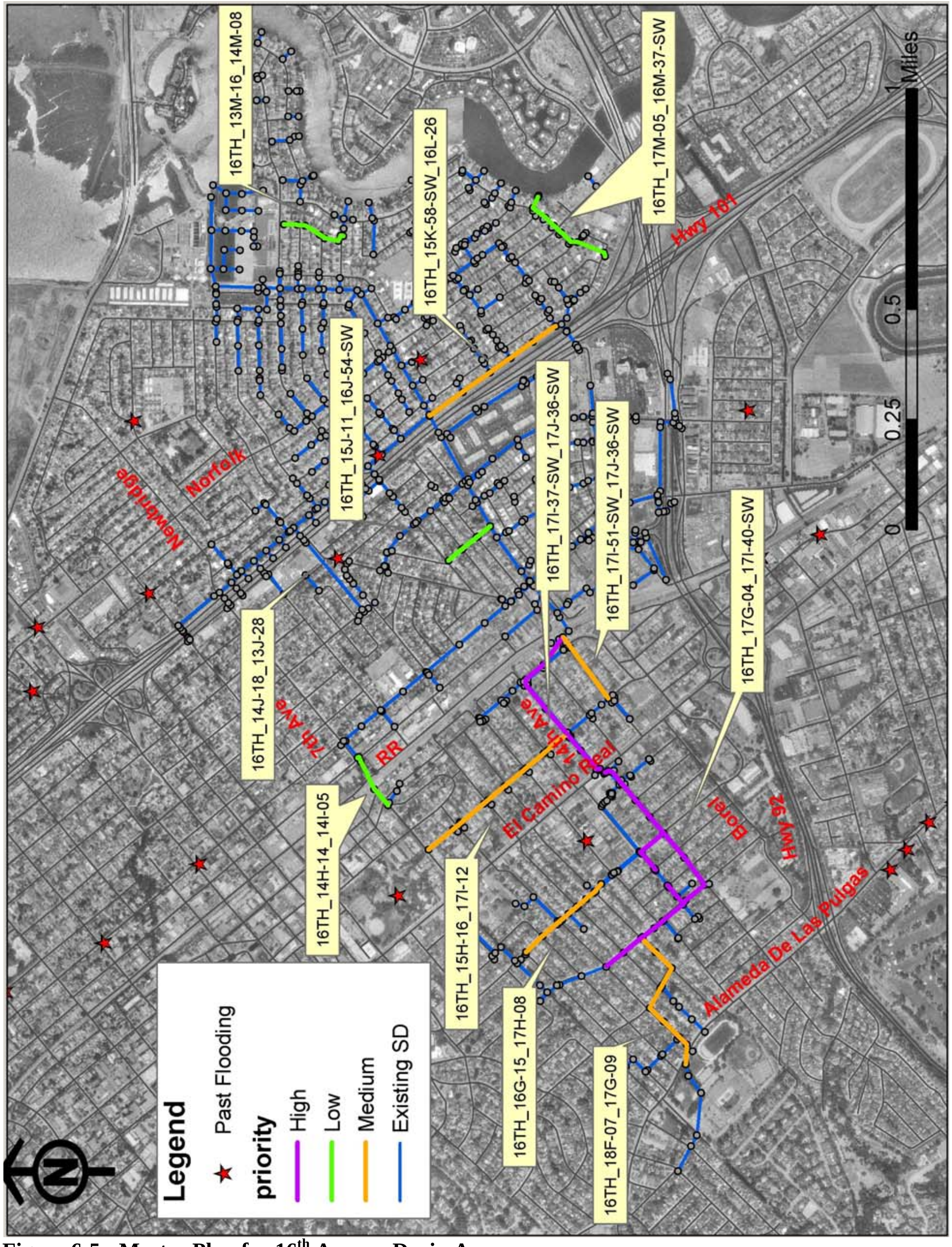


Figure 6-5: Master Plan for 16th Avenue Drain Area

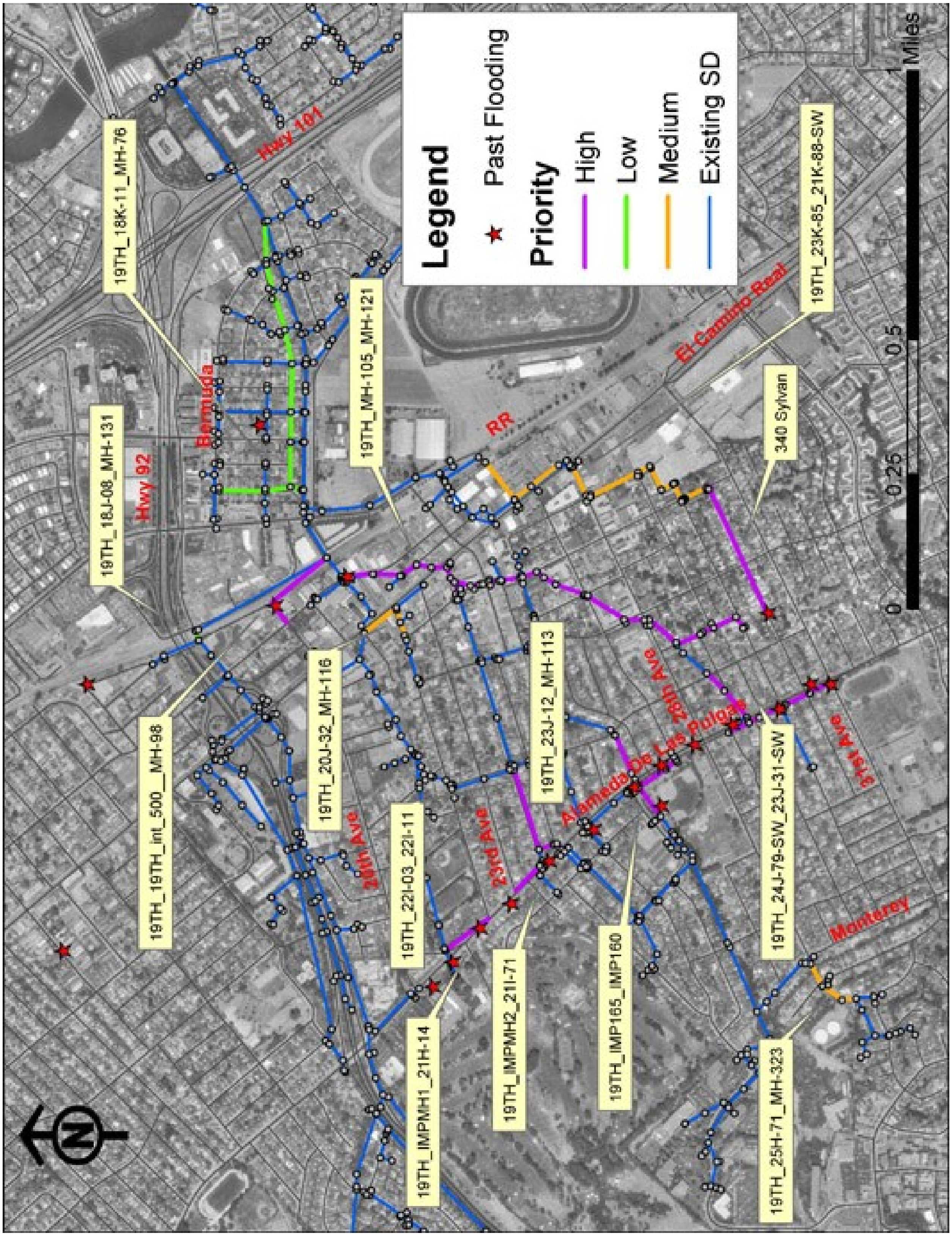


Figure 6-6: Drainage Master Plan for 19th Avenue Drain Watershed

SYSTEMS TRIBUTARY TO LAUREL CREEK

The Laurel Creek drainage basin is approximately 4.6 square miles. The tributary storm drain system consists of 1440 nodes, 155,930 linear feet (29.5 miles) of pipes and culverts, and 41,390 linear feet (7.8 miles) of channel. The basin is bounded to the north by the 19th avenue basin, to the east by Marina Lagoon, to the west by the San Mateo Creek basin, and to the south by the City of Belmont.

Historic Problem Areas

The City of San Mateo has identified the following as areas which have historically been problem flooding areas: 57-61 Otay; behind the houses at Shasta Drive; the end of Viewridge Drive; and the Laurel Creek culvert at Laurelwood Drive.

Identified Deficiencies

MOUSE analysis of the Laurel Creek system identifies flooding at 424 nodes. Of these, 144 have less than one foot of flooding depth; 132 have flood depths between one and two feet; and 148 have flooding depths greater than two feet. A map of the watershed identifying historic problem areas, system segments not meeting performance criteria, and proposed master plan improvements is presented as Figure 6-7.

DIRECT DRAINAGE TO MARINA LAGOON

A relatively small area of San Mateo bound roughly by the 16th Avenue Drain, J. Hart Clinton Drive, the Foster City limit, State Highway 92 and U.S. Highway 101 drains through direct outfalls to Marina Lagoon. The Bridgepointe Shopping Center is the most prominent drainage contributor in this watershed.

Historic Problem Areas

The City does not report significant flooding problems in this area.

Identified Deficiencies

A few isolated low priority improvements are recommended in the Capital Improvement Program. These are shown on Figures 6-5, 6-6, and 6-7.

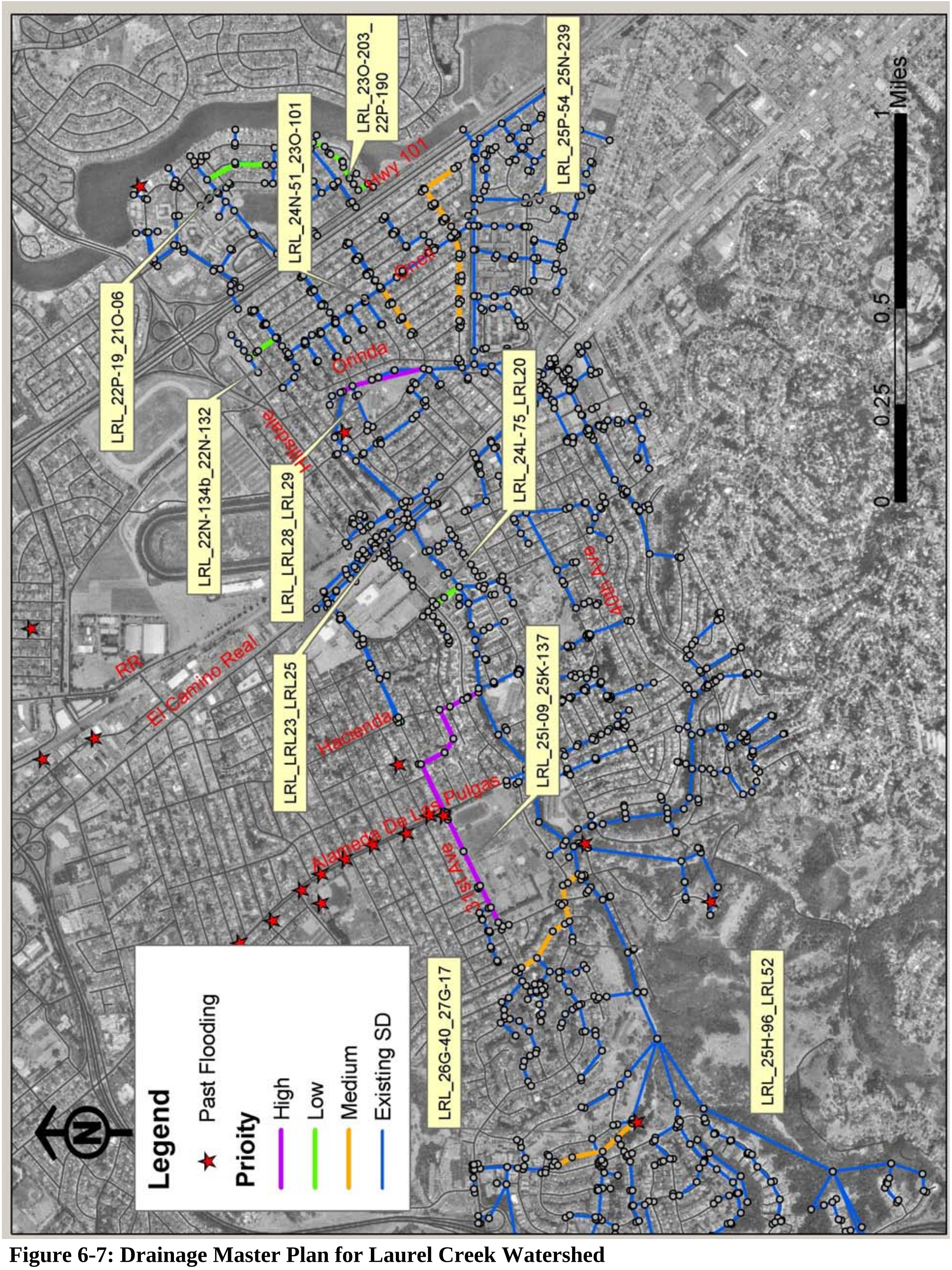


Figure 6-7: Drainage Master Plan for Laurel Creek Watershed

CHAPTER 7
PUMP STATIONS

San Mateo currently operates ten stormwater pumping facilities. All of the stormwater pump stations are situated east of El Camino Real. An eleventh station, the Laurel Creek Stormwater Pump Station (4116 Branson) has been shut down; while the tenth station, the Fifth Avenue Park Station that dewaters a City-owned parking structure has no real impact on storm drainage in the city. This chapter evaluates pump station adequacy in the context of the stormwater master plan, recommending rehabilitation as necessary. After discussing general pump station design criteria, individual pump stations are evaluated, deficiencies listed, and master plan improvements proposed.

GENERAL PUMP STATION CRITERIA

Some of San Mateo's stormwater pumping facilities are approaching forty years of service, and should not be expected to meet standards employed in current design practice. If City staff are able to operate and maintain a station without undue hardship and the station has adequate flow capacity, there is no need for master plan improvement. General pump station design criteria used in master plan evaluation are listed below.

Capacity

Pump stations have been evaluated for adequate capacity within the MOUSE model. Pump stations are generally considered adequate if there is sufficient pump capacity to discharge design runoff into the receiving waters or if excess flows can be stored without causing property damage. Table 7-1 (page 7-4) lists pump station design inflows and capacities.

Ideally at least two identical pumps would be installed in every storm water pump station for some redundancy and ease of maintenance. It is not necessary to include standby pumps in a stormwater station, because providing excess capacity is expensive and generally not justified by the relatively small risk of having a major storm event coincide with mechanical failure. All things considered, however, installing a larger number of smaller pumps is generally better than a lesser number of large pumps for the same capacity. When individual pumps comprise a smaller percentage of overall pump station capacity, having one pump fail is less detrimental. In terms of redundancy and ease of maintenance, all of the pumping units within one particular station should be identical.

Pumps and Drivers

Pump and driver types differ from station to station in San Mateo, primarily due to the different construction periods and different loading conditions. A general trend in current pump station design is to use electric motors for prime power rather than direct-drive engines due to noise, ventilation and air quality considerations.

Pump Operation

Lead and lag pumps should be automatically alternated on every start to minimize pump cycling, and extend the operating life of the equipment. Sufficient wet well storage must also be available in order to prevent excessive pump cycling for proposed operating levels. Operations and maintenance personnel do not indicate that excessive pump cycling is a problem at any of the stations. Control systems used in San Mateo have the ability to rotate lead and lag pump sequences.

The maximum number of pump starts per hour should be held below the maximum criterion established by pump, motor, or engine manufacturers. In the absence of specific data, pump starts should be limited to six per hour. This criterion is based on general limits set by large electric motor manufacturers; diesel engine suppliers also recommend that engines should run at least five to ten minutes at full operating temperatures each time they are started.

Pumping equipment must be specified so that motor or engine nameplate ratings are not exceeded at any point on the pump characteristic curve. Pump performance under different hydraulic conditions should be analyzed to ensure that pumps operate within manufacturers' recommended limits. There is no observed motor or engine overloading at any San Mateo stormwater pump station.

Excessive pump wear, vibration, noise, or cavitation could be indicative of more serious hydraulic problems associated with the sump and intake geometries, although this does not appear to be a problem within San Mateo.

Standby Power

An emergency engine-generator, capable of starting the largest motor while running all other motors and auxiliary loads, should be installed at each stormwater pump station that does not utilize engines as pump drivers. Diesel is the preferred fuel, but natural gas engines may be considered as an alternative since they are reliable and burn cleanly. Natural gas engines tend to be underpowered compared to diesel engines. There is also a risk that the fuel will not be available when needed. Gasoline is not an acceptable fuel for stationary engines because it is a fire and explosion hazard, and the allowable storage period is very short. Diesel fuel is much less hazardous and can be stored for up to a year in double walled tanks meeting requirements set forth by the Fire Department. All fuel piping must be double contained. Proper ventilation for engine aspiration and cooling should be provided, and each unit should be regularly exercised under load; either through pump testing with water, load banks, or a combination of both.

Generators must be present on-site and connected to the power supply with an automatic transfer switch to be considered as available in an emergency under FEMA flood hazard mapping requirements. The use of portable generators, or even permanently parked generators with manual transfer switches, is only feasible where crews may respond to high water alarms during power outages, physically reach the pump station with a generator, and manually restore power before property damage has occurred. Small lift or pumping stations that generally handle nuisance flows (flows for which significant property damage would not occur should the pump station fail) do not necessarily require a standby power source.

Controls

Pump starts and stops may be controlled in a number of ways depending upon the age and condition of the equipment at any individual pump station. Newer pump stations often use a programmable logic controller (PLC) or a simpler programmable pump controller. Pump station controls and level monitoring systems shall be coordinated with City operations and maintenance staff regarding function, standardization and ease of use. Control systems must also be provided with standby power to ensure that the station can function even during prolonged power outages. The preferred mechanism for providing standby power to control systems is rechargeable batteries, so that engines or engine-generators do not need to start during a power outage where pumping is not required.

Equipment Housing

All electrical equipment in or open to the wet well must be explosion-proof and should be placed a minimum of one foot above the base flood elevation (BFE). Submersible motors should also be explosion-proof. Control panels must be located so that they are not subject to possible flooding, which is currently a major problem at the Coyote Point and Poplar Avenue stations. All equipment must be housed in NEMA-rated weatherproof enclosures or in buildings. Sufficient lighting (including back-up battery power) should be provided so that crews may work on equipment during the night. Also, access must be provided that will allow for the removal and reinstallation of all equipment. Noise abatement, visual impacts, and other aesthetics should also be considered. This is particularly important where pump stations are located near residential areas, although neighborhood complaints do not appear to be a major problem in San Mateo.

Ventilation

Good ventilation is important to maintaining a dry, benign environment for mechanical and electrical equipment within a pump station, particularly since many of the stations are located in a marine environment. Proper ventilation reduces the deterioration of equipment due to condensation, and provides safe working conditions for city crews, particularly important in confined spaces.

PUMP STATION EVALUATION

Table 7-1 provides a summary of pump station capacities and emergency readiness throughout San Mateo. Figure 7-1 locates each pump station within the city, and detailed descriptions follow.

TABLE 7-1: PUMPING STATION SUMMARY

ID	Station Name	Address	Year Built	Design Inflow (cfs)	Station Capacity (cfs)	Standby Power
07	42nd Avenue	4000 Pacific Blvd.	1988	10	15	Manual
08	Hillsdale	3397 Pacific Blvd.	1964	15	15	None
13	Casanova[1]	4012 Casanova Drive	1968	84	104	Manual
24	Poplar Avenue	Levee at Monte Diablo	1973	Storage	161	Manual
25	Coyote Point	20 Airport Blvd.	1973	Overflow	156	Manual
27	Fathom Drive	401 Fathom Drive	1966	---	7	None
33	Marina Lagoon	2100 Detroit Drive	1983	Storage	1,670	Automatic
34	3rd & Detroit	2002 Detroit Drive	1983	75	89	Automatic
35	16th Avenue	2055 Detroit Drive	1983	---	10	None

[1]Scheduled for replacement in 2004. Capacity given per specifications.

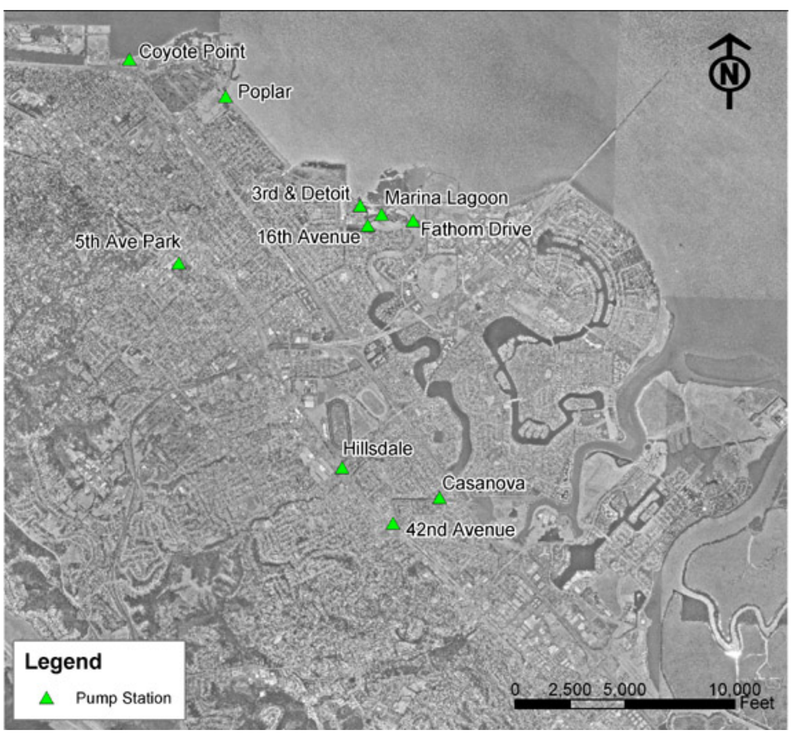


Figure 7-1:
Pump Station Locations

42nd Avenue Pump Station

4000 Pacific Boulevard

Constructed 1988

Tributary Area: 42nd Avenue undercrossing at railroad

Outfall: Local storm drain system

Existing Equipment:

(2) Peerless 14" AV axial flow pumps
3,300 gpm @ 26' TDH
(1,160 rpm)

(1) submersible sump pump

30 hp vertical electric motor drivers

Standby Power:
Manual plug for portable 480V engine-generator

<u>Master Plan Recommendations</u>

High Priority: None

Medium Priority: None

Low-Priority (next major replacement): Replace axial flow pumps and electric motors below grade with submersible pumps and motors.

The 42nd Avenue Pump Station is situated off of Pacific Boulevard alongside the Union Pacific Railroad right-of-way. This facility was built to pump collected water from the 42nd Avenue railroad undercrossing into the storm drain system in Pacific Boulevard.

Pumping equipment and electric motor drive units are housed below grade, with motor starters and controls above grade in a weather-tight enclosure. Personnel and equipment access is through hatches in the buried structure's roof. Although O&M staff indicates that the electric motors have never been flooded, this potential exists. When the pump drivers require replacement, it should be with submersible style motors designed for below grade installation.

Using portable standby power and manual transfer has been deemed acceptable due to available storage in the interchange that provides time for crews to respond, and the station is located above the potentially flooded area.

Ventilation is provided for entry into confined spaces. Replacement with submersible equipment would eventually reduce the need for confined space entry.

Hillsdale Pump Station

3397 Pacific Boulevard

Constructed 1964

Tributary Area: Hillsdale Blvd undercrossing at railroad

Outfall: Local storm drain system

Existing Equipment:

(2) Peerless 14" AV
axial flow pumps
3,300 gpm @ 26' TDH
(1,160 rpm)

30 hp vertical electric motors

Standby Power: None

Master Plan Recommendations

High Priority: None

Medium Priority: Provide manual transfer switch for portable standby power generator.

Low-Priority: Replace axial flow pumps and electric motors below grade with submersible pumps and motors. Relocate electrical control equipment and motor starters above-grade. Building a new submersible pump station within the interchange is recommended.

The Hillsdale Pump Station is located on Pacific Boulevard at the on-ramp to eastbound Hillsdale Boulevard. This facility pumps stormwater runoff from the Hillsdale underpass into the local storm drain system in Pacific Boulevard.

Similarly to the 42nd Avenue Pump Station, pumping equipment and electric motor drive units are housed below grade. While the electric service panel is located above grade in a weather-tight enclosure, switchgear, motor starters and controls are housed below ground in a confined space. Personnel access is through a manhole flush with the sidewalk and ladder. Equipment access is through steel-plated openings in the buried structure's roof.

Particularly with no provisions for standby power, electrical equipment and motors are subject to flooding, as is the underpass.

When the pump drivers require replacement, it should be with submersible style motors designed for below grade installation.

Ventilation is provided for entry into confined spaces. Replacement with submersible equipment and relocating new equipment above grade would eventually eliminate the need for routine confined space entry. Space is available within the interchange for electrical equipment and a standby generator:

Casanova Pump Station

4012 Casanova Drive

Constructed 1968
Scheduled for Replacement in 2004

Tributary Area: 170 acres of residential neighborhood.

Outfall: Laurel Creek

New Equipment:

(4) Flygt submersible rail-mounted pumps
11,700 gpm @ 15' TDH; 60 hp (500 rpm)
20" diameter discharge

(1) Flygt submersible rail-mounted low flow pump
200 gpm @ 15' TDH; 3 hp (1,740 rpm)

Standby Power:
Manual transfer switch and plug for portable engine-generator.

Master Plan Recommendations

High Priority: None

Medium Priority: None

Low-Priority: None

The Casanova Pump Station is located across Laurel Creek from Casanova Park in a residential neighborhood.

Originally built in 1968, the facility is on schedule for a complete replacement before the winter of 2004-2005.

Four new rail-mounted submersible pumps, one low-flow submersible pump, a new motor control center and provisions for manual transfer to a portable engine-generator will be provided.

Manual transfer and portable standby power are included in the pump station rehabilitation plans. During a power outage coincident with the most intense rainfall of the 10-year design storm, City crews would have about an hour to restore power before property is endangered (one foot above the curb). Unless this is deemed unacceptable by the City, the planned standby power equipment should be adequate.

Provisions for backup power to controls and telemetry systems should also be made.

Storm runoff can bypass the pumping facility through flapgated outfalls to Laurel Creek, which will operate when Marina Lagoon and Laurel Creek are sufficiently low.

Poplar Avenue Pump Station

Bayfront Levee near Monte Diablo Avenue

Constructed 1973

Tributary Area: 820 acres of northern San Mateo

Outfall: San Francisco Bay

Equipment:

(2) 30” Cascade axial flow pumps
18,700 gpm, 140 hp (580 rpm)
horizontal electric motors with right angle gear drives

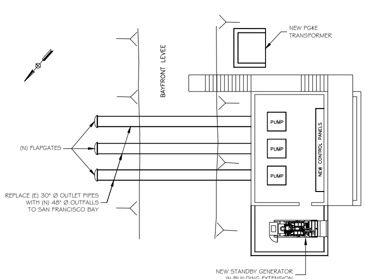
(1) 30” Allis-Chalmers axial flow pump
35,000 gpm, 250 hp (585 rpm)
vertical electric motor

Standby Power:
Manual transfer switch and plug for portable engine-generator

Master Plan Recommendations

This facility is scheduled for complete rehabilitation as part of the 2002 *Flood Management Strategies* report prepared by Schaaf & Wheeler:

(3) new 34,500 gpm axial flow pumps
(3) new 150 hp vertical electric motors
New MCC/MSB and standby generator with ATS
Seismic retrofit of building to code



The Poplar Avenue Pump Station is situated against the bayfront levee, which protects the Shoreview area from tidal flooding. The station’s intake is connected to a series of feeder channels that drain the golf course, areas to the west, and areas to the south through the Shoreline Park.

After pump station rehabilitation, the design 100-year storage elevation within Shoreline Park will be 0.8 foot NGVD, or 98.4 feet on City of San Mateo Datum.

Pump station rehabilitation also addresses the two most chronic problems at Poplar Avenue Pump Station:

1. Unreliable PG&E service forces crews to wade through often knee-deep water to plug in the portable generator.

2. Aging motor control equipment is difficult and expensive to maintain. Parts will not be available indefinitely.

Coyote Point Pump Station

20 Airport Boulevard

Constructed 1973

Tributary Area: 320 acres of northern San Mateo and Burlingame. 150 acres will be added per Chapter 5.

Outfall: San Francisco Bay

Equipment:

(2) 36" Johnston axial flow pumps
25,000 gpm, 125 hp (585 rpm)
horizontal electric motors with right angle gear drives

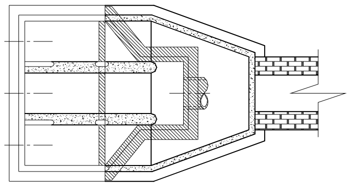
(2) 20" Fairbanks-Morse axial flow pumps
10,000 gpm, 40 hp (880 rpm)
vertical electric motors

Standby Power:
Manual transfer switch and plug for portable engine-generator

<u>Master Plan Recommendations</u>

This facility is scheduled for complete rehabilitation as part of the 2002 *Flood Management Strategies* report prepared by Schaaf & Wheeler:

- **(3) new 34,500 gpm axial flow pumps**
- **(3) new 150 hp vertical electric motors**
- **New MCC/MSB and standby generator with ATS**
- **Seismic retrofit of building to code**



The Coyote Point Pump Station is also situated against the bayfront levee, at the western edge of Coyote Point Recreation Area near the Burlingame border. Tributary storm runoff flows under Highway 101 through a culvert at Howard Avenue. Runoff in excess of pump station capacity overflows and runs down Airport Boulevard toward the San Mateo Municipal Golf Course where it joins the Shoreview storage area and is pumped to San Francisco Bay by the Poplar Avenue station.

Pump station rehabilitation at Coyote Point also addresses chronic problems with PG&E service and aging electrical equipment similar to Poplar Avenue Pump Station, which was constructed at the same time.

Both Coyote Point and Poplar Avenue stations will utilize the same mechanical and electrical equipment for interchangeability and ease of maintenance.

Fathom Drive Pump Station

401 Fathom Drive

Constructed 1966

Tributary Area: Small wetland area adjacent to J. Heart Clinton Drive (no urban runoff)

Outfall: Marina Lagoon through local storm drain

Equipment:

(2) 8" Johnston axial flow pumps (replaced 1985)
5 hp vertical electric motors

Standby Power:
None

Master Plan Recommendations

High Priority: None

Medium Priority: None

Low-Priority: None

The Fathom Drive Pump Station serves only to control the level of standing water within a wetland area adjacent to J. Hart Clinton Drive near the eastern border with Foster City.

Storm drain systems are not tributary to this facility and it plays no significant role within the Storm Drain Master Plan.

Standby power is not necessary as any overflow is released to Marina Lagoon at a safe elevation without encroaching upon any property fronting Fathom Drive.

All electrical service and motor control equipment is readily accessible from the surface, housed in a weather-tight enclosure.

City maintenance staff do not report any problems with this pumping facility.

Marina Lagoon Pump Station

2100 Detroit Drive

Constructed 1983

Tributary Area: 16th Avenue Drain, 19th Avenue Drain and Laurel Creek watersheds (10 square miles)

Outfall: San Francisco Bay

Existing Equipment:

(5) Patterson 72x72 AFV
275 rpm axial flow pumps
150,000 gpm @ 10' TDH

(5) water cooled 6.3:1
TGW Thyssen Getriebe
right angle gear drives

(5) air cooled 545 hp
Cummins VT A28P
1800 rpm diesel engines

2,000 gallon buried double-contained fuel tank
400 gallon day tank inside building

(1) Patterson 48x48 AFV axial flow pump
75,000 gpm at 295 rpm
200 hp 1,860 rpm vertical electric motor using 6.3:1 planetary gear drive

Standby Power:
Onan 40kW diesel EG-set for lighting and control circuits

Master Plan Recommendations

High Priority: None
Medium Priority: None
Low-Priority: None

Without question, the Marina Lagoon Pump Station protects the most property of any pumping facility within San Mateo. The pump station is located at the terminus of a 1,400 acre-foot storage facility created from the remnants of O'Neill Slough and Seal Slough that provides flood protection, recreation opportunities, an aesthetic amenity and ecological resource.

This is a well-designed facility in excellent condition. Operation and maintenance have never been a problem and the station was designed to facilitate both routine maintenance and major equipment overhauls.

The station is fully automatic with prime power supplied by five 545 horsepower Cummins diesel engines through right angle gear drives. A 40 kW standby diesel engine-generator provides backup electrical power to operate the entire station during PG&E outages. All FEMA requirements for automatic operation are satisfied. Pump starts are alternated among the five engine drive units and each engine is regularly exercised (one run per day during the summer when tidal inflow from O'Neill Slough is available; possibly less during winter).

The smaller electric driven axial flow pump is available to fill Marina Lagoon with bay water (reverse direction), but provides no additional flood control pumping.

3rd & Detroit Pump Station

2002 Detroit Drive

Constructed 1983

Tributary Area: 830 acres

Outfall: San Francisco Bay

Equipment:

(2) Peerless 36MF axial flow pumps 20,000 gpm, 19' TDH, 125 hp (585 rpm)

(1) GE 125 hp vertical hollow shaft electric motor

(1) Scania 125 hp diesel drive unit with 3:1 right angle gear

Standby Power:
Automatic standby engine-generator for 120V lighting and control circuits

<u>Master Plan Recommendations</u>

High Priority: None

Medium Priority: None

Low-Priority: None

The Detroit Drive pump station drains residential and commercial properties located in the wedge framed by San Mateo Creek, J. Hart Clinton Drive, 16th Avenue Drain and Highway 101.

This facility is located at the mouth of Seal Slough on the Bay side of the Marina Lagoon Pumping Station and the south side of East Third Avenue (J Hart Clinton Drive).

Hydrologic modeling shows that with one-percent inflow (225 cfs peak) and only one pump operating during a power outage (the direct drive pump), available storage in the drainage system and pump forebay limits the maximum ponding elevation to 0.4 foot NGVD (98.1 feet City Datum). Available topography shows that the lowest natural ground in the area (wetlands) is at least elevation 98 feet City Datum, so additional pumping capacity is not required, although the pump station has one empty space for an additional 20,000 gpm pump.

The station has an automatic bar screen cleaning machine, which maintenance staff would like to see installed at the Marina Lagoon Pump Station as well.

16th Avenue Pump Station

2055 Detroit Drive

Constructed 1983

Tributary Area: 16th Avenue Drain

Outfall: San Francisco Bay

Equipment:
(1) 30 hp axial flow prump with vertical electric motor

Standby Power:
None

Master Plan Recommendations

High Priority: None

Medium Priority: None

Low-Priority: None

The 16th Avenue Pump Station is associated with a gate structure located at the mouth of 16th Avenue Drain as it empties into Marina Lagoon. The gate has traditionally been closed during the summer months (April to September) to keep higher water levels in Marina Lagoon from backing up into local storm drains and protect lagoon water quality by diverting summer low flows from 16th Avenue Drain directly to San Francisco Bay.

This facility is not relevant during the winter rainy season and serves no storm drainage function.

It is, however, imperative that the gates remain in the fully open position during the winter months (October to April).

CHAPTER 8
CAPITAL IMPROVEMENTS

Chapters 6 and 7 evaluate San Mateo's storm drain collection and pumping systems, and recommend prioritized capital improvements to address deficiencies. This chapter provides a Capital Improvement Program that recognizes these priorities. The CIP provides an overall guideline for the City to use in preparing annual budgets and securing funds as discussed in Chapter 10. Exigent circumstances and future experience on the ground may necessitate deviations from the Storm Drain CIP. A master plan is intended to be just that; a tool for planning. Capital improvement priorities are not intended to be hard and fast.

CAPITAL IMPROVEMENT PRIORITIES

The proposed CIP for storm drainage in San Mateo is broken into three priority levels for funding and implementation:

High Priority Projects needed to remedy recurring or significant drainage problems identified by the City and confirmed through modeling. Property may be at risk on a frequent basis and at the least, commerce is regularly interrupted during the winter months. This portion of the CIP is intended to be completed within ten years.

Medium Priority Local drainage projects necessary to reduce less significant flood risks during more extreme runoff events, identified through the evaluation process described in Chapter 4.

Low Priority Projects that would eliminate local flooding that presents a nuisance but is not considered to significantly threaten property. These portions of the CIP could be completed as funding becomes available, either through additional local development or as ancillary projects to other street or other utility work.

ALTERNATIVE IMPROVEMENT PROJECTS

To increase storm drain system capacity, two essential types of projects are available: installing a new relief sewer parallel to the system lacking capacity; or replacing the overloaded pipe with larger diameter pipe in the same alignment. The two alternatives can be made equivalent to one another using the following formula, assuming that pipe material and length are equal:

$$D_R = \left(D_e^{2.63} + D_p^{2.63} \right)^{0.38}$$

where D_R = diameter of replacement pipe;
D_e = diameter of overloaded pipe; and
D_p = diameter of parallel relief drain.

The selection of a capacity improvement strategy will vary from project to project; and be governed by field constraints such as conflicting utilities, rights-of-way, and traffic control. The Storm Drain Capital Improvement Program for San Mateo generally utilizes parallel relief drains unless right-of-way or other constraints appear to favor the actual replacement of pipe.

Installing new parallel drains should be more cost effective than replacing pipes in most cases, since the required pipe size is smaller and the existing pipe does not need to be removed. Given the 40 percent contingency applied to unit cost estimates for master planning, no differentiation is made between the cost of pipe replacement and parallel drain installation.

Traditional cut and cover methods of construction will be employed for most storm drain construction. However the utilization of bore and jack, trenchless (e.g. directional drilling), and other methods may find application in special circumstances such as railroad crossings. Discussions with industry representatives indicate that some other special techniques such as sliplining and pipe bursting are only applicable to smaller (i.e. 24-inch and less) pipe sizes.

CAPITAL IMPROVEMENT PROGRAM

A proposed Storm Drain Capital Improvement Program is presented as Appendix C. In summary:

High Priority Capital Improvements	\$20,000,000
Medium Priority Capital Improvements	\$10,000,000
Low Priority Capital Improvements	\$5,000,000
Total Capital Improvement Program	\$35,000,000

COST OF IMPROVEMENTS

Appendix C provides cost estimating information by project type, priority and watershed. Costs have been estimated using information from other projects, cost estimating guides, and engineering judgment. A fifty percent contingency to cover design and contract administration (15%) and other unknown circumstances (30%) is applied to all cost estimates.

CHAPTER 9
MAINTENANCE AND REPLACEMENT

The Master Plan document is not intended as a treatise on operations and maintenance requirements or techniques. (City operations and maintenance staff are the foremost authorities on this subject.) Rather, some foresight is provided into anticipated ongoing maintenance schedules, which include periodic replacement of major storm system components.

GENERAL CRITERIA

Table 9-1 presents very general criteria that may be useful in establishing maintenance regimens. Again, city staff will have the best feel for the necessary frequency and extent of ongoing maintenance on a system-by-system basis. Also, maintenance needs will fluctuate depending upon seasonal and annual factors, particularly the amount of precipitation; and to a lesser extent, the general climate.

It is vitally important that all collection, storage, and pumping systems be in working order prior to the start of San Mateo's wet season near the end of October. Realizing the limited number of maintenance staff, and the limited number of hours in a year, it is a given that certain items will have higher priorities than others.

TABLE 9-1: STORM SYSTEM MAINTENANCE GUIDELINES

Category	Schedule
Inlet Inspection	annually (summer-fall)
Inlet Cleaning	as required (ongoing)
Storm Drain Pipe Cleaning	continuous if possible (ongoing)
Channel Cleaning	annually (fall)
Detention Basin Dredging	every ten years
Pump Exercising	monthly (year round)
Engine Exercising	monthly at full load (year round)
Equipment Lubrication	per manufacturers' recommendations
Drain and fill diesel fuel tank	every six months
Motor / Engine Control Testing	annually (fall)

COLLECTION SYSTEM MAINTENANCE

The storm drain and channel system cannot function if one of its components is plugged, and whether or not hydraulic analyses say criteria are met, blocked inlets or pipes will cause flooding; potentially with serious consequences. Although even the most rigorous maintenance programs cannot prevent all problems during every event, it is important that debris does not accumulate.

Actual maintenance techniques may include grate cleaning, inlet flushing, pipe flushing (hydrojetting), balls and mandrels for cleaning, vactoring, and physically entering storm pipes to remove accumulated debris by hand. Table 9-2 provides a summary inventory of storm drain collection infrastructure in San Mateo.

TABLE 9-2: STORM DRAIN COLLECTION SYSTEM INVENTORY

Pipe Type	Diameter / Size	Total Length in System (feet)
Reinforced Concrete Pipe	8”	740
	10”	330
	12”	99,630
	15”	85,080
	18”	74,200
	21”	31,140
	24”	44,770
	27”	14,720
	30”	14,780
	33”	10,030
	36”	35,140
	42”	91,900
	48”	15,200
	54”	4,760
	60”	2,960
	66”	5,100
	72”	3,770
	120”	260
Elliptical Pipe	19” x 30”	2,210
	38” x 60”	460
	48” x 76”	2,340
	53” x 83”	4,300
Arch Pipe	36” x 22”	950
	43” x 27”	720
	14’ x 5’-8”	2,020
Egg Shaped Pipe	48” x 32”	580
Total Pipe Length		**419,990**
Ditches and Canals		127,750

The City is responsible for about 80 miles of underground pipe and about 24 miles of open channels and ditches.

CHANNEL MAINTENANCE

Routine removal of mud and debris within open channels maintained by the City of San Mateo is necessary to preserve design capacities. Visual inspection should be conducted annually for any build-up of mud or debris within channel reaches or underneath any bridge or culvert crossings. Any significant build-up of mud or debris should be removed by mechanized equipment or manually removed by shovels. Mechanical equipment may need to be lowered into the creek using a crane from an accessible location.

Within the reaches of San Mateo Creek and Laurel Creek between San Francisco Bay and U.S. Highway 101, channel inverts are at or below mean sea level (0.0 feet NGVD). The natural earthen bottom tends to be clean and absent of vegetation. However, prior to every flood season in October, City crews should remove any bank vegetation that encroaches beyond each toe of the excavated channel. Emergent wetland vegetation and even dense weeds can be allowed to remain along channel banks where they naturally occur. However, any woody brush or other vegetation that grows below the top of bank should be removed by City personnel during their annual maintenance. The City of San Mateo must obtain and keep current any necessary permits from governing jurisdictional agencies.

Changes in the perceived value of riparian corridors, streams, and associated wetlands, over the last 20 years have lead to the development of complex environmental regulations. Streams, no matter how degraded or radically altered, that used to be thought of as flood conveyances to be maintained at will, are now valued as a dwindling natural resource. This has lead to an increasing amount of federal, state, and regional regulation of stream maintenance activities previously thought to be unencumbered by such regulatory oversight. Appendix D provides further regulatory guidance.

PUMPING FACILITY MAINTENANCE

Stormwater pump stations are critical to maintain since mechanical or electrical failure can jeopardize system operation. Each pump station should have a bound copy of its site-specific operations and maintenance manual on site; and all personnel need to be familiar with their content.

Proper equipment lubrication and maintenance following manufacturers' recommendations (which must be included in the operations and maintenance manual) is essential to efficient operation and longevity, particularly when one considers how infrequent pump operation may be. For this reason it is also recommended that any pump station control system that does not automatically alternate lead and lag pump status be retrofitted so that each pump within a station operates roughly the same number of hours every year.

Pumps

Large axial flow pumps with right angle gear drives are the predominant pump type in the system and require routine maintenance. Shafts and bearings need to be periodically balanced and/or replaced. The frequency of inspection (pumps need to be pulled out of the building) will vary depending upon the "L-10" bearing life rating of the pump in question. Average bearing life is defined as the operating hours at which half of the group of bearings fails and the rest continue to operate. AFBMA (the Anti-Friction Bearing Manufacturers Association) defines average life statistically as three to five times the L-10 life. Grease is the most maintenance free bearing lubricant – and used at the Marina Lagoon Pump Station. Other pumps in San Mateo have drip fee oil systems, which ensure the lowest bearing operating temperatures. Consequently the oiling reservoir needs to be checked on a routine basis and topped off as necessary

Engines

Manufacturers' maintenance instructions should be followed to the letter, particularly when engines are still under warranty. Maintenance schedules depend somewhat on whether an engine is used as the prime pump driver or is on standby (for power generation). A typical schedule of maintenance based on references provided by Cummins/Onan (Sanks, 1989) is provided as Table 9-3; giving both operating hours and calendar time.

TABLE 9-3: TYPICAL MAINTENANCE FREQUENCY FOR ENGINES AND EG-SETS

Maintenance Task	Operating Time	Calendar Time
Inspect fuel, oil level, coolant	8 hours	1 month
Inspect air cleaner, battery	50 hours	1 year
Clean governor linkage, breather, air cleaner	100 hours	1 year
Clean fuel filter, replace oil filter, change crankcase oil, check switchgear	200 hours	1 year
Clean commutator, collector rings, relays, cooling system; inspect brushes, valve clearances, starting and stopping systems, water pump	500 hours	1 year
Check injectors, grind valves (if required), remove carbon, clean oil passages, replace secondary fuel filter, clean generator, grease bearings	1000 hours	----

Diesel engines should be operated at full power for at least 15 to 30 minutes after reaching operating temperatures once a month to eliminate carbon deposits where source water makes this possible. Diesel oil is safer to store than most fuels and is easy to obtain and transport, but diesel deteriorates in storage and must be turned over every six months to one year.

STORAGE FACILITY MAINTENANCE

Marina Lagoon should be monitored for the accumulation of sediment from fluvial (freshwater drainage) and marine (bay) sources. Once average sediment deposition approaches an elevation of 94 feet (near the lowest winter pumping level) active storage will begin to be compromised and the lagoon should be dredged as necessary to elevation 91.

SYSTEM REPLACEMENT

With predominantly reinforced concrete pipe, the collection system can be expected to last almost indefinitely. System breaks, joint misalignment, and other problems do occur, of course, so part of the annual maintenance budget should be reserved for periodic pipe repair and replacement. Pump facilities, on the other hand, rely heavily on mechanical and electrical equipment that will wear out and become obsolete over time. On average, pumping equipment can be expected to last anywhere from 30 to 40 years or more with proper maintenance. Structural facilities should last much longer although metal, wood, and even concrete surfaces all require regular care. Table 9-4 lists San Mateo's pumping facilities, their approximate age, and possible dates for planned equipment replacement and major rehabilitation or full replacement. City maintenance crews need to monitor the condition of these facilities and prepare for system replacement several years in advance. Equipment replacement schedules are staggered to avoid a large number of simultaneous projects.

TABLE 9-4: PUMPING FACILITY REPLACEMENT SCHEDULE

ID	Station Name	Year	Age (years)	Mechanical Replacement	Major Rehabilitation
07	42nd Avenue	1988	16	2020	2050
08	Hillsdale	1964	40	---	2010
13	Casanova[1]	1968	36	---	2004
24	Poplar Avenue[2]	1973	31	---	2005
25	Coyote Point[2]	1973	31	---	2005
27	Fathom Drive[3]	1966	38	---	2025
33	Marina Lagoon	1983	21	2025	2050
34	3rd & Detroit	1983	21	2020	2045
35	16th Avenue	1983	21	2030	2055

[1]Replacement scheduled for Summer 2004
[2]Near-term replacement recommended by *Flood Management Strategies* Report (2002).
[3]Equipment replaced in 1985.

CHAPTER 10
FUNDING

Chapter 8 presents a Capital Improvement Program to reduce flood risks from local runoff throughout San Mateo. This chapter provides an overview of several funding mechanisms available to the city for financing capital storm drain projects. Funding requirements for the CIP are estimated and those costs are distributed to various land uses.

FUNDING SOURCES

The City is operating under political and legal constraints to the raising of monies for public works projects. Residents in public forums have voiced their political concerns, and the City's attorney must work through the legal aspects of each type of potential funding mechanism. This study does not attempt to promulgate a detailed financing plan for the Storm Drain CIP; rather, it provides a menu of possible capital sources for City leaders and residents to consider.

General Funds

If allowed, the City could conceivably cover all or portions of the Capital Improvement Program. It is unlikely, however, that projects of this magnitude could be paid for out of the City's reserves. Operation and maintenance costs have traditionally been borne by the general fund.

Loans

The City could apply to the California Infrastructure Bank for a loan to finance up-front costs subject to approval of the project by owners or voters. Interest rates are relatively low at the present time. This source of borrowing is generally less costly than financing assessment bonds and could show property owners that the City is endeavoring to lessen their costs.

Grants

Grant funding may be available through local, regional, state, of federal governments. As an adjunct to this funding source, agencies responsible for facilities that need improvement; for example, Caltrans; might be expected to pay for those improvements. For instance, the State paid for local storm drain improvements (culverts) as part of the Highway 101 Auxiliary Lane Project.

Redevelopment Agencies

This source of funding may be applicable when storm drain problems are contributing to a "blighted" condition in particular neighborhoods. The assessment of this funding source must be made on a case-by-case basis.

Taxation

Although "taxation" is not the most popular term, the formation of a **Mello-Roos District** could allows for the adoption of a tax designed to fit the needs of projects outlined in Chapter 8. The tax cannot be on assessed value and can be any formula that is equitable and fits the needs of the project. A two-thirds vote is required but with good advance preparation and a strong support committee, it may be achievable.

Benefit-Assessment Districts

A benefit-assessment district assigns project costs in direct proportion to the benefits received. Typical assessment district formation procedures are briefly outlined below.

1. Investigate general attitudes toward benefit assessment district formation by polling about one percent of the affected properties.

2. Educate property owners who will bear the top 100 assessments as to the need for the project, the importance to the community and their willingness to support the campaign.

3. Establish an annual assessment that will not require re-approval from property owners by avoiding increases above the amount first approved at benefit assessment district formation.

4. Send a "protest hearing" (not "election") ballot to all property owners affected including an information statement and a postage pre-paid return form showing approval or disapproval of the specific assessment proposed. (Returned ballot forms are public records and can be examined by those interested.) The vote taken is for the dollar value of assessments favoring the proceeding. Once $1 more than 50 percent of the total to be assessed is reported in favor, the proceeding is completed. Note that it is not required that 50 percent of all property owners record their approval/protest — only 50 percent of the total dollars to be assessed.

5. Typically two to five percent of all owners will file inquiries about the project and the process. City staff prepares consistent and reliable answers to each inquiry.

Benefit assessment districts are often formed for specific projects within a specific watershed. The only properties assessed are those that directly benefit from the projects, and in direct proportion to that benefit. Storm drain improvements do benefit individual properties, but they also benefit the city as a whole since much of the CIP provides relief to flooded streets and improves commerce.

Connection Fees

Based on geographic information provided by the City, about 8 percent of all parcels are currently identified as vacant. The increased costs of providing adequate storm drainage infrastructure due to any particular development project should be borne by those developing the land, not existing property owners. In such cases, it will be appropriate for the city to charge a one-time connection fee for added capital costs in addition to scheduled user fees and capital debt retirement fees. The MOUSE model can be used to identify that portion of the CIP directly attributable to individual developments.

Storm Drain User Fees

Annual operating costs are properly paid for through utility user fees. Whether these fees can also be used to retire capital debt is not entirely clear. However, whether a particular parcel benefits from the Capital Improvement Program or not, *every* property within the city contributes runoff to the storm drainage system at large. Therefore it should be appropriate that all property owners in San Mateo contribute to the operation, maintenance, and improvement of the storm drain system in direct proportion to their demand on the system. This principal is used to establish necessary capital improvement drainage assessments in the subsequent paragraphs.

FUNDING REQUIREMENTS

Regardless of the mechanism(s) chosen to finance capital improvements, the costs of those improvements will likely be funded through the issuance of bonds, retiring debt with annual revenues. For the purposes of this master plan, the following assumptions are made:

(1) Capital costs are based on 2004 dollars (ENR Index = 8,040).

(2) Costs are amortized over 20 years.

(3) Amortization is at an interest rate of 6 percent.

Two optional funding schedules are examined: (1) funding only High Priority and Medium Priority projects; and (2) funding the entire CIP.

Schedule 1: High Priority CIP

Present worth (2004) capital cost = $20,000,000

Annual revenues needed = P $(^{A/P,6\%,20\ yrs})$ = $20,000,000 (0.0872) = $1,744,000 per year

Schedule 2: Entire CIP

Present worth (2004) capital cost = $35,000,000

Annual revenues needed = P $(^{A/P,6\%,20\ yrs})$ = $35,000,000 (0.0872) = $3,052,000 per year

Income should be collected from property owners city in direct proportion to their demand on the storm drain system; that is, in proportion to the runoff potential from their land. Revenue to retire debt can therefore be based on assessments tied to land use and parcel size. Although every parcel of land is unique in its runoff potential, cataloging each individual property would lead to onerous and costly administration. Rather, land use may be categorized into basic types, each with a characteristic runoff coefficient. These coefficients have been used to formulate capital improvements, so there is a direct nexus between the CIP and assessments collected to pay for it.

Table 10-1 lists several basic types of land use within the City of San Mateo and a use factor related to the runoff generating capacity of each land use. A combination of lot size and use factor proportions the collection of revenue throughout the city. To simplify revenue collection, residential land use is split into two major groups (single family and multiple-family) with all properties within each group assigned the same use factor regardless of any minor variations used to develop the CIP. It may also be noted that open space areas and public streets do generate storm runoff that must be collected and discharged through the system. Revenues that need to be collected from these land uses are spread evenly among all other land use types, assuming that all property owners city share in the value of open space and a transportation network.

TABLE 10-1: LAND USE AND RUNOFF POTENTIAL

Land Use Category	Percent of Total Parcels	Use Factor
Single Family Residential	58	0.4
Medium Density Residential	12	0.7
High Density Residential	5	0.8
Commercial and Industrial	14	0.9
Parks and Recreation	1	0.2
Open Space	10	0.0

Land use factors from Table 10-1 determine the annual revenue that must be collected from each parcel. Revenue is collected based on one unit of runoff potential (a factor equivalent to unity) per parcel acreage as follows:

Schedule 1: High Priority CIP
Annual revenues needed = $1,744,000 per year / 4,345 net effective acres = $400 per acre

Schedule 2: Entire CIP
Annual revenues needed = $3,052,000 per year / 4,345 net effective acres = $700 per acre

Table 10-2 presents the annual revenue that must be collected per acre by various land use types to retire capital improvement debt over a twenty year period at six percent interest.

TABLE 10-2: ANNUAL REVENUE NEEDED TO RETIRE CAPITAL DEBT (PER ACRE)

Land Use Category	CIP Schedule 1 ($400/acre)	CIP Schedule 2 ($700/acre)
Single Family Residential (0.4)	$160	$280
Medium Density Residential (0.7)	$280	$490
High Density Residential (0.8)	$320	$560
Commercial and Industrial (0.9)	$360	$630
Parks and Recreation (0.2)	$80	$140

For a 5,000 square foot single family residential property, Schedule 1 (high priority CIP) would impose an annual storm drain debt retirement fee of $18 while Schedule 2 (entire CIP) raises that fee to $32 per year (both in 2004 dollars). Fee administration is simply based on land use category and parcel size.

Under this funding mechanism individual properties are assessed in direct proportion to their use of storm drain facilities. This master plan recommends that typical runoff factors be established for various land uses (and expanded if necessary) rather than tracking actual runoff factors by parcel due to the administrative workload this would entail.

APPENDIX A
LIST OF TECHNICAL TERMS AND ACRONYMS

Acre-Foot A quantity of water that would cover 1 acre to a depth of 1-foot, equal to about 325,000 gallons.

Amortization The process of liquidating a debt by installing payments or payment into a sinking fund; to prorate over a defined period at a specified interest rate.

Antecedent An event that precedes another event.

Backwater Water held back by a downstream control such as a bridge, constricted channel, or tide.

Base Flood See *one-percent flood*.

Caltrans California Department of Transportation.

CDFG California Department of Fish and Game.

CEQA California Environmental Quality Act.

City City of San Mateo, California.

Confluence The junction of two streams or storm drain pipes.

Conveyance The ability of a stream, channel or pipeline to pass a certain rate of flow.

Cross Section A vertical section of a stream channel or drainage structure that provides a side view of the structure; a transect taken at right angles to flow direction.

Cfs A rate of flow equivalent to 1 cubic foot, about 7 2 gallons, passing a point during 1 second (approximately 450 gallons/minute).

Design Flow The magnitude of flow (see *discharge*) that is used in design of channel modifications and drainage facilities such as storm sewers and pump stations.

Discharge The volume of water passing through a channel during a given period of time, usually measured in cubic feet per second (cfs).

El Niño	A disruption of the ocean-atmosphere system in the Tropical Pacific having important consequences for weather and climate around the globe. An El Niño tends to increase rainfall across the southern tier of the United States. The 1997-1998 El Niño was very strong, and caused destructive flooding throughout Northern California.
FEMA	Federal Emergency Management Agency.
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
Floodplain	An area of land inundated by *floodwaters*. Floodplains may consist of standing or moving water.
Floodwaters	Those flows of water that cannot be contained within the natural stream channel.
Freeboard	Vertical distance between the top of an embankment adjoining a channel and the water level in the channel. It is a factor of safety designed into a project.
Hydrograph	A plot of *discharge* (flow) against time.
Mean Sea Level	The average height of the surface of the sea of all stages of the tide over a 19-year period.
Mitigation	To moderate, reduce, or alleviate the impacts of a proposed activity; includes, in order: avoiding the impact by not taking a certain action or parts of an action; minimizing impacts by limiting the degree or magnitude of the action and its implementation; rectifying the impact by repairing, rehabilitation, or restoring the affected environment; reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; compensating for the impact by replacing or providing substitute resources or environments (Council of Environmental Quality, 1978).
National Geodetic Vertical Datum (NGVD)	The *mean sea level* in 1929.

NFIP	National Flood Insurance Program.
One Hundred Year Flood	The *one-percent flood*.
One Percent Flood	A flood magnitude that has a one percent chance of being equaled or exceeded in any one year.
Ordinary High Water	The area of a watercourse subject to Section 404 of the Federal Clean Water Act of 1972. The area affected is determined by the elevation of the 2.3-year flood event (ordinary high water flow) which is field checked by biologists using physical characteristics.
Overbank	In a river or creek, the area between the main channel and the limits of the *floodplain*.
Overflow	*Floodwater* that leaves a channel over its bank(s).
RCB	Reinforced Concrete Box (culvert).
Reach	A subdivision of a creek, ditch or storm drain system for convenience of study and reference.
Riparian	Vegetation and wildlife living within, and immediately adjacent to a river, stream or lake. In this report, riparian means the creek environment.
Riverine Flooding	Flooding from a freshwater source such as a river, creek, or stream.
Roughness Coefficient	Represents the frictional resistance of a surface to the flow of water. Used in hydraulic computations.
RWQCB	Regional Water Quality Control Board.
SFHA	Special Flood Hazard Area
SPRR	Southern Pacific Railroad.
SWRCB	California State Water Resources Control Board.

Tidal Flooding — Flooding from a saltwater body subject to influence from tides, such as an ocean, estuary, or bay.

USACE — United States Army Corps of Engineers.

USFWS — United States Fish and Wildlife Service.

USGS — United States Geological Survey.

Watershed — The geographical region or area drained by a stream. May also be referred to as a drainage basin, catchment or tributary.

Wetlands — As used herein, areas that under normal circumstances have hydrophytic vegetation, hydric soils, and wetland hydrology.

APPENDIX B
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APPENDIX C
CAPITAL IMPROVEMENT PROGRAM

A

16TH AVENUE

Project Identifier	Project	Priority Level: High	Priority Level: Medium	Priority Level: Low
16TH_17G-04_17I-40-SW	36" parallel pipes with some double pipes and a few (total length = 42') 42" pipes. Improvements running SE under Edinburgh from Aragon approx. 1,550'. Thence turning left, and running approx. 1,800' NE under Barneson. Additionally, improvements under and tributary to Maple (600'), as well as tributary to Edinburgh, approx. 250' length, located approx. 350' NE along Edinburgh from Barneson.	$1,950,000.00		
16TH_17I-37-SW_17J-36-SW	36" parallel pipe. From El Camino Real NE along 14th Ave approximately 2,000'.	$787,500.00		
16TH_14J-18_13J-28	18" new pipe, approximately 560' in length running under Sunnybrae Blvd from Birch Ave to Idaho Street	$117,000.00		
16TH_17I-51-SW_17J-36-SW	24" parallel pipe. From Palm NE along 16th Ave approximately 900'.		$240,000.00	
16TH_18F-07_17G-09	21" parallel pipe crossing Alameda de las Pulgas and running approximately 125' NE under Aragon. 30" parallel pipe continuing NE under Aragon approx. 500' before turning right and running SE under Harvard for 240'. 18" parallel pipe continuing SE under Harvard for approx. 300', thence turning left and running NE under Avila for approx. 500'.		$480,000.00	
16TH_16G-15_17H-08	18" parallel pipe running under Maple Street from Sonora Drive approximately 1,200' SE to just past Avila Road.		$247,500.00	
16TH_15H-16_17I-12	24" parallel pipe running under Palm Ave from 9th Avenue SE approximately 2100' to 14th Avenue.		$555,000.00	
16TH_15K-58-SW_16L-26	36" parallel pipe between the east side of 101 and residential homes. Beginning at Queens Ave running NW approx. 1,800' to discharge into 16th Ave Creek.		$705,000.00	

	Project Identifier	Project	Priority Level High	Priority Level Medium	Priority Level Low
16TH AVENUE	16TH_15J-11_16J-54-SW	18" parallel pipe running from the intersection of Folkstone Ave and Fleetwood Drive SE approximately 630', discharging to 16th Avenue Creek			$135,000.00
16TH AVENUE	16TH_13M-16_14M-08	18" parallel pipe running approximately 760' from Herschel Street at Kehoe Ave, S and SW to the intersection of Harrison Ave.			$157,500.00
16TH AVENUE	16TH_17M-05_16M-37-SW	A combination of 15", 18", 21" and 24" parallel pipes running from Adams Street, under houses in a NE direction for approx. 375' to Hamlet Street. Thence running under Hamlet street in a NE direction approx. 660', until turning SE near Eisenhower St to discharge into the Lagoon.			$255,000.00
16TH AVENUE	16TH_14H-14_14I-05	24" parallel pipe running under 9th Ave from Rosewood Drive, approx 685' under the railroad to Claremont Street.			$180,000.00
19TH AVENUE	19TH_19th_int_500_MH-98	36" parallel pipe from 20th and Palm to 19th Drain	$375,000.00		
19TH AVENUE	19TH_22I-03_22I-11	18" parallel pipe on 24th Ave from ADLP to Isabelle	$225,000.00		
19TH AVENUE	19TH_IMPMH2_21I-71	18" parallel pipe on ADLP from 23rd to 24th Ave	$112,500.00		
19TH AVENUE	19TH_IMPMH1_21H-14	18" parallel pipe on ADLP from 22rd to La Salle	$75,000.00		
19TH AVENUE	19TH_IMP165_IMP160	18" parallel pipe on ADLP from 27th to Parkway 36" parallel pipe from Esenada to Isabelle	$465,000.00		
19TH AVENUE	19TH_24J-79-SW_23J-31-SW	18" parallel pipe, on ADLP from Ventura to 31st. 24" parallel pipe from ADLP to Juniper	$390,000.00		
19TH AVENUE	19TH_MH-105_MH-121	48" parallel pipe 24th to Palm	$750,000.00		
19TH AVENUE	19TH_23J-12_MH-113	36" parallel pipe, Juniper to 26th Ave 48" parallel pipe, 26th Ave to 24th Ave 18" parallel pipe on Juniper	$1,200,000.00		
19TH AVENUE	19TH_20J-32_MH-116	18" parallel pipe Paulson/Flores to El Camino/Ladato		$180,000.00	
19TH AVENUE	19TH_23K-85_21K-88-SW	24" parallel pipe from Sylvan/Flores to El Camino/28th Ave 36" parallel pipe from El Camino/28th to Railroad		$855,000.00	
19TH AVENUE	19TH_25H-71_MH-323	18" parallel pipe on 28th Ave from 31st to Monterey		$127,500.00	

	Project Identifier	Project	Priority Level		
			High	Medium	Low
19TH AVENUE	19TH_18K-11_MH-76	36" pipe along Fiesta 24" parallel pipe on Fiesta from Bermuda to turn 10' culvert on channel under Bermuda			$2,100,000.00
	19TH_18J-08_MH-131	48" parallel culvert under railroad			$450,000.00

	Project Identifier	Project	Priority Level		
			High	Medium	Low
LAUREL CREEK	LRL_25I-09_25K-137	24" parallel pipe on 31st from Del Monte to Isabelle 36" parallel pipe from 31st/Isabelle to Laurel Channel	$1,230,000.00		
	LRL_LRL23_LRL25	72" culvert under El Camino Real	$1,500,000.00		
	LRL_LRL28_LRL29	72" parallel culvert under school	$825,000.00		
	LRL_24L-75_LRL20	18" on Edison, from Hillsdale to Laurel Channel			$108,000.00
	LRL_26G-40_27G-17	36" parallel pipe, near Shasta and Glendora		$495,000.00	
	LRL_25H-96_LRL52	24" parallel pipe, on Monterey from 31st to Hillsdale 24" parallel pipe, on Hillsdale from Monterey to Laurel Crk		$435,000.00	
	LRL-25P-54_25N-239	18" parallel pipe, on 40th Ave from Gillis to Pasadena 18" parallel pipe, on 40th Ave from Branson to Pasadena		$495,000.00	
	LRL_24N-51_23O-101	24" parallel pipe, on 39th Ave from Durand to Pasadena		$225,000.00	
	LRL_L22N-134b_22N-132	18" parallel pipe, from Hillsdale to Santa Clara			$90,000.00
	LRL_22P-19_21O-06	18" parallel pipe, on LLano			$195,000.00
	LRL_23O-203_22P-190	18" parallel pipe near Kimberly			$240,000.00
COYOTE POINT	CY_8H-01_Des_1	New channel from Hwy 101 to bay levee	$4,500,000.00		
	CY_11G-21_9H-04	30" parallel pipe on Monte Diablo, Delaware to Amphlett, 30" pipe on Delaware, from Monte Diablo to Tilton	$1,307,000.00		
	CY_9G-18-SW_8G-32	24" parallel pipe on Indian from Humboldt to Amphlett	$210,000.00		
	CY_8G-34_9H-04	36" parallel pipe on Amphlett from Monte Diablo to Indian	$360,000.00		
	CY_7G-09_7G-12	18" parallel pipe, on Bayshore (State to Poplar)		$315,000.00	
	CY_8H-14_8H-01	24" parallel pipe on Bayshore near Dore		$300,000.00	

	Project Identifier	Project	Priority Level		
			High	Medium	Low
COYOTE POINT	CY_11G-10_11F-09	18" parallel pipe, Santa Inez to Monte Diablo 30" parallel pipe, Santa Inez to Monte Diablo 30" parallel pipe, on Santa Inez (Ellsworth to 18")		$1,290,000.00	
	CY_10H-20_9H-24	18" parallel pipe, on Amphlett (Cypress to Monte Diablo)		$330,000.00	
	CY_12F-10_11E-40	18" pipe along Elm from Tilton to Poplar		$525,000.00	
	CY_10F-03_10F-54-SW	36" parallel pipe, Santa Inez to Poplar		$390,000.00	
	CY_5G-19_5G-24-SW	Coyote Point Dr			$46,500.00
	CY_7F-16_7F-20-SW	18" pipe at Humboldt and Peninsula			$45,000.00
	CY_9D-13_9D-16	18" and 36" pipe at San Mateo Dr and Peninsula			$45,000.00
	CY_IMP-11E-03_11E-46-SW	36" parallel pipe on El Camino (Engle to Poplar)			$90,000.00
	CY_12G-23_12G-03	18" pipe at Ellsworth and Tilton			$45,000.00
	CY_10G-07_9F-25	24" parallel on El Dorado b/t Santa Inez and Poplar	$335,000.00		
	CY_IMPR-10I-08_9I-17	18" parallel pipe Norfolk to Ontario and 18" new pipe on Lindeberg from 2nd to Sharon	$270,000.00		
DETROIT DRIVE	DET_11K-50_12K-32	24" parallel pipe on Ocean View	$180,000.00		
	DET_12J-11_11L-33	18" pipe from Cary to arched pipeline 24" pipe from existing arched pipeline, along Patricita, Newbridge and Shoreview to 66" pipe near pump station	$2,250,000.00		
	DET_10J-05_10K-27	24" parallel pipe, Shoreview/Fallon to 3rd Ave		$255,000.00	
	DET_12L-09_11L-33	48" parallel pipe, along Dale from Daisy to Shoreview and then east of Shoreview to 66" pipe near pump station.		$810,000.00	
SAN MATEO CREEK	SM_16F-26_15F-22	18" parallel pipe, 3rd Ave. (Harvard to Franklin) 24" parallel pipe, 3rd Ave. (Franklin to W 3rd) 18" parallel pipe, 3rd Ave. (W 3rd to Virginia)		$300,000.00	
	SM_13F-09_13G-54-SW	18" parallel pipe, El Camino (St Mathews to Crystal Springs)		$186,000.00	
	SM_13H-08_13H-22	18" parallel pipe, 5th Ave (Main to Claremont)		$144,000.00	
	SM_14G-12_20G-40-SW	18" parallel pipe, B St. (Baldwin to 4th)	$495,000.00		
	SM_31E-05_30E-16	24" parallel pipe, Palhemus (Ralston to Tower) 30" parallel pipe, Polhemus (near Timberlane)			$159,000.00

SAN MATEO CREEK	Project Identifier	Project	Priority Level		
			High	Medium	Low
	SM_IMP29E-33-SW_29E-16	21" parallel pipe, De Anza (near Alderwood)			$45,000.00
	SM_32E-02_32E-01	18" parallel pipe, near Lakewood and Polhemus			$45,000.00
	SM_18E-04_17D-12-SW	18" parallel pipe, Coumbia (near Tulane) 18" parallel pipe,Crystal Springs (near Tulane)			$135,000.00
	SM_18D-04_18D-03	18" parallel pipe, Oak Valley Road near Parrott Drive			$45,000.00
	SM_14F-16_14F-13	18" parallel pipe, W 3rd Avenue (east of Camino Real)			$45,000.00

Totals by Priority Level		**$20,000,000.00**	**$10,000,000.00**	**$5,000,000.00**
Total Citywide				**$35,000,000.00**

APPENDIX D
PERMIT REQUIREMENTS FOR MAINTENANCE

This Appendix is intended to provide background information and describe the current regulatory and permit requirements typically associated with municipal stream maintenance activities. Schaaf & Wheeler also provides several recommendations to the City of San Mateo (City) based on our understanding of the City's stream maintenance needs.

BACKGROUND

Changes in the perceived value of riparian corridors, streams, and associated wetlands, over the last 20 years has lead to the development of complex environmental regulations. Streams, no matter how degraded or radically altered, that used to be thought of as flood conveyances to be maintained at will, are now valued as a dwindling natural resource. This has lead to an increasing amount of federal, state, and regional regulation of stream maintenance activities previously thought to be unencumbered by such regulatory oversight. Yet, there is still no comprehensive legislation that defines a set of allowable stream maintenance activities and automatically covers them under a single state-wide or regional permit. The result is a complex tangle of overlapping and, at times, conflicting local, state, and federal regulation.

Water agencies and municipalities on the mid peninsula are exercising one or more of the following options in order to address stream maintenance activities:

1. *Regional Stream Maintenance Program (SMP)* – a CEQA-certified, pre-permitted, multi-year maintenance/enhancement program for all water courses within a single or multiple watersheds administered by a local agency (e.g., the Santa Clara Valley Water Agency) or joint powers authority (e.g., the San Francisquito Creek JPA);

2. *Local Comprehensive SMP* – a CEQA-certified, pre-permitted, multi-year maintenance/enhancement program for all water courses within a given watershed, multiple city jurisdictional area, or within the boundaries of a single municipality;

3. *Targeted SMP* – same as above, but for a single identified stream or stream reach within a single municipality;

4. *Stabilization and Maintenance Project* – a project specific plan to implement channel stabilization and maintenance at a single or multiple sites, including the minimum level of environmental documentation and appropriate single-project regulatory permits;

5. *Emergency Repair and Maintenance* – implementation of emergency repair and maintenance activities for which permits are simultaneously or retroactively procured;

6. *Landowner Intervention* – implementation of permitted or non-permitted channel maintenance and bank stabilization work by adjacent landowners at specific sites believed to represent an immediate hazard to private property.

Due to the planning burden and expense associated with the first three SMP alternatives, municipalities usually employ the fourth and fifth approaches. For better or worse, the fifth approach, that of Emergency Repair and Maintenance, has become the *modus operandi* of many municipalities as it appears to circumvent some of the time-consuming and costly regulatory activities. The risk, however, is that regulatory agencies may not issue after-the-fact approvals for these activities and, at worst, may require that unacceptable erosion control measures be removed. More importantly, the *Regional General Permit No. 5: Repair and Protection Activities in Emergency Situations* issued by the San Francisco District of the U.S. Army Corps of Engineers (USACE) expired on August 31, 2003. As a result, emergency stream maintenance activities for which categorical exclusion under CEQA may have applied, can no longer obtain a concomitant emergency permit from USACE.

Municipalities on the mid peninsula generally discourage landowner repair. Although at times, City staff appears to cast a "blind eye" to homespun bank repair measures. Site specific repair, emergency repair, and landowner intervention often share the common liability of improving conditions at a discrete site while exacerbating opposite bank or downstream conditions. The lack of an integrated watershed-wide approach can lead towards significant cumulative effects.

ENVIRONMENTAL DOCUMENTATION REQUIREMENTS

Stream channel and bank repair projects are almost always defined as a project under the California Environmental Quality Act (CEQA), as well as under the National Environmental Policy Act (NEPA) if federal funding is involved. Stream maintenance activities, however, may or may not require CEQA/NEPA compliance under one of two conditions: 1) maintenance activities are not defined as a project or 2) an exemption (i.e., statutory or categorical use) under CEQA or a categorical exclusion under NEPA applies.

An environmental law flow chart (Attachment 1) is included at the end of this memorandum to illustrate CEQA and NEPA processes described below.

CEQA

Generally, the implementation of CEQA entails three separate phases:

- Phase I - preliminary review of a project to determine whether it is subject to CEQA;
- Phase II - preparation of an Initial Study to determine whether the project may have a significant environmental effect; and
- Phase III - preparation of an EIR if the project may have a significant environmental effect or preparation of a Negative Declaration if no significant effects will occur.

Components of these phases are described in more detail below.

Key Participants in the CEQA Process

Since the City of San Mateo is the California government agency that will have the principal responsibility for internally approving and carrying out stream maintenance activities within its jurisdiction, the City is considered to be the ***lead agency*** under CEQA. As such, the City will employ CEQA guidelines to determine if a proposed stream maintenance action is a "project" subject to CEQA, review for exemptions, and submit an application to the responsible agency and the State Clearing House (SCH). The ***responsible agency*** is an agency other than the lead agency that has a legal responsibility for approving the project, such as the California Department of Fish and Game (CDFG). The City may also wish to designate a certain ***trustee agency*** in the application that has jurisdiction over certain resources held in trust, but do not have legal authority over approving or carrying out City projects, such as the San Francisco Public Utilities Commission managing Crystal Springs Reservoir/Upper San Mateo Creek and the State Lands Commission managing San Mateo's bay lands.

Phase I

The City, as lead agency, will first determine if a stream maintenance activity or suite of activities are considered to be a project under CEQA. With some exceptions, stream maintenance activities undertaken by the City will fall under the definition of a project. Regional, local, and targeted SMPs, as described in the introduction, are always accorded project status under CEQA, and require an Initial Study leading to either a negative declaration or environmental impact report (EIR). Discrete stream maintenance projects, described under approaches four and five of the introduction, may, however, qualify for one of two exemptions as follows:

Statutory Exemption – blanket exemption from CEQA's procedures and policies to address emergency situations, such as floods, soil or geologic movements that pose a clear and imminent danger to life, health, property, or essential public services.

Categorical Exemption – blanket exemption from CEQA's procedures and policies for 29 classes of projects that will not have a significant effect on the environment, including: Class 1 - Repair or Maintenance of Existing Structures or Facilities, and Class 4 - Minor Alterations of Land, Water, or Vegetation, and Classes 7 and 8 – Agency Maintenance, Restoration, or Enhancement of Natural Resources or the Environment.

When the responsible public agency decides that the project is either statutorily or categorically exempt from CEQA and approves the project, the agency may file a notice of exemption, although it is not required to do so. It is important to note that, although a project may be declared exempt from CEQA, regulatory agencies may still request that certain CEQA documents be submitted with the project's environmental permit applications.

Phase II

Once the lead/responsible agency determines that a particular stream maintenance activity is subject to CEQA and that no statutory or categorical exemptions apply, then the City would generally prepare an Initial Study. This is a preliminary analysis, in consultation with relevant trustee agencies, to determine whether an EIR or a Negative Declaration is needed. CEQA requires an Initial Study to include a description of the project, environmental setting, potential environmental impacts, and mitigation measures for any significant effects.

Phase III

If the Initial Study concludes that stream maintenance activities, without mitigation, may have a significant effect on the environment, an EIR must be prepared: otherwise the City may prepare a Negative Declaration or Mitigated Negative Declaration. Unless the project includes a comprehensive SMP, municipal stream maintenance projects often result in a Mitigated Negative Declaration (MND).

Mitigated Negative Declaration. A MND is a written statement, accompanied by an Initial Study, briefly explaining while the proposed stream maintenance will not have a significant environmental effect and outline the mitigation measures that will be included in the project to avoid significant effects. The MND will undergo a process similar to, but more abbreviated than, the EIR process, including public notice and review, revisions, adoption of final MND, and approval of lead agency's action/project.

Environmental Impact Report. An EIR will be prepared if the stream maintenance project causes significant effects on the environment that cannot be addressed by a MND. An EIR is a detailed informational document prepared by the lead agency that analyzes a project's potential significant effects and identifies mitigation measures and reasonable alternatives to avoid the significant effects. There are two types of EIRs that are commonly employed for stream maintenance activities: *Project* EIRs and *Program* EIRs.

Project EIRs, are the most common for stream maintenance activities and typically identify an individual maintenance action or several closely related actions within a discrete project site or reach. The project EIR requires a high level of effort, but the end product is geographically and temporally restrictive. Therefore, public agencies, JPAs, and municipalities are increasingly writing program EIRs in support of more comprehensive, long-term SMPs. That is, the City writes a single EIR that covers a maintenance program linking a series of maintenance actions within multiple streams that are characterized as one large project. Program EIRs may also be prepared to include agency plans, policies, and regulatory programs.

Time Requirements

There are strict time limits the lead agency must follow. Specifically, the lead agency must decide to prepare an EIR or Negative Declaration within 30 days, complete a MND within 105 days, and complete an EIR within one year from the date the application is deemed complete.

NEPA

Proposed stream maintenance activities and projects are only expected to require NEPA compliance if Federal funding is involved, such as Federal Emergency Management Agency (FEMA) flood damage monies or U.S. Environmental Protection Agency (USEPA) 319h funds. If NEPA applies to a proposed City maintenance program or action, the ensuing process is very similar to that described above for CEQA, including three separate phases:

- Phase I - preliminary review of a proposal to determine whether it is subject to NEPA and, if so, whether a categorical exclusion applies;
- Phase II - preparation of an Environmental Assessment (EA) to determine whether the project may have a significant environmental impact; and
- Phase III - preparation of an Environmental Impact Statement (EIS) if the project may have a significant environmental impact or preparation of a Finding of No Significant Impact (FONSI) if no significant effects will occur.

Due to the similarity of the NEPA/CEQA process, as well as the low likelihood that the City will be required to undergo NEPA for stream maintenance activities, a detailed description of its components is not warranted for the purposes of this memorandum.

REGULATORY PERMIT REQUIREMENTS

Environmental permits to conduct channel stabilization and stream maintenance activities within the San Mateo County are principally required by three agencies, including USACE, CDFG, and the San Francisco Regional Water Quality Control Board (RWQCB). In cases where proposed stream maintenance actions may jeopardize federally-listed threatened and endangered species, acquisition of project permits may also require Section 7 endangered species consultations with U.S. Fish and Wildlife Service (USFWS) and/or National Oceanic and Atmospheric Agency (NOAA) Fisheries. Regional trust agencies, such as the Bay Conservation and Development Commission (BCDC) impose permit requirements where lower portions of watersheds enter the San Francisco Bay. Finally, the City has developed internal site development, floodplain management, and heritage tree ordinances with which stream maintenance activities must comply.

Federal state, regional, and local permits that are anticipated for channel stabilization and maintenance activities are described for each agency in greater detail below. A sample permitting flow chart (Attachment 2) is also provided.

USACE

Under Section 404 of the Clean Water Act (CWA), the USACE regulates certain activities that "discharge dredged or fill material into waters of the United States." Waters of the U.S. are defined to generally include such resources as tidal waters, most rivers, lakes, and streams, and certain types of wetlands. Channel stabilization and stream maintenance activities that propose to place fill, e.g. culverts, gabions, rock rip rap, logs, etc., in the channel must obtain a permit from USACE.

It is important to note that, in streams, waters of the U.S. include the bed and banks of the channel only up to ordinary high water (OHW) or the 2.33-year flood event. Formal wetland delineations are often conducted to determine the specific bank elevation of OHW, as well as the limit of Waters of the U.S. where streams become intermittent or ephemeral. Clear wetland delineation becomes very important when assessing the area of impact of a proposed stream maintenance activity in order to determine what type of USACE permit will be required.

USACE issues two types of permits under Section 404: general permits and standard (individual) permits. General permits are issued by USACE to streamline the permit process, while individual permits are more rigorously reviewed and are reserved for projects that impact more than 1/3 acre of tidal waters or non-tidal waters greater than 1/2 acre. Specifically, the USACE Nationwide Permit (NWP) program authorizes 43 different categories of activities, each of which is governed by specific conditions for the particular NWP, as well as 27 general conditions that apply to all NWPs.

There are eight NWPs that can be used individually, or stacked in combination, for channel stabilization and stream maintenance activities. They are listed as follows:

- ***NWP 3 Maintenance*** **–** the repair, rehabilitation, or replacement of any previously authorized, currently serviceable structure or fill, provided that the structure or fill is not to be put to uses differing from those uses specified in the original permit. This NWP authorizes the repair, rehabilitation, or replacement of those structures or fills damaged by storms or floods provided the work commences within two years of the date of their damage.

- ***NWP 7 Outfall Structures and Maintenance*** **–** permits activities related to construction of outfall structures and associated intake structures where the effluent from the outfall is authorized or in compliance with the National Pollutant Discharge Elimination System (NPDES) program. Under this permit maintenance excavation, including dredging, to remove accumulated sediments blocking or restricting outfall and intake structures.

- ***NWP 13 Bank Stabilization*** **–** permits bank stabilization activities necessary for erosion prevention, provided the bank stabilization is less than 500 feet in length or less than one cubic yard of fill per running foot.

- ***NWP 18 Minor Discharges*** **–** permits minor discharges of dredged or fill material in waters of the U.S. below the plane of the OHW mark or high tide line, provided it is less than 25 cubic yards and will not cause the loss of more than 1/10 acre of wetlands.

- ***NWP 27 Stream and Wetland Restoration Activities*** **–** permits activities in waters of the U.S. associated with restoration of former waters, the enhancement of degraded wetlands and riparian areas, the creation of new wetland and riparian areas, and the restoration and enhancement of open water habitats. The main provision requires that the project reach be in non-federal public or private ownership.

- ***NWP 31 Maintenance of Existing Flood Control Facilities*** **–** permits discharge or placement of fill material resulting from activities associated with maintenance of existing flood control facilities, including retention/detention basins and channels that were previously permitted or constructed by the USACE. To qualify for this NWP, the City must have a USACE-approved "maintenance baseline" which describes the existing physical characteristics that maintenance activities will be attempting to maintain.

- ***NWP 33 Temporary Construction, Access and Dewatering*** **–** permits temporary structures, work and discharges, including cofferdams for dewatering channel stabilization and stream maintenance sites provided the associated primary activity is authorized by USACE.

In order for the City to apply for a USACE permit, several types of information must be submitted, including a completed application form, project description, legible drawings, and appropriate fees. Sixty percent plans and specifications usually suffice. Application forms, NWP information, and guidance for completing the forms are available on line at:

www.spn.usace.army.mil:/regulatory/apply.html .

Questions and completed applications should be directed to:

Mr. Edward A. Wiley, South Section Chief
U.S. Army Corps of Engineers
San Francisco District, Regulatory Branch
333 Market Street
San Francisco, CA 94105-2197
voice: 415.977.8464
facsimile: 415.977.8483

CDFG

California Department of Fish and Game Code section 1602 requires any person, state or local governmental agency, or public utility to notify CDFG before beginning any activity that will do one or more of the following: 1) substantially obstruct or divert the natural flow of a river, stream, or lake; 2) substantially change or use any material from the bed, channel, or bank of a river, stream, or lake; or 3) deposit or dispose of debris, waste, or other material containing crumbled, flaked, or ground pavement where it can pass into a river, stream, or lake. This applies to all perennial, intermittent, and ephemeral rivers, streams, and lakes in the state. In addition, all aquatic and riparian habitats occurring between the outer edges (drip line) of riparian vegetation along one top of bank to outer edge of riparian vegetation rooted in the opposite top of bank is under CDFG jurisdiction.

The City's anticipated channel stabilization and stream maintenance activities are likely to alter or remove accumulated bed sediments, wood debris log jams, and unwanted vegetation within the bed and banks of streams, as well as place protective structures, such as rock vortex weirs and biotechnical bank stabilization. Hence, CDFG project approvals and permits are likely to be required. CDFG issues two types of Lake and Streambed Alteration Agreements applicable to channel stabilization and stream maintenance: Section 1601 for public entities and Section 1603 for private entities.

Except in the case of emergency work, the City initiates a three step process with CDFG prior to project implementation, including 1) notification, 2) determination, and 3) agreement negotiation.

Notification

In order to notify CDFG, the City must submit a complete notification package and fee to the CDFG regional office that serves San Mateo County. The notification package is available from the Central Coast Regional office in Napa, CA or online from the CDFG website at

www.dfg.ca.gov/1600/notification_pkg.html.

After you notify CDFG, they will determine whether your notification package is complete. CDFG will make this determination within 30 calendar days of receiving the notification package if you are applying for a regular agreement (i.e., an agreement for a term of five years or less). If the notification package is incomplete, CDFG will contact you and specify the information you need to provide to make it complete. They will not process your notification package until it receives the additional information. If your notification package is complete, they will process it n 30 days.

Please note that the 30-day time period does not apply to notifications for long-term agreements (i.e., agreements for a term greater than five years).

Determination

After CDFG receives a complete notification package, they will determine whether you will need a Streambed Alteration Agreement for your proposed channel stabilization and stream maintenance activity. An agreement will be required if the activity could substantially adversely affect an existing fish and wildlife resource. If an agreement is required, CDFG will conduct an onsite inspection, if necessary, and submit a draft agreement to you. The draft agreement will include measures to protect fish and wildlife resources while conducting the project. If you are applying for a regular agreement, CDFG will submit a draft agreement to you within 60 calendar days after your notification is complete. The 60-day time period will not begin until your notification is complete. The 60-day time period does not apply to notifications for long-term agreements.

Agreement Negotiation

After the City receives the draft agreement from CDFG, you will have 30 calendar days to notify them whether the measures in the draft agreement are acceptable. If you agree with the measures included in the draft agreement, you will need to sign the agreement and submit it to them. If you disagree with any measures in the draft agreement, you must notify CDFG in writing and specify the measures that are not acceptable. Upon written request, CDFG will meet with you within 14 calendar days of receiving the request to resolve the disagreement.

After CDFG receives the signed draft agreement, it will make it final by signing it. However, they will not sign the agreement until it receives the City's notification fee and complies with the California Environmental Quality Act (Pub. Resources Code, § 21000, et seq.). After you receive the final agreement, you may begin the project the agreement covers, provided you have obtained any other necessary local, state, and federal authorizations.

Emergency Work

You do not need to notify the Department or obtain a Section 1601 Streambed Alteration Agreement before beginning the following emergency work: 1) immediate emergency work necessary to protect life or property; 2) immediate emergency repairs to public service facilities necessary to maintain service as a result of a disaster in an area in which the Governor has proclaimed a state of emergency; and 3) emergency projects undertaken, carried out, or approved by a state or local governmental agency to maintain, repair, or restore an existing highway, within the existing right-of-way of the highway, that has been damaged as a result of fire, flood, storm, earthquake, land subsidence, gradual earth movement, or landslide, within one year of the damage. Although notification is not required *before* beginning the emergency work, you must notify CDFG in writing within 14 days *after* beginning the work.

Costs

The fee schedule-section 699.5 in title 14 of the California Code of Regulations- is included in the notification package sent by CDFG or available on the webpage. Applicable fees are summarized as follows:

a. 1601 Applications (from public agencies) - $154.00 non-refundable application fee, plus:

    1. No additional fee for projects costing less than $25,000.

    2. $618.75 additional processing fee for projects costing from $25,000 to $500,000 [for a total of $772.75].

    3. $1,236.5 additional processing fee for projects costing over $500,000 [for a total of $1,390.50].

b. 1601 Routine Maintenance Activities (public agencies) if performed under Memorandum of Understanding with the Department of Fish and Game:

    1. $129.50 each for the first 20 maintenance projects.

    2. $102.75 each for the second 20 maintenance projects.

    3. $78.25 each for maintenance projects in excess of 40.

    4. Projects under this subsection pertain to those waterways under prior 1601 agreement upon which public agencies propose to perform routine maintenance; to be submitted at least 30 days prior to commencement of work.

Questions and completed notifications, applications, and signed agreements should be directed to:

Mr. Robert Floerke, Regional Manager
California Department of Fish and Game
Central Coast Region
P.O. Box 47
Yountville, CA 94599
Tel.: (707) 944-5500 Fax: (707) 944-5563

RWQCB

A single permit (401 water quality certification) from the RWQCB is required for discharges associated with channel stabilization and stream maintenance activities. This permit is inextricably linked with USACE permits, such that it has both federal and state components. These are summarized below.

Federal Component – 401 Certification

The Federal CWA, in Section 401, specifies that states must certify that any activity subject to a permit issued by a federal agency, such as USACE, meets all state water quality standards. In California, the State Water Resources Control Board (SWRCB) and the regional boards are responsible for taking certification actions for activities subject to any permit issued by USACE pursuant to Section 404 (or for any other Corps' permit, such as permits issued pursuant to Section 10 of the Rivers and Harbors Act of 1899). Such certification actions, also known as 401 certification or water quality certification, include issuing a 401 certification that the activity subject to the federal permit complies with state water quality standards.

401 certification is necessary for all of USACE's NWPs and, under the current regulations, the RWQCB may no longer waive certification requirements. Therefore, should 401 certification be denied, the USACE NWP will be denied also. As a result, acquisition of 401 certification is paramount to the permit application process.

State Component - Waste Discharge Requirements

Under California's Porter-Cologne Water Quality Control Act (Porter-Cologne), the regional boards regulate the "discharge of waste" to "waters of the state". All parties proposing to discharge waste that could affect waters of the state must file a report of waste discharge with the appropriate regional board. The regional board will then respond to the report of waste discharge by issuing waste discharge requirements (WDRs) in a public hearing, or by waiving WDRs (with or without conditions) for that proposed discharge.

Both of the terms "discharge of waste" and "waters of the state" are broadly defined in Porter-Cologne, such that discharges of waste include fill, any material resulting from human activity, or any other "discharge" that may directly or indirectly impact "waters of the state". While all "waters of the United States" that are within the borders of California are also "waters of the state", the converse is not true - "waters of the United States" is a subset of "waters of the state."

It is important to note that, while Section 404 permits and 401 certifications are required when the activity results in fill or discharge directly below the ordinary high water line of waters of the United States, any activity that results or may result in a discharge that directly or indirectly impacts waters of the state or the beneficial uses of those waters are subject to WDRs. In practice, most regional boards rely on applications for 401 certification to determine whether WDRs need also be issued for a proposed project.

Application Process

The San Francisco Bay RWQCB has produced a combined 401 certification/waiver of WDRs application form to ensure that applicants do not need to file both a report of waste discharge and an application for 401 certification. Once it has received a complete application for 401 certification from the City, the RWQCB must act on the application within 60 days, although it may request up to one year of additional time to interact with USACE. Depending on the complexity of this interaction, the RWQCB may take between three and twelve months to issue 401 certification. Once the RWQCB issues certification, the USACE permit becomes valid as well.

In order for the City to apply it must complete an Application for 401 Water Quality Certification and/or Report of Waste Discharge (form R2C502). Several types of information must be submitted, similar to that required for NWP and Section 1601 permits, including a completed application form, project or activity information, dredge and fill information, mitigation, proof of CEQ compliance, and applicable drawings.

Fees

All applications for certification must include an initial deposit of $500. The total fee, including deposit, for issuing certification increases with acreage of fill from $1,000 to $10,000 and/or according to cubic yards of material dredged ranging from $500 to $10,000.

Application forms, additional information, and instructions for completing the forms are available on line at:

www.swrcb.ca.gov/rwqcb2/certs.htm

Questions should be directed to the RWQCB's San Mateo County (Bayside) technical staff representative, Habte Kifle at (510) 622-2371.

Completed applications should be sent to:

Ms. Loretta K. Barsamian, Executive Officer
San Francisco Bay (Region 2)
Regional Water Quality Control Board
1515 Clay Street
Oakland, CA 94612
Tel: (510) 622-2300 Fax: (510) 622-2460

BCDC

The San Francisco Bay Conservation and Development Commission is a California state agency which was established to accomplish two primary goals: first, to prevent the unnecessary filling of San Francisco Bay; and second, to increase public access to and along the Bay shoreline. The Commission is responsible for carrying out two state laws: the McAteer-Petris Act and the Suisun Marsh Preservation Act and two plans: the San Francisco Bay Plan and the Suisun Marsh Protection Plan. These laws and plans were adopted to protect the Bay and the Suisun Marsh as great natural resources for the benefit of the public and to encourage development compatible with this protection

The BCDC's jurisdiction extends 100 feet of the Bay front, including tidally influenced channels, such as Seal Slough. It will only be necessary for the City to obtain a permit for dredging and fill activities from BCDC when conducting stream maintenance near the mouths of creeks.

Application Process

To obtain the required BCDC approval, it is necessary to complete an application form, provide the necessary additional information and exhibits, and pay a processing fee. After a complete application is filed, the BCDC has a maximum of 90 days to act on the application. Thereafter, if the BCDC votes to approve the project, a permit with relevant conditions will be issued.

The size, location, and impacts of a project determine which type of permit is appropriate for a particular project. In turn, the type of permit that is applied for affects the information that must be provided to complete a permit application. A brief description of each type of permit follows. In an *emergency*, any of the three types of permits can be issued almost immediately if a project is needed to protect life, health, or property.

Regionwide Permit. *Routine maintenance* work that qualifies for approval under an existing BCDC regionwide permit can be authorized in a very short period of time by the executive director without commission review or a public hearing.

Administrative Permit. An administrative permit can be issued for an activity that qualifies as a *minor repair or improvement* in a relatively short period of time and without a public hearing on the application. Although an administrative permit application can be processed quickly, the proposed project must be reviewed against the same policies that are used to determine whether a major permit can approved.

Major Permit. A major permit is issued for work that is more extensive than a minor repair or improvement. A public hearing is held on an application for a major permit and the application may be reviewed at hearings held by the engineers and designers who advise the BCDC.

Most channel stabilization and stream maintenance activities anticipated by the City indicate that a regionwide or administrative permit would be sufficient.

Once the BCDC receives an application, their staff has 30 days to determine whether the application is complete. If it is complete, it is officially filed and processed in one of three ways depending on the type of permit that is appropriate for the particular work that is to be authorized by the permit. Work on a project cannot begin until the application has been evaluated and approval has been issued. A permit is not effective until it has been signed by the applicant and returned to the BCDC.

Application forms, additional information, and instructions for completing the forms are available on line at: www.bcdc.ca.gov/commdoc/overview.htm

Questions should be directed to the BCDC's permit staff by telephone at (415) 362-3600 or via e-mail at info@bcdc.ca.gov .

Completed applications should be sent to:

Mr. Robert Bathe, Chief of Permits
50 California Street, Suite 2600
San Francisco, CA 94111
Tel.: (415) 352-3600 Fax: (415) 352-3606

CITY OF SAN MATEO

The City has two general ordinances and one internal permit with which public works projects must comply when conducting channel stabilization and stream maintenance activities. They are elucidated below.

Heritage Tree Ordinance and Tree Removal Permit

The City has adopted tree ordinance that protects native trees having a trunk 10 inches or greater in diameter-at-breast- height (dbh) and any tree with a trunk 16 inch dbh or greater. Heritage trees occupy the banks of most earthen reaches of stream courses within the City. Removal of a heritage tree or pruning of more than one-third of the crown requires a permit from the Superintendent of Landscape Resources. There is a replanting deposit of $150 and the permit costs $40.

Site Development Ordinance

Several provisions of this ordinance may apply as follows:

(1) Protect public and private lands from erosion, earth movement, flooding, and ensure the maximum preservation of the natural scenic character of the City by establishing minimum standards and requirements relating to land grading, excavations and fills, and removal of major vegetation by establishing procedures by which these standards and requirements may be enforced;

(2) Ensure that the development of each site relates to adjacent lands so as to maximize visually pleasant relationships and minimize physical problems which could result in increased development or maintenance costs.

(3) Regulate development on or near steep slopes in order to protect the public health, safety and welfare and preserve the natural setting of the hillsides. Minimize the risk of personal injury, damage to property, and impact on water quality from potential landslides, erosion, earth creep, storm water runoff, and other hazards associated with hillside areas of the City. Preserve existing topographical forms, open spaces, habitat areas and visual resources from encroachment by new hillside development.

Floodplain Management Ordinance
The following provisions may apply:

(1) Control the alteration of natural floodplains, stream channels, and natural protective barriers, which help accommodate or channel flood waters.

(2) Control filling, grading, dredging, and other development which may increase flood damage.

(3) Prevent or regulate the construction of flood barriers which will unnaturally divert flood waters or which may increase flood hazards in other areas.

RECOMMENDATIONS
Schaaf & Wheeler has several recommendations regarding environmental documentation and regulatory permits intended to promote cost and time savings through multi-tasking.

First, comprehensive, long-term stream maintenance needs should be addressed by a single Local Comprehensive SMP and attendant programmatic EIR that covers a multi-year maintenance/enhancement program for all water courses within the City. While the initial costs of developing the SMP and EIR are significant, subsequent project and permit costs should be significantly reduced over a long period of time.

Secondly, in order to minimize duplication of permit applications for a given project or action, the City should first determine the applicability of the existing permits to the current project through informal consultations with the regulatory agencies. When new permits are indicated, the City should use the Joint Aquatic Resources Permit Application (JARPA), accepted by the USACE, RWQCB, CDFG, and BCDC for concurrent interagency application, instead of the regular individualized application forms.

The JARPA form is available at www.abag.ca.gov/bayarea/sfep/projects/JARPA/JARPA.html

Pre-consultation with agency staff is encouraged early in a project's planning to determine each agencies policies relative to the project and for assistance in completing the JARPA application. Draft applications can be submitted for any project and are strongly encouraged for large or complex projects. Draft applications allow agency staff to better advise the City on the relevant policies, procedures and type of detailed information that is needed to complete the application.

APPENDIX E
MOUSE MODEL

The unsteady hydraulic model used to evaluate the San Mateo storm drainage system is available under separate cover.